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WETLANDS OF MARYLAND






U.S. Department of the Interior • Fish and Wildlife Service

Maryland Department of Natural Resources

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by

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Introduction

Wetlands are lands that are wet for significant periods during the year that typically create anaerobic (low oxygen) conditions favoring the growth of hydrophytic plants and the formation of hydric soils. These areas are commonly called marshes, swamps, and bogs, although other terms are locally applied (e.g., Delmarva bays). Wetlands may be permanently flooded by shallow water, permanently saturated by groundwater, or periodically inundated or saturated for varying periods during the growing season in most years. Many wetlands are the periodically flooded lands that occur between uplands and salt or fresh waterbodies (e.g., lakes, rivers, streams, and estuaries). Other wetlands, however, may be isolated from such waterbodies. These wetlands are located in areas with seasonally high water tables that are surrounded by upland. Wetlands are important natural resources providing numerous values to society, including fish and wildlife habitat, flood protection, erosion control, and water quality maintenance.

The Fish and Wildlife Service (Service) has always recognized the importance of wetlands to waterfowl, other migratory birds and wildlife. The Service's responsibility for protecting these habitats comes largely from international treaties concerning migratory birds and from the Fish and Wildlife Coordination Act. The Service has been active in protecting these resources through various programs. The National Wildlife Refuge System was established to preserve and enhance migratory bird habitat in strategic locations across the country. More than 10 million ducks breed annually in U.S. wetlands and millions more overwinter here. The Service also reviews Federal projects and applications for Federal permits that involve wetland alteration and makes recommendations to eliminate or minimize habitat loss and environmental degradation.

Since the 1950s, the Service has been particularly concerned about wetland losses and their impact on fish and wildlife populations. In 1954, the Service conducted its first nationwide wetlands inventory which focused on important waterfowl wetlands. This survey was performed to provide information for considering fish and wildlife impacts in land-use decisions. The results of this inventory were published in a well-known Service report entitled *Wetlands of the United States*, often referred to as Circular 39 (Shaw and Fredine 1956).

Since this survey, wetlands have undergone many changes, both natural and human-induced. The conversion of wetlands for agriculture, residential and industrial developments and other uses has continued. During the 1960s, the general public in many states became more aware of wetland values and concerned about wetland losses. They began to realize that wetlands provided significant public benefits besides fish and wildlife habitat, especially flood protection and water quality maintenance. Prior to this time, wetlands were regarded by most people as wastelands and mosquito breeding habitats, whose best use could only be attained by conversion to alternative uses, e.g., draining for agriculture, dredging and filling for industrial and housing developments, and filling with sanitary landfill. Unfortunately, many people still hold these views.

Scientific studies demonstrating wetland functions have been instrumental in increasing public awareness of wetland benefits and stimulating concern for wetland protection. In the 1960s and 1970s, research on coastal wetlands established their vital link to estuarine productivity and local commercial and recreational fisheries. These studies coupled with reports of accelerating destruction of coastal wetlands moved some state legislatures to take action to reduce future losses of these wetlands. Several states passed laws to protect coastal wetlands, including Massachusetts (1963), Rhode Island (1965), Connecticut (1969), New Jersey (1970), Maryland (1970), Georgia (1970), New York (1972), and Delaware (1973). Soon after, four of these states adopted inland or nontidal wetland protection legislation: Massachusetts, Rhode Island, Connecticut and New York. Most of the other states in the Nation with coastal wetlands followed the lead of these northeastern states and enacted laws to protect or regulate uses of coastal wetlands. During the early 1970s, the Federal government also assumed greater responsibility for wetlands through Section 404 of the Federal Water Pollution Control Act of 1972 (later amended as the Clean Water Act of 1977) and by strengthening wetland protection under Section 10 of the Rivers and Harbors Act of 1899. Federal permits are now required for numerous types of construction in many wetlands, although normal agricultural and forestry activities are exempt and some wetland types do not qualify as regulated wetlands according to current field delineation procedures (Tiner 1993).

In the 1980s, there was some increased state and Federal legislative action to protect wetlands. Vermont, New Jersey, Washington, Maryland, and Maine for example, were among the states passing laws to regulate uses of inland wetlands. The U.S. Congress passed the Emergency Wetlands Resources Act of 1986 to promote the conservation of the Nation's wetlands to maintain their public benefits. Congress also attempted to decrease the amount of wetland drainage by agriculture by including the "Swampbuster" provision in the Food Security Act of 1985 to remove Federal farm program subsidies from farmers who drain wetlands and put them into croplands after the effective date of the Act. These laws and other governmental action showed increased concern over the loss and degradation of wetlands and a desire to stem this loss and maintain wetlands and their values for future generations.

With increased public interest in wetlands and strengthened government regulation in the 1970s, the Service considered how it could contribute to this resource management effort, since it has prime responsibility for protection and management of the Nation's fish and wildlife and their habitats. The Service recognized the need for sound ecological information to make decisions regarding policy, planning, and management of the country's wetland resources, and established the National Wetlands Inventory Project (NWI) in 1974 to fulfill this need. The NWI aims to generate scientific information on the characteristics and extent of the Nation's wetlands. The purpose of this information is to foster wise use of U.S. wetlands and to provide data for making quick and accurate resource decisions.

Two very different kinds of information are needed: (1) detailed maps and (2) status and trends reports. First, detailed wetland maps are needed for impact assessment of site-specific projects. These maps serve a purpose similar to the U.S.D.A. Soil Conservation Service's soil survey maps, the National Oceanic and Atmospheric Administration's coastal and geodetic survey maps, and the U.S. Geological Survey's topographic maps. Detailed wetland maps are used by local, state and Federal agencies as well as by private industry and organizations for many purposes, including watershed management plans, environmental impact assessments, permit reviews, facility and corridor sitings, oil spill contingency plans, natural resource inventories, wildlife surveys, and other uses. To date, wetland maps have been prepared for 85 percent of the lower 48 states, 25 percent of Alaska, and all of Hawaii. Over 40,000 individual large-scale maps have been produced. Mapping is scheduled to be completed for the lower 48 states by September 30, 1998. Secondly, national estimates of the current status and recent losses and gains of wetlands are needed in order to provide improved information for reviewing the effectiveness of existing Federal programs and policies, for identifying national or regional problems and for general public awareness. Technical and popular reports about these trends have been published (Frayer *et al.* 1983; Tiner 1984; Dahl and Johnson 1991; Frayer 1991).

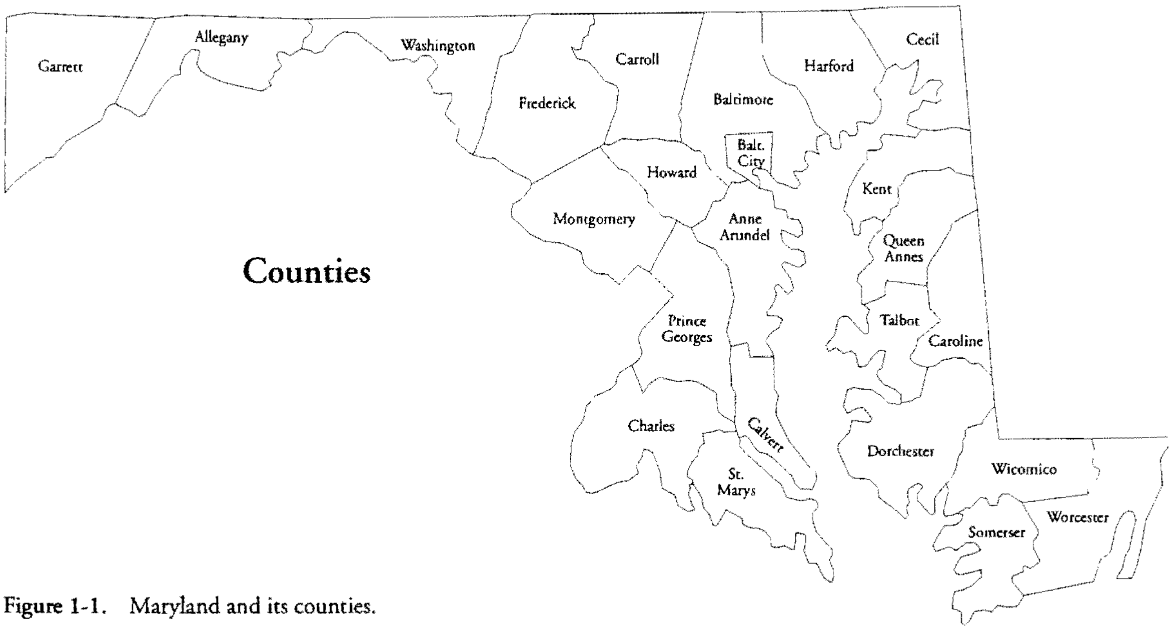

Figure 1-1. Maryland and its counties.

Table 1-1. Acreage of Maryland counties in 1992. (Source: Hoffman 1992)

County	Land Area (square miles)	County	Land Area (square miles)
Allegany	421	Howard	251
Anne Arundel	418	Kent	278
Baltimore	598	Montgomery	495
Calvert	213	Prince Georges	487
Caroline	321	Queen Annes	372
Carroll	452	St. Marys	373
Cecil	360	Somerset	338
Charles	452	Talbot	259
Dorchester	593	Washington	455
Frederick	663	Wicomico	379
Garrett	657	Worcester	475

Maryland Wetlands Inventory

A comprehensive wetlands inventory was needed in Maryland primarily to produce a current account of the distribution and extent of wetlands and deepwater habitats in the state. Some statewide information (i.e., acreage summaries) was available for planning and policy analysis, but this was based on a 1973 inventory of wetlands 5 acres and larger that were designated on U.S. Geological Survey maps (Metzgar 1973). Many wetlands are not shown on these maps. Extensive mapping of the state's tidal marshes was performed for regulation under the Wetlands Act of 1970. Subsequently, the acreages of these coastal wetlands were compiled to aid in regulatory decision-making (McCormick and Somes 1982). Since then, there undoubtedly have been changes in the tidal wetlands due to natural causes as well as human activities. Similar detailed maps were not available for nontidal wetlands. The National Wetlands Inventory Project (NWI) would produce a consistent set of wetlands maps for the entire state to aid in wetland conservation and management.

Around 1980, the Service initiated a wetlands inventory in Maryland as part of its NWI Project. This inventory would eventually produce detailed maps for the entire state, identify the current status of Maryland's wetlands, and serve as the base from which future changes can be determined.

Description of the Study Area

Maryland occupies 9,837 square miles of land (Hoffman 1992). The state is divided into 23 counties, with the two largest being Frederick and Garrett Counties and the two smallest being Calvert and Howard Counties (Figure 1-1; Table 1-1). Baltimore is an independent city occupying 80 square miles.

Two major U.S. ecoregions include parts of Maryland. The eastern portion of the state, roughly from Baltimore and Montgomery Counties east, falls within the Southeastern

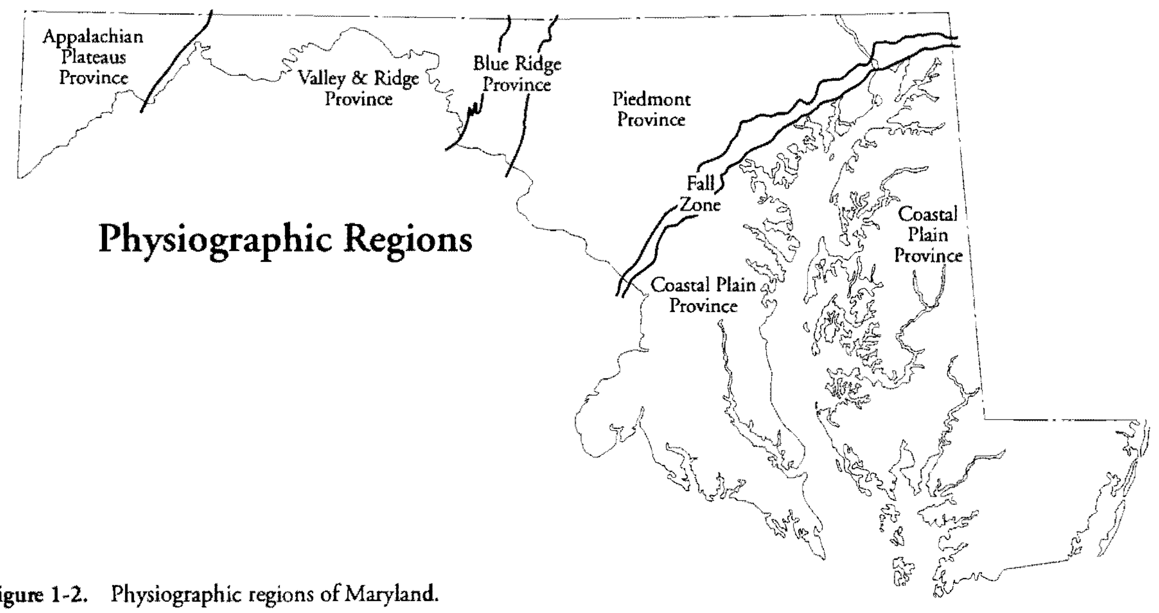

Figure 1-2. Physiographic regions of Maryland.

Mixed Forest, while the western section of the state is in the Appalachian Oak Forest as defined by Bailey (1978). Moreover, the state contains the majority of Chesapeake Bay which has a dominant influence on the region's climate, biological resources, and economy.

Six physiographic regions can be found within the state: (1) Coastal Plain, (2) Fall Zone, (3) Piedmont, (4) Blue Ridge, (5) Valley and Ridge, and (6) Appalachian Plateaus (Figure 1-2). The Coastal Plain can be further subdivided into two regions: the Lower (Outer) Coastal Plain (Eastern Shore) and the Upper (Inner) Coastal Plain (Western Shore). The nearly level Lower Coastal Plain is contrasted by the more rolling Upper Coastal Plain on the western shore of Chesapeake Bay. The Piedmont is characterized by rolling hills. At higher elevations are the mountains of the Appalachian Plateaus, Blue Ridge, and the Valley and Ridge provinces.

The climate in Maryland is quite different from east to west. The eastern part of the state is much warmer than the western part with annual temperatures averaging around 56 degrees Fahrenheit (F) in the east and 48 degrees F in Garrett County (Owenby *et al.* 1992). January is the coldest month and averages about 27 degrees F in Garrett County and 34 degrees F in the Bay area. July brings the warmest temperatures, averaging 77 degrees F in the east and 68 degrees F in Garrett County. Annual average precipitation varies from a high of about 46 inches in the western part of Garrett County to a low of 38.5 inches in the eastern part of this county and the western portion of Cumberland County. Precipitation in the Bay area averages about 44 inches annually. Monthly precipitation ranges from about 3 to 5 inches across the state. July and August bring the most rain in the east, while the period May through August produces higher rainfall in the west.

Purpose and Organization of this Report

The purpose of this publication is to report the findings of the Service's wetlands inventory of Maryland. The discussion will focus on wetlands with a few references to deepwater habitats which were also inventoried. The following chapters will include discussions of wetland concept and classification (Chapter 2), inventory techniques and results (Chapter 3), wetland formation and hydrology (Chapter 4), hydric soils (Chapter 5), wetland vegetation and plant communities (Chapter 6), wetland values (Chapter 7), wetland trends (Chapter 8) and wetland protection (Chapter 9). The appendices provide lists of Maryland's wetland plants arranged by life form. Scientific names of plants follow the *National List of Scientific Plant Names* (U.S.D.A. Soil Conservation Service 1982). Common names generally follow field guides by Tiner (1987, 1988, 1993). A map showing the general distribution of Maryland's wetlands and deepwater habitats is provided as an enclosure at the back of this report.

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U.S. Fish and Wildlife Service's Wetland Definition and Classification System

Introduction

The Service's wetland classification was published in 1979 as a report entitled *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin *et al.* 1979). It was developed by a four-member team consisting of Lewis M. Cowardin (U.S. Fish and Wildlife Service), Virginia Carter (U.S. Geological Survey), Francis C. Golet (University of Rhode Island) and Edward T. LaRoe (National Oceanic and Atmospheric Administration), with assistance from numerous Federal and state agencies, university scientists, and other interested individuals. Four key objectives for the new system were established: (1) to develop ecologically similar habitat units, (2) to arrange these units in a system that would facilitate resource management decisions, (3) to furnish units for inventory and mapping, and (4) to provide uniformity in concept and terminology throughout the country. The classification system went through three major drafts and extensive field testing prior to its final publication. Since its publication, the Service's classification system has been widely used by Federal, state, and local agencies, university scientists, and private industry and non-profit organizations for identifying and classifying wetlands. Thus, the system appears to have provided uniformity in wetland concept and terminology, despite continued debate over what should constitute a wetland from the regulatory perspective. Such debate is probably inevitable due to the potential restrictions on land-use. Yet, there is much agreement on what is a wetland among knowledgeable scientists.

Wetland Definition

Conceptually, wetlands usually lie between the better drained, rarely flooded uplands and the permanently flooded deep waters of lakes, rivers and coastal embayments (Figure 2-1). Wetlands include the variety of marshes, bogs, swamps, shallow ponds, and bottomland forests that occur throughout the country. They usually form in upland depressions or along rivers, lakes and coastal waters in areas subject to periodic flooding. Some wetlands, however, occur on slopes where they are associated with groundwater seepage areas or drainageways.

To accurately inventory this resource, the Service had to determine where along the natural soil moisture continuum wetland ends and upland begins. While many wetlands lie in distinct depressions or basins that are readily observable, the wetland-upland boundary is not always easy to identify. This is especially true along many floodplains, on glacial till deposits, in broad flats and gently sloping terrain typical of the Coastal Plain, and in areas of major hydrologic modification. In these more difficult areas, only a skilled wetland ecologist or other specialist can accurately identify the wetland boundary. To help ensure accurate and consistent wetland determinations, an ecologically-based definition was constructed by the Service.

In developing a multi-disciplinary definition of wetland, the Service first acknowledged that "There is no single,

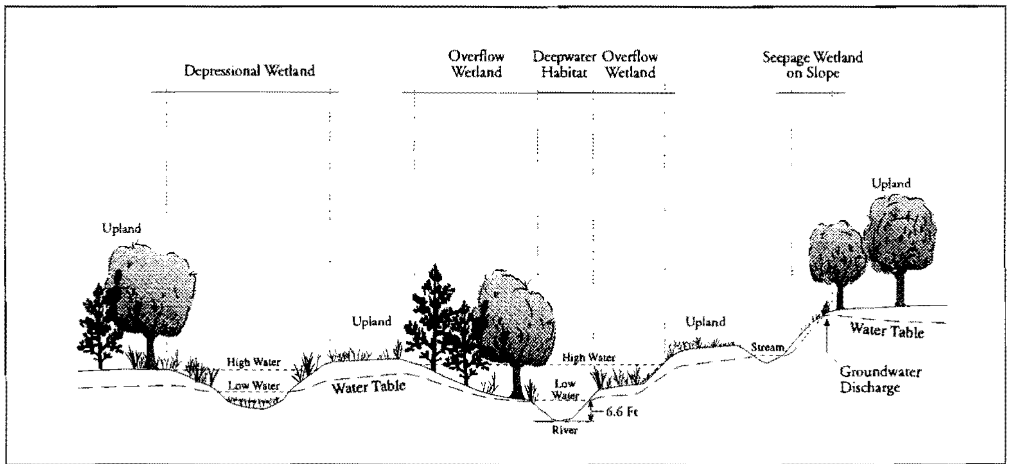

Figure 2.1. Schematic diagram showing wetlands, deepwater habitats, and uplands on the landscape. Note differences in wetlands due to hydrology and topographic position.

Table 2-1. Definitions of "wetland" according to selected Federal agencies and state statutes.

Organization (Reference)	Wetland Definition	Comments
U.S. Fish and Wildlife Service (Cowardin, *et al.* 1979)	"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."	This is the official Fish and Wildlife Service definition and is being used for conducting an inventory of the Nation's wetlands. It emphasizes flooding and/or soil saturation, hydric soils and vegetation. Shallow lakes and ponds are included as wetland. Comprehensive lists of wetland plants and soils are available to further clarify this definition.
U.S. Army Corps of Engineers (Federal Register, July 19, 1977) and U.S. Environmental Protection Agency (Federal Register, December 24, 1980)	Wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."	Regulatory definition in response to Section 404 of the Clean Water Act of 1977. Excludes similar areas lacking vegetation, such as tidal flats, and does not define lakes, ponds and rivers as wetlands. Aquatic beds are considered "vegetated shallows" and included as other "waters of the United States" for regulatory purposes.
U.S.D.A. Soil Conservation Service (National Food Security Act Manual, 1988)	"Wetlands are defined as areas that have a predominance of hydric soils and that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions, except lands in Alaska identified as having a high potential for agricultural development and a predominance of permafrost soils."	This is the Soil Conservation Service's definition for implementing the "Swampbuster" provision of the Food Security Act of 1985. Any area that meets hydric soil criteria is considered to have a predominance of hydric soils. Note the geographical exclusion for certain lands in Alaska.
State of Maryland (Tidal Wetlands Act; Natural Resources Article, Annotated Code of Maryland Sections 9-101-9-603)	"Tidal wetlands" are defined as "all State and private tidal wetlands, marshes, submerged aquatic vegetation, lands, and open water affected by the daily and periodic rise and fall of the tide within the Chesapeake Bay and its tributaries, the coastal bays adjacent to Maryland's coastal barrier islands, and the Atlantic Ocean to a distance of 3 miles offshore of the low water mark."	State regulatory definition for Tidal Wetlands Act. Encompasses intertidal and subtidal areas, including marshes, submerged aquatic beds, and open water.
State of Maryland (Nontidal Wetlands Act; Natural Resources Article, Annotated Code of Maryland Sections 8-1201-8-1211)	"Nontidal wetland" is an area meeting the following conditions: "(a) . . . an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation; (b) is determined according to the Federal Manual; (c) does not include tidal wetlands regulated under Natural Resources Article, Title 9, Annotated Code of Maryland."	State regulatory definition for Nontidal Wetlands Protection Act. Essentially the same as the Federal regulatory definition used for the Clean Water Act. Specifies use of the Federal wetland delineation manual in attempt to be consistent with Federal government. Excludes tidal wetlands subject to Tidal Wetlands Act.

correct, indisputable, ecologically sound definition for wetlands, primarily because of the diversity of wetlands and because the demarcation between dry and wet environments lies along a continuum" (Cowardin *et al.* 1979). After all, a wealth of wetland definitions grew out of different needs for defining wetlands among various groups or organizations, e.g., wetland regulators, waterfowl managers, hydrologists, flood control engineers, and water quality experts. The Service has not attempted to legally define wetland, since each state or Federal regulatory agency may define wetland somewhat differently to suit its administrative purposes. In Pennsylvania, the state has adopted the Federal regulatory definition from Section 404 of the Clean Water Act for its own regulatory programs. According to existing wetland laws, a wetland is whatever the law says it is (Table 2-1). The Service needed to develop a scientifically-based definition that would allow accurate identification and delineation of the Nation's wetlands for resource management purposes.

The Service defines wetlands as follows:

"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year." (Cowardin *et al.* 1979)

In defining wetlands from an ecological standpoint, the Service emphasizes three key attributes of wetlands: (1) hydrology—the degree of flooding or soil saturation, (2) wetland vegetation (hydrophytes), and (3) hydric soils. All areas considered wetland must have enough water at some time during the year to stress plants and animals not adapted for life in water or saturated soils. Most wetlands have hydrophytes and hydric soils present, yet many are nonvegetated (e.g., tidal mudflats). The Service has prepared a list of plants occurring in the Nation's wetlands (Reed 1988) and the Soil Conservation Service has developed a national list of hydric soils (U.S.D.A. Soil Conservation Service 1991) to help identify wetlands.

Particular attention should be paid to the reference to flooding or soil saturation during the growing season in the Service's wetland definition. When soils are covered by water or saturated to the surface, free oxygen is generally not available to plant roots. During the growing season, most plant roots must have access to free oxygen for respiration and growth; flooding at this time would have serious implications for the growth and survival of most plants. In a wetland situation, plants must be adapted to cope with these stressful conditions. If, however, flooding only occurs in winter when the soil is frozen and plants are dormant, there is little or no effect on them. In areas where the soil does not freeze in winter, root growth and plant activity may continue through this season and winter wetness may have an important effect on plant growth as observed in loblolly and slash pines in the southeastern U.S. (Haywood *et al.* 1990).

Wetlands typically fall within one of the following four categories: (1) areas with both hydrophytes and hydric soils (e.g., marshes, swamps and bogs), (2) areas without hydrophytes, but with hydric soils (e.g., farmed wetlands), (3) areas without soils but with hydrophytes (e.g., seaweed-covered rocky shores), and (4) periodically flooded areas without soil and without hydrophytes (e.g., gravel bars and tidal mudflats). All wetlands must be periodically saturated or covered by shallow water during the growing season, whether or not hydrophytes or hydric soils are present. Effectively drained hydric soils that are no longer capable of supporting hydrophytes due to a major change in hydrology are not considered wetland. Areas with effectively drained hydric soils are, however, good indicators of historic wetlands, which may be suitable for restoration.

It is important to mention that the Service does not generally include permanently flooded deep water areas as wetland, although nontidal shallow waters are classified as wetland. Instead, these deeper waterbodies are defined as deepwater habitats, since water and not air is the principal medium in which dominant organisms live. Along the coast in tidal areas, the deepwater habitat begins at the extreme spring low tide level. In nontidal freshwater areas, this habitat starts at a depth of 6.6 feet (2 m) because the shallow water areas are often vegetated with emergent wetland plants.

Wetland Classification

The following section represents a simplified overview of the Service's wetland classification system. Consequently, some of the more technical points have been omitted from this discussion. When actually classifying a wetland, the reader is advised to refer to the official classification document (Cowardin *et al.* 1979) and should not rely solely on this overview.

The Service's wetland classification system is hierarchial or vertical in nature proceeding from general to specific, as

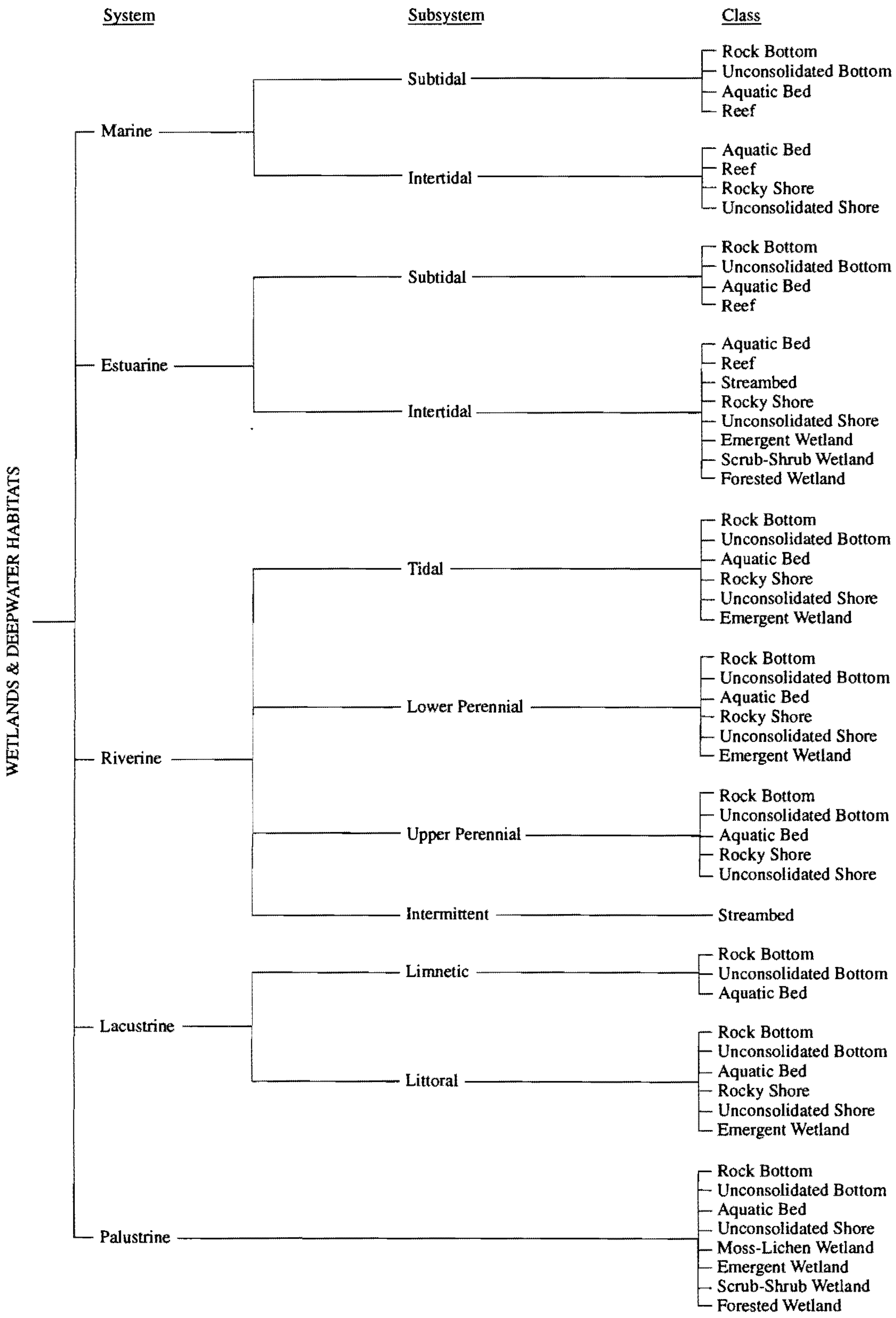

Figure 2-2. Classification hierarchy of wetlands and deepwater habitats (system through class) following the U.S. Fish and Wildlife Service's official classification system (Cowardin *et al.* 1979). The Palustrine system does not include any deepwater habitats.

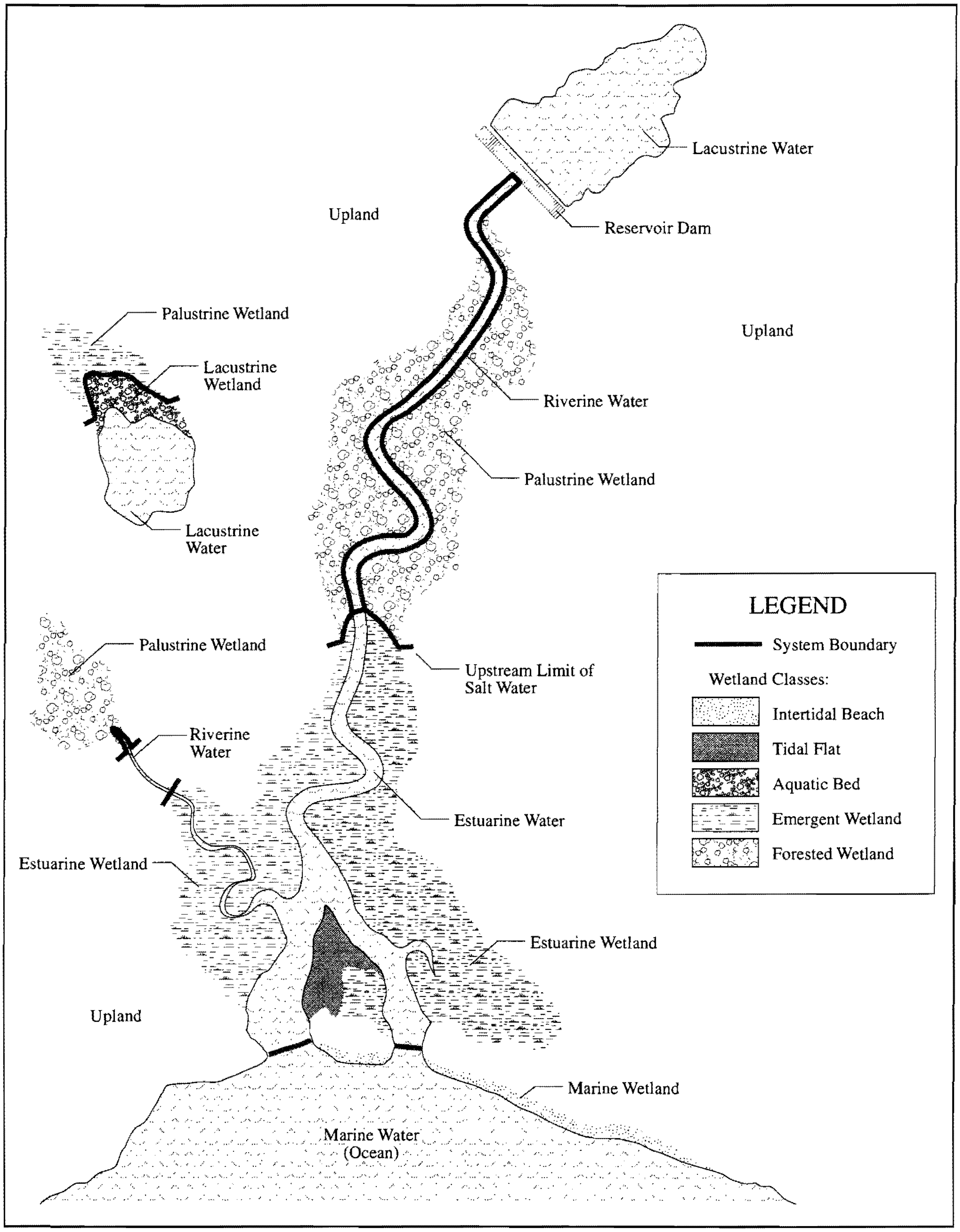

Figure 2-3. Diagram showing major wetland and deepwater habitats systems on the landscape. Predominant wetland classes are designated.

Table 2-2. Classes and subclasses of wetlands and deepwater habitats. (Cowardin *et al.* 1979)

Class	Brief Description	Subclasses
Rock Bottom	Generally permanently flooded areas with bottom substrates consisting of at least 75% stones and boulders and less than 30% vegetative cover.	Bedrock; Rubble
Unconsolidated Bottom	Generally permanently flooded areas with bottom substrates consisting of at least 25% particles smaller than stones and less than 30% vegetative cover.	Cobble-gravel; Sand; Mud; Organic
Aquatic Bed	Generally permanently flooded areas vegetated by plants growing principally on or below the water surface line.	Algal; Aquatic Moss; Rooted Vascular; Floating Vascular
Reef	Ridge-like or mound-like structures formed by the colonization and growth of sedentary invertebrates.	Coral; Mollusk; Worm
Streambed	Channel whose bottom is completely dewatered at low water periods.	Bedrock; Rubble; Cobble-gravel; Sand; Mud; Organic; Vegetated
Rocky Shore	Wetlands characterized by bedrock, stones or boulders with areal coverage of 75% or more and with less than 30% coverage by vegetation.	Bedrock; Rubble
*Unconsolidated Shore	Wetlands having unconsolidated substrates with less than 75% coverage by stone, boulders and bedrock and less than 30% vegetative cover, except by pioneer plants. (*NOTE: This class combines two classes of the 1977 operational draft system—Beach/Bar and Flat)	Cobble-gravel; Sand; Mud; Organic; Vegetated
Moss-Lichen Wetland	Wetlands dominated by mosses or lichens where other plants have less than 30% coverage.	Moss; Lichen
Emergent Wetland	Wetlands dominated by erect, rooted, herbaceous hydrophytes.	Persistent; Nonpersistent
Scrub-Shrub Wetland	Wetlands dominated by woody vegetation less than 20 feet (6 m) tall.	Broad-leaved Deciduous; Needle-leaved Deciduous; Broad-leaved Evergreen; Needle-leaved Evergreen; Dead
Forested Wetland	Wetlands dominated by woody vegetation 20 feet (6 m) or taller.	Broad-leaved Deciduous; Needle-leaved Deciduous; Broad-leaved Evergreen; Needle-leaved Evergreen; Dead

noted in Figure 2-2. In this approach, wetlands are first defined at a rather broad level—the SYSTEM. The term SYSTEM represents "a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors." Five systems are defined: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The Marine System generally consists of the open ocean and its associated high-energy coastline, while the Estuarine System encompasses salt and brackish marshes, nonvegetated tidal shores, and brackish waters of coastal rivers and embayments. Freshwater wetlands and deepwater habitats fall into one of the other three systems: Riverine (rivers and streams), Lacustrine (lakes, reservoirs and large ponds), or Palustrine (e.g., marshes, bogs, swamps and small shallow ponds). Thus, at the most general level, wetlands can be defined as either Marine, Estuarine, Riverine, Lacustrine or Palustrine (Figure 2-3).

Each system, with the exception of the Palustrine, is further subdivided into SUBSYSTEMS. The Marine and Estuarine Systems both have the same two subsystems, which are defined by tidal water levels: (1) Subtidal—continuously submerged

Table 2-3. Water regime modifiers, both tidal and nontidal groups. (Cowardin *et al.* 1979)

Group	Type of Water	Water Regime	Definition
Tidal	Saltwater and brackish areas	Subtidal	Permanently flooded tidal waters
		Irregularly exposed	Exposed less often than daily by tides
		Regularly flooded	Daily tidal flooding and exposure to air
		Irregularly flooded	Flooded less often than daily and typically exposed to air
	Freshwater	Permanently flooded–tidal	Permanently flooded by tides and river or exposed irregularly by tides
		Semipermanently flooded–tidal	Flooded for most of the growing season by river overflow but with tidal fluctuation in water levels
		Regularly flooded	Daily tidal flooding and exposure to air
		Seasonally flooded-tidal	Flooded irregularly by tides and seasonally by river overflow
		Temporarily flooded-tidal	Flooded irregularly by tides and for brief periods during growing season by river overflow
Nontidal	Inland freshwater and saline areas	Permanently flooded	Flooded throughout the year in all years
		Intermittently exposed	Flooded year-round except during extreme droughts
		Semipermanently flooded	Flooded throughout the growing season in most years
		Seasonally flooded	Flooded for extended periods in growing season, but surface water is usually absent by end of growing season
		Saturated	Surface water is seldom present, but substrate is saturated to the surface for most of the season
		Temporarily flooded	Flooded for only brief periods during growing season, with water table usually well below the soil surface for most of the season
		Intermittently flooded	Substrate is usually exposed and only flooded for variable periods without detectable seasonal periodicity (not always wetland; may be upland in some situations)
		Artificially flooded	Duration and amount of flooding is controlled by means of pumps or siphons in combination with dikes or dams

areas and (2) Intertidal—areas alternately flooded by tides and exposed to air. Similarly, the Lacustrine System is separated into two systems based on water depth: (1) Littoral—wetlands extending from the lake shore to a depth of 6.6 feet (2 m) below low water or to the extent of nonpersistent emergents (e.g., arrowheads, pickerelweed, or spatterdock) if they grow beyond that depth, and (2) Limnetic—deepwater habitats lying beyond the 6.6 feet (2 m) at low water. By contrast, the Riverine System is further defined by four subsystems that represent different reaches of a flowing freshwater or lotic system: (1) Tidal—water levels subject to tidal fluctuations for at least part of the growing season, (2) Lower Perennial—permanent, flowing waters with a well-developed floodplain, (3) Upper Perennial—permanent, flowing water with very little or no floodplain development, and (4) Intermittent—channel containing nontidal flowing water for only part of the year.

The next level—CLASS—describes the general appearance of the wetland or deepwater habitat in terms of the dominant vegetative life form or the nature and composition of the substrate, where vegetative cover is less

Table 2-4. Salinity modifiers for coastal and inland areas. (Cowardin *et al.* 1979)

Coastal Modifiers[1]	Inland Modifiers[2]	Salinity (‰)	Approximate Specific Conductance (Mhos at 25° C)
Hyperhaline	Hypersaline	> 40	> 60,000
Euhaline	Eusaline	30-40	45,000-60,000
Mixohaline (Brackish)	Mixosaline[3]	0.5-30	800-45,000
Polyhaline	Polysaline	18-30	30,000-45,000
Mesohaline	Mesosaline	5-18	8,000-30,000
Oligohaline	Oligosaline	0.5-5	800-8,000
Fresh	Fresh	< 0.5	< 800

[1]Coastal modifiers are employed in the Marine and Estuarine Systems.
[2]Inland modifiers are employed in the Riverine, Lacustrine and Palustrine Systems.
[3]The term "brackish" should not be used for inland wetlands or deepwater habitats.

than 30 percent (Table 2-2). Of the 11 classes, five refer to areas where vegetation covers 30 percent or more of the surface: Aquatic Bed, Moss-Lichen Wetland, Emergent Wetland, Scrub-Shrub Wetland and Forested Wetland. The remaining six classes represent areas generally lacking vegetation, where the composition of the substrate and degree of flooding distinguish classes: Rock Bottom, Unconsolidated Bottom, Reef (sedentary invertebrate colony), Streambed, Rocky Shore, and Unconsolidated Shore. Permanently flooded nonvegetated areas are classified as either Rock Bottom or Unconsolidated Bottom, while exposed areas are typed as Streambed, Rocky Shore, or Unconsolidated Shore. Invertebrate reefs are found in both permanently flooded and exposed areas.

Each class is further divided into SUBCLASSES to better define the type of substrate in nonvegetated areas (e.g., bedrock, rubble, cobble-gravel, mud, sand, and organic) or the type of dominant vegetation (e.g., persistent or nonpersistent emergents, moss, lichen, or broad-leaved deciduous, needle-leaved deciduous, broad-leaved evergreen, needle-leaved evergreen and dead woody plants). Below the subclass level, DOMINANCE TYPE can be applied to specify the predominant plant or animal in the wetland community.

To allow better description of a given wetland or deepwater habitat in regard to hydrologic, chemical and soil characteristics and to human impacts, the classification system contains four types of specific modifiers: (1) Water Regime, (2) Water Chemistry, (3) Soil, and (4) Special. These modifiers may be applied to class and lower levels of the classification hierarchy.

Water regime modifiers describe flooding or soil saturation conditions and are divided into two main groups: tidal and nontidal. Tidal water regimes are used where water level fluctuations are largely driven by oceanic tides. Tidal regimes can be subdivided into two general categories, one for salt and brackish water tidal areas and another for freshwater tidal areas. This distinction is needed because of the special importance of seasonal river overflow and groundwater inflows in freshwater tidal areas. By contrast, nontidal modifiers define conditions where surface water runoff, groundwater discharge, and/or wind effects (i.e., lake seiches) cause water level changes. Both tidal and nontidal water regime modifiers are presented and briefly defined in Table 2-3.

Water chemistry modifiers are divided into two categories which describe the water's salinity or hydrogen ion concentration (pH): (1) salinity modifiers and (2) pH modifiers. Like water regimes, salinity modifiers have been further subdivided into two groups: halinity modifiers for tidal areas and salinity modifiers for nontidal areas. Estuarine and marine waters are dominated by sodium chloride, which is gradually diluted by fresh water as one moves upstream in coastal rivers. On the other hand, the salinity of inland waters is dominated by four major cations (i.e., calcium, magnesium, sodium, and potassium) and three major anions (i.e., carbonate, sulfate, and chloride). Interactions between precipitation, surface runoff, groundwater flow, evaporation, and sometimes plant evapotranspiration form inland salts which are most common in arid and semiarid regions of the country. Table 2-4 shows ranges of halinity and salinity modifiers which are a modification of the Venice System (Remane and Schlieper 1971). The other set of water chemistry modifiers are pH modifiers for identifying acid ($pH<5.5$), circumneutral (5.5-7.4) and alkaline ($pH>7.4$) waters. Some studies have shown a good correlation between plant distribution and pH levels (Sjors 1950; Jeglum 1971). Moreover, pH can be used to distinguish between mineral-rich (e.g., fens) and mineral-poor wetlands (e.g., bogs).

The third group of modifiers—soil modifiers—are presented because the nature of the soil exerts strong influences on plant growth and reproduction as well as on the animals living in it. Two soil modifiers are given: (1) mineral and (2) organic. In general, if a soil has 20 percent or more organic matter by weight in the upper 16 inches, it is considered an organic soil, whereas if it has less than this amount, it is a mineral soil. For specific definitions, please refer to Appendix D of the Service's classification system (Cowardin *et al.* 1979) or to *Soil Taxonomy* (Soil Survey Staff 1975).

The final set of modifiers—special modifiers—were established to describe the activities of people or beaver affecting wetlands and deepwater habitats. These modifiers include: excavated, impounded (i.e., to obstruct outflow of water), diked (i.e., to obstruct inflow of water), partly drained, farmed, and artificial (i.e., materials deposited to create or modify a wetland or deepwater habitat).

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National Wetlands Inventory Mapping Techniques and Results

Introduction

The National Wetlands Inventory Project (NWI) utilizes remote sensing techniques with supplemental field investigations for wetland identification and mapping. High-altitude aerial photography ranging in scale from 1:58,000 to 1:80,000 has served as the primary remote imagery source. Most recently, the source imagery for the NWI has become 1:40,000 color infrared photography. Once suitable high-altitude photographs are obtained, there are seven major steps in preparing wetland maps: (1) field investigations, (2) photointerpretation, (3) review of existing wetland information, (4) quality assurance, (5) draft map production, (6) interagency review of draft maps, and (7) final map production. Steps 1, 2, and 3 encompass the basic data collection phase of the inventory. After publication of final wetland maps for Maryland, the Service (through funding by the Maryland Department of Natural Resources) constructed a digital wetland map database for Maryland. All NWI maps were digitized and data entered into a computer. This database generated acreage data for wetlands and deepwater habitats on a county, physiographic region, and major watershed basis. It also was used to prepare an overlay for the production of the state wetland map (see enclosure at back of report). Some maps have been recently updated in conjunction with local wetland trends studies (Foulis and Tiner 1994b, c; Tiner and Foulis 1992a, b) or other special projects. The procedures used to inventory Maryland's wetlands are discussed and the results of this inventory presented in the following sections.

Wetlands Inventory Techniques

Mapping Photography

For mapping Maryland's wetlands, the Service used aerial photography acquired from 1977 to 1990 (Figure 3-1). Most of this photography was 1:58,000 color infrared (CIR) acquired by U.S. Geological Survey's (USGS) High-Altitude Aerial Photography Program in the early 1980s. Since most of the photos are from 1981-82, the effective period of this inventory can be considered the early 1980s. Several quads on the Eastern Shore have been updated (1988/89) with 1:40,000 color infrared photography acquired by USGS's National Aerial Photography Program. In addition, wetland status and trends studies have been conducted in several counties which have produced more accurate wetland acreage summaries due to the improved resolution of the 1:40,000 CIR photography. These counties are Anne Arundel, Calvert, Charles, Prince Georges, and St. Marys.

Photointerpretation and Collateral Data

Photointerpretation was performed by the Department of Forestry and Wildlife Management, University of Massachusetts, Amherst and by U.S. Fish and Wildlife Service personnel in the Region 5 office. All photointerpretation was done in stereo using mirror stereoscopes. Photointerpretation was done in accordance with standard NWI conventions. Farmed wetlands were originally not mapped due to national policy, largely based on the technical difficulties of identifying these areas with just one date of photography. (*Note:* The Soil Conservation Service (SCS), now called the National Resources Conservation Service, is currently mapping farmed wetlands using multi-year photos.) Updated maps (1988/89), however, have some obvious pothole-like depressions in cultivated fields mapped as farmed wetlands. Collateral data sources used to aid in wetland detection and classification included: (1) USGS topographic maps; (2) SCS soil surveys; (3) U.S. Department of Commerce coastal and geodetic survey maps; and (4) 1:80,000 black and white photography (late 1970s). (*Note:* This photography was used to produce the original NWI maps for the southeastern part of Maryland and some western areas, but most of these maps were updated with the more recent color infrared photographs; see Figure 3-1.)

Wetland photointerpretation, although extremely efficient and accurate for inventorying most wetlands, does have certain limitations (Tiner 1990). Consequently, some problems arose during the course of the survey. Additional field work or use of collateral data was necessary to help overcome these constraints. The major problems and their resolution are discussed below.

1. Identification of freshwater aquatic beds and nonpersistent emergent wetlands. Due to the primary use of spring photography, these wetland types were not

interpretable. They were generally classified as open water or unconsolidated shore (in tidal areas only), unless vegetation was observed during field investigations.

2. Inclusion of small upland areas within delineated wetlands. Small islands of higher elevation and better drained uplands naturally exist within many wetlands. Due to the minimum size of mapping units, small upland areas may be included within designated wetlands. Field inspections and/or use of larger-scale photography may be used to refine wetland boundaries when necessary.

3. Mapping temporarily flooded and seasonally saturated forested wetlands on the Coastal Plain, especially those dominated by loblolly pine on the Eastern Shore. These wetlands are difficult to identify in the field, let alone through air photointerpretation. Consequently, these wetlands were mapped conservatively, with many of these wetlands not shown on the NWI maps. The boundaries of these wetlands when mapped should be considered quite general. Field studies are required to refine the wetland boundaries for most wetlands, especially these temporarily flooded and/or seasonally saturated types. Bluish-toned emulsions of the March 28, 1982 aerial photography, in particular, seemed to mask forested wetland signatures. The updated maps produced from 1:40,000 CIR photography identify much more acreage of these problematic wetlands due to superior spectral resolution and additional field verification.

4. Brackish/freshwater and tidal/nontidal boundary breaks and associated wetland classification. The general limits of these areas were often checked during routine field investigations. A report on the extent of brackish waters in Maryland (Webb and Heidel 1970) was used to generally identify brackish water limits. Boundaries should be considered approximate.

5. Delineation of intertidal flats. The photos used for the inventory were not always captured at low tide, so all intertidal flats were not visible. Coastal and geodetic survey maps and topographic maps provided collateral data on location of tidal flats.

6. Problem associated with "pothole" flooding. Isolated depressional wetlands called "potholes" are prevalent in parts of the Eastern Shore, especially near the Delaware border around Millington. Many of these wetlands were flooded at the time that the aerial photos were taken. Consequently, vegetation within these basins was not always apparent. In general, subtle photo signatures of flooded vegetation could be detected. Undoubtedly, however, some vegetated areas may be missed or misclassified (e.g., emergent versus scrub-shrub).

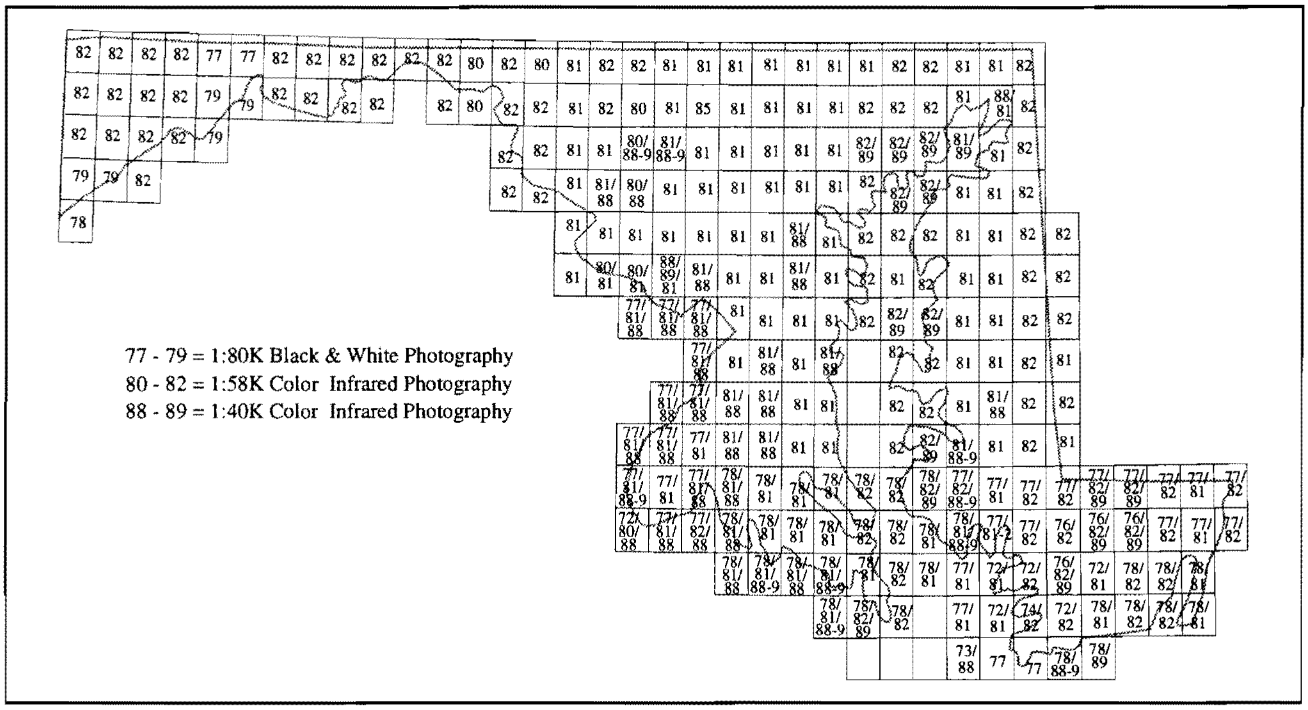

Figure 3-1. Index of aerial photography used to produce National Wetlands Inventory maps for Maryland. The blocks represent individual 1:24,000 quadrangles. Blocks with multiple dates indicate areas where updated NWI maps have been prepared.

Field Investigations

Ground-truthing surveys were conducted to collect information on plant communities of various wetlands and to gain confidence in detecting and classifying wetlands from aerial photography. Detailed notes were taken at hundreds of sites throughout the state. In addition to these sites, observations were made at countless other wetlands for classification purposes, and notations were recorded on appropriate topographic maps. In total, approximately six months of field work were spent in Maryland's wetlands over the course of several years.

Draft Map Production

Upon completion of photointerpretation, two levels of quality assurance were performed: (1) regional quality control, and (2) national consistency quality assurance. Regional review of each interpreted photo was accomplished by Regional Office's NWI staff to ensure identification of all wetlands within Regional mapping standards and proper classification. In contrast, national quality control by the NWI Group at St. Petersburg, Florida, entailed spot-checking of photos to ensure that national standards had been successfully followed. Once approved by quality assurance, draft large-scale (1:24,000) wetland maps were produced by the Group's support service contractor using Bausch and Lomb zoom transfer scopes.

Draft Map Review

Draft maps were sent to the following agencies for review and comment:

(1) U.S. Fish and Wildlife Service, Annapolis Field Office; (2) U.S. Army Corps of Engineers (Baltimore District); (3) U.S.D.A. Soil Conservation Service; (4) U.S. Environmental Protection Agency (Region III); (5) National Marine Fisheries Service; and (6) Maryland Department of Natural Resources (Tidewater Administration and Water Resources Administration).

In addition, the Regional Office's NWI staff conducted field checks and a thorough examination of draft maps to ensure proper placement of wetland polygons and labels as well as accurate classification.

Final Map Production

All comments received were evaluated and incorporated into the final maps, as appropriate. Final maps were published between 1980-1989. The earliest NWI maps (produced from 1:80,000 black and white photography for southeastern Maryland) were published in 1980-81, but they were updated and republished in 1988 and 1989.

Wetland Map Database Construction and Products

Upon publication of the original set of final NWI maps in 1985, the Service began construction of a statewide wetland map database by digitizing NWI maps. The database and its general applications are described by Tiner and Pywell (1983). The database was completed in 1989, including digitizing the updated NWI maps for southeastern Maryland. This database can generate county and statewide wetland acreage summaries and produce color-coded wetland maps for specific areas. Acreage summaries were produced for the following geographical areas in Maryland: state, each county, physiographic regions (i.e., Coastal Plain, Fall Zone, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateaus; see Figure 1-2), and major watersheds. The latter represent USGS hydrologic units with boundaries derived from the USGS hydrounit file (originally digitized from a 1:2,000,000-scale map). Watershed boundaries, therefore, are approximate. A few color-coded (1:50,000 scale) wetland maps of several counties were produced for the Maryland Department of Natural Resources. In addition, the database produced a set of small-scale wetland overlays that were used to produce a state wetland map (enclosed at the back of this report). Duplicate digital tapes were given to the Nontidal Wetlands Division of the Maryland Water Resources Administration.

Wetlands Inventory Results

National Wetlands Inventory Maps

A total of 154 1:24,000-scale NWI maps were produced. These maps identify the size, shape, and type of wetlands and deepwater habitats in accordance with NWI specifications. The minimum mapping unit (mmu) for wetlands ranges between approximately 1-3 acres where 1:58,000 CIR photography was used. The minimum mapping unit is the smallest unit that is consistently mapped. Most wetlands smaller than this size are not mapped, although some more conspicuous ones are designated. The updated NWI maps have an mmu of about one acre in size, due to improved spectral resolution of the 1:40,000 CIR photography. Linear wetlands (less than 100 feet wide) occurring along streams and in drainage divides were not usually mapped. Evaluations of NWI maps in Massachusetts and Maine determined that these maps had accuracies exceeding 95 percent (Swartwout *et al.* 1982; Nichols 1994). Another study by the Vermont

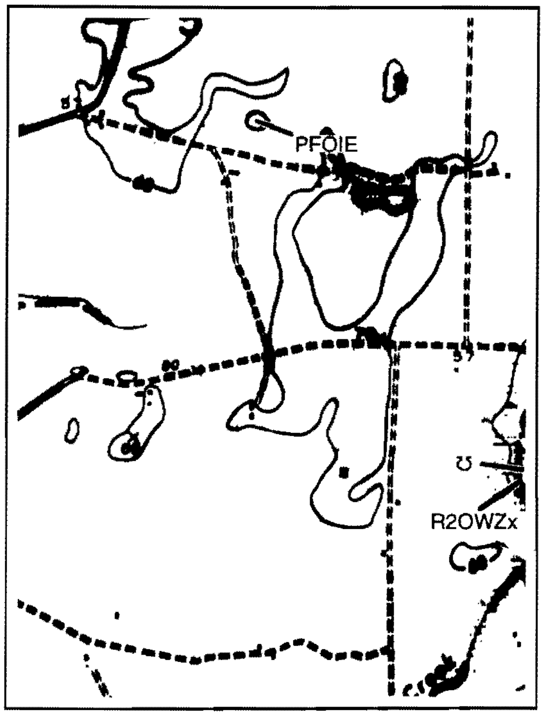

Figure 3-2. Portion of an original NWI map (Delmar quadrangle) derived by interpreting 1:80,000 black and white panchromatic photography. Compare with Figures 3-3 and 3-4 to see differences in mapping detail due to improved spectral and spatial resolution of color infrared photography.

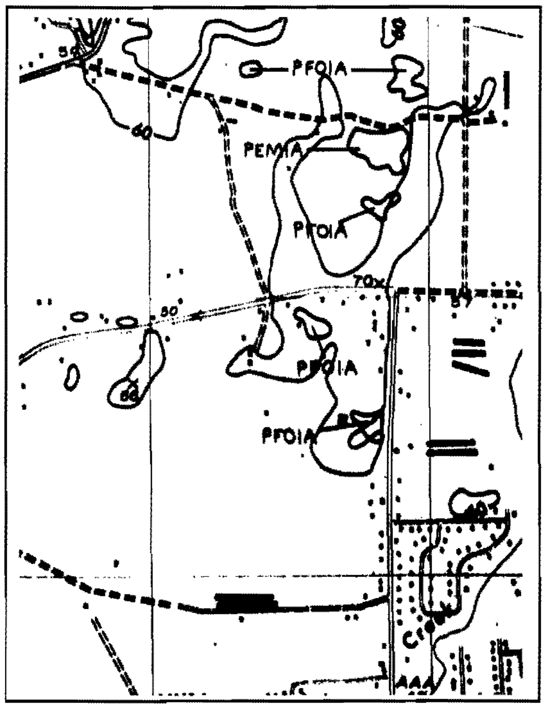

Figure 3-3. Portion of the first revision of the Delmar NWI map based on interpreting 1:58,000 color infrared photography.

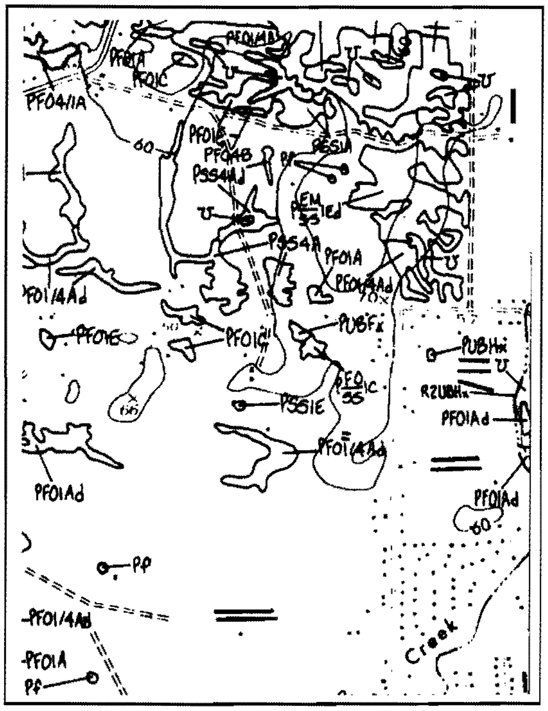

Figure 3-4. Portion of the most recently updated Delmar NWI map based on interpreting 1:40,000 color infrared photography. Note the increased internal delineations possible with this scale of imagery.

Agency of Natural Resources found that 91 percent of the 261 wetlands examined were accurately mapped (Crowley *et al.* 1988). This high accuracy is possible because the inventory technique involves a combination of photointerpretation, field studies, use of existing information and interagency review of draft maps. Despite this high overall accuracy, there are wetlands that are difficult to photointerpret, such as seasonally saturated wetlands and temporarily flooded forested wetlands. Map accuracies for these types, narrow wetlands, and wetlands below the minimum mapping unit are lower than for most wetland types. Final maps have been available since 1984-85. Figures 3-2 through 3-4 show three examples of a large-scale NWI map: an early version (original NWI map), a first generation updated map (produced from 1:58K aerial photos), and the latest version of NWI map (based on 1:40K aerial photos). The increased detail in the newer versions is apparent. Small-scale wetland maps (1:100,000) have been produced for several areas: Baltimore NE and SE; Washington NE, NW, and SW; Wilmington NW and SW; and Salisbury SW and NW. Copies of NWI maps can be ordered from Maryland Geological Survey, Attn: Publications, 2300 St. Paul Street, Baltimore, Maryland 21218 (Dale Shelton at 410-554-5505). In addition, a state wetland map has been prepared; it is provided with this report as an enclosure.

Wetland and Deepwater Habitat Acreage Summaries[1]

State Totals

According to this survey, Maryland possesses roughly 600,000 acres of wetlands and 1.6 million acres of deepwater habitats, excluding marine waters and smaller rivers and streams that either appear as linear features on wetlands maps or wetlands that were not identified due to their small size because they were farmed. About 9.5 percent of the state's land surface is represented by wetlands.

Nearly all (99.3%) of the state's wetlands fall within two systems—palustrine (57.3% or 342,626 acres) and estuarine (42.0% or 251,542 acres) (Figure 3-5). Table 3-1 shows the acreages of different types of wetlands for Maryland.

Maryland has over 250,000 acres of salt and brackish wetlands. Emergent wetlands are the predominant estuarine wetland type, occupying 205,815 acres and accounting for almost 82 percent of the state's estuarine wetlands (Figure 3-6). The effect of sea level rise is evident by the 16,271 acres of forested wetlands listed under the estuarine wetland category.

Over 340,000 acres of palustrine wetlands were inventoried in Maryland. The overwhelming majority of these (or 88.7%) are nontidal wetlands (Table 3-1). Forested wetlands predominate (Figure 3-7). Deciduous forested wetlands are the most common type, representing 59 percent of the state's palustrine wetlands, more abundant than the rest combined.

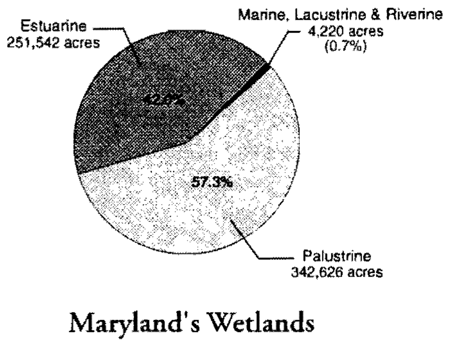

Figure 3-5. Relative abundance of Maryland's wetlands. Over half are freshwater types.

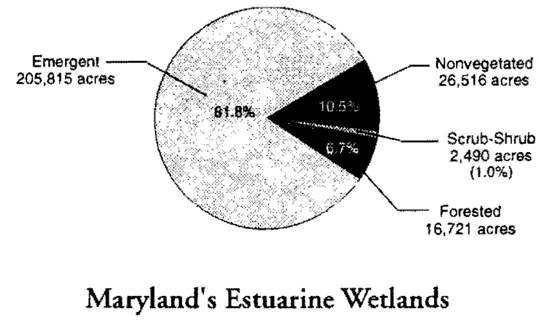

Figure 3-6. Relative extent of Maryland's estuarine wetlands.

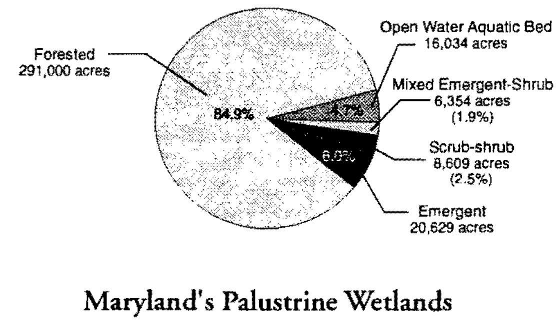

Figure 3-7. Relative extent of Maryland's palustrine wetlands.

[1]The acreage data reported are based on polygon data. Wetlands and watercourses (e.g., streams) mapped as linear features (i.e., dashed lines) are not reflected in these figures. Also, comparison of wetland acreage totals between different aggregates, e.g., county totals versus physiographic region totals, differ due to computer round-off procedures.

Table 3-1. Wetland and deepwater habitat acreage summaries for Maryland as of 1981/82. Totals have been rounded off to the nearest acre.

Marine Wetlands (Beaches)	731
Estuarine Wetlands	
Nonvegetated	26,516
Emergent (Salt/Brackish)	172,346
Emergent (Oligohaline)	33,469
Deciduous Scrub-Shrub	1,534
Evergreen Scrub-Shrub	956
Deciduous Forested	856
Evergreen Forested	13,448
Dead Forested	2,417
Total Estuarine Wetlands	**251,542**
Palustrine Wetlands	
Aquatic Bed	526
Emergent (Tidal)	3,799
Emergent (Nontidal)	16,830
Scrub-Shrub (Tidal)	2,470
Deciduous Scrub-Shrub (Nontidal)	5,538
Evergreen Scrub-Shrub (Nontidal)	601
Mixed Emergent-Shrub (Nontidal)	6,354
Deciduous Forested (Tidal)	28,802*
Evergreen Forested (Tidal)	2,316
Mixed Forested (Tidal)	1,176
Deciduous Forested (Nontidal)	202,446**
Evergreen Forested (Nontidal)	15,303
Mixed Forested (Nontidal)	39,795
Dead Forested/Open Water	1,162
Open Water	15,508
Total Palustrine Wetlands	342,626
Riverine Wetlands	
Emergent (Tidal)	1,597
Nonvegetated (Tidal)	241
Vegetated (Nontidal)	8
Nonvegetated (Nontidal)	229
Total Riverine Wetlands	2,075
Lacustrine Wetlands	
Emergent	545
Nonvegetated	869
Total Lacustrine Wetlands	1,414
TOTAL WETLANDS	598,388

- 304,063

Estuarine Waters	
Salt/Brackish Waters	1,378,834
Oligohaline Waters	163,890
Total Estuarine Waters	1,542,724
Lacustrine Waters	21,062
Riverine Waters	
Tidal	16,866
Nontidal	20,153
Total Riverine Waters	37,019
TOTAL DEEPWATER HABITATS	1,600,805

* Includes 50 acres of cypress swamp
** Includes 78 acres of cypress swamp

Table 3-2. Wetland acreage for each county in Maryland as of 1981/82. Totals have been rounded off to the nearest acre. (*Note:* Acreages of palustrine wetlands may be conservative, especially for Eastern Shore Counties where many temporarily flooded and seasonally saturated wetlands were not mapped. More detailed mapping will usually identify more acreage.)

County	Estuarine Wetland Acreage	Palustrine Wetland Acreage	Other Wetland Acreage*	1981-82 Total	1988-90 Total**
Allegany	—	612	5	617	—
Anne Arundel	2,774	13,202	180	16,156	16,225
Baltimore City	64	155	31	250	—
Baltimore County	2,491	3,384	367	6,242	—
Calvert	3,630	7,077	—	10,707	10,734
Caroline	2,121	28,027	366	30,514	—
Carroll	—	4,229	562	4,791	—
Cecil	2,184	6,646	188	9,018	—
Charles	4,909	21,755	22	26,686	27,010
Dorchester	100,529	68,259	380	169,168	—
Frederick	—	7,243	82	7,325	—
Garrett	—	7,068	14	7,082	—
Harford	6,649	5,863	15	12,527	—
Howard	—	2,977	140	3,117	—
Kent	3,706	11,570	37	15,313	—
Montgomery	—	9,566	133	9,699	—
Prince Georges	2,019	17,309	188	19,516	19,470
Queen Annes	8,453	24,040	18	32,511	—
St. Marys	6,600	9,671	25	16,296	16,730
Somerset	62,408	19,155	—	81,563	—
Talbot	9,781	9,993	193	19,967	—
Washington	—	2,101	9	2,110	—
Wicomico	14,277	23,141	343	37,761	—
Worcester	18,954	39,603	929	59,486	—

* Riverine, Lacustrine, and Marine wetlands.

** Available for only a few counties where more detailed mapping was performed. The difference between the 1988/89 acreage and the 1981/82 acreage *does not* simply translate into wetland losses or gains, as the recent mapping was more accurate. See status and trend reports for more information: Tiner and Foulis (1992a, b) and Foulis and Tiner (1994a, b, c).

County Totals

Wetlands were most abundant in Dorchester and Somerset Counties (Table 3-2; Figure 3-8). These counties contained about 42 percent of the state's wetlands. Dorchester alone possessed roughly 28 percent of the state's wetlands. Wetlands were also widespread in Worcester, Wicomico, Queen Annes, Caroline, and Charles Counties.

Wetland and deepwater habitat acreage data for each county (listed in alphabetical order) are presented below. These data are for polygons shown on the NWI maps and do not include acreage data from linear features (i.e., streams and wetlands mapped as a dashed line) or acreage of wetlands that were not mapped.

Allegany County

Allegany County had 617 acres of wetlands. Only 0.2 percent of the County is represented by wetlands.

Palustrine Wetlands	
Emergent (Nontidal)	39
Deciduous Scrub-Shrub (Nontidal)	60
Mixed Deciduous Shrub-Emergent (Nontidal)	11
Deciduous Forested (Nontidal)	238
Evergreen Forested (Nontidal)	2
Dead Forested/Open Water (Nontidal)	12
Open Water (Nontidal)	250
Total Palustrine Wetlands	**612**
Riverine Wetlands	5
TOTAL WETLANDS	617

Allegany County had 2,601 acres of deepwater habitats: 217 acres of lacustrine waters and 2,384 acres of riverine waters.

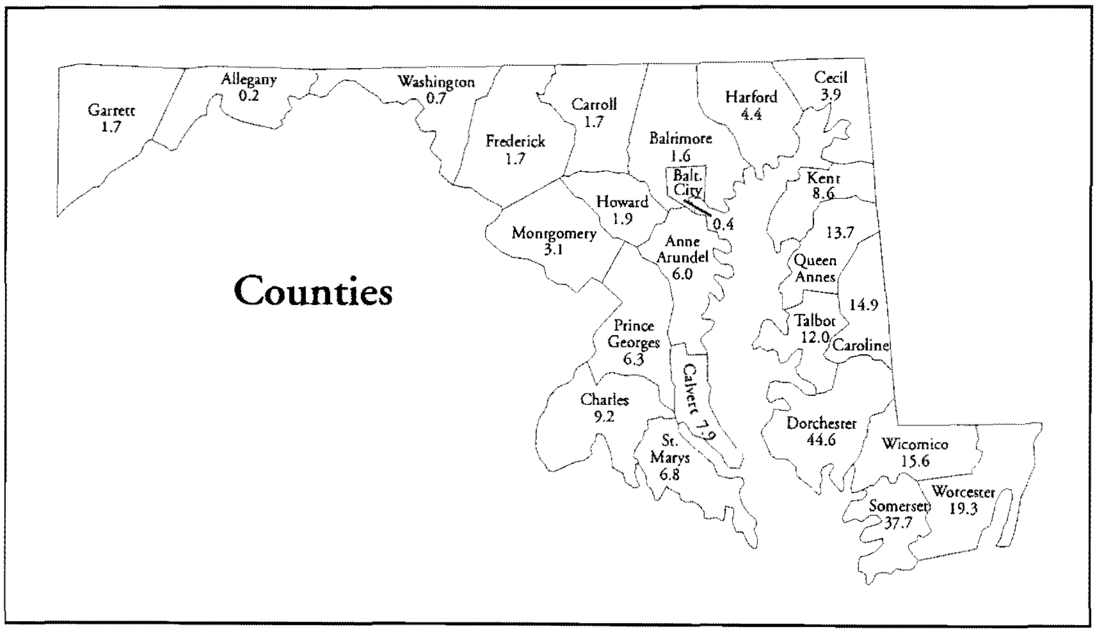

Figure 3-8. Percentage of county land surface occupied by wetlands.

Anne Arundel County

Anne Arundel County had 16,156 acres of wetlands. This represents 6.0 percent of the County.

Estuarine Wetlands	
Nonvegetated	744
Emergent (Salt/Brackish)	1,702
Emergent (Oligohaline)	296
Deciduous Scrub-Shrub	32
Total Estuarine Wetlands	2,774
Palustrine Wetlands	
Aquatic Bed	6
Emergent (Tidal)	375
Emergent (Nontidal)	547
Deciduous Scrub-Shrub (Tidal)	140
Deciduous Scrub-Shrub (Nontidal)	117
Evergreen Scrub-Shrub (Nontidal)	4
Mixed Deciduous Shrub-Emergent (Nontidal)	275
Deciduous Forested (Tidal)	405
Deciduous Forested (Nontidal)	10,385
Evergreen Forested (Nontidal)	5
Mixed Forested (Nontidal)	123
Dead Forested/Open Water (Nontidal)	42
Open Water (Nontidal)	778
Total Palustrine Wetlands	13,202
Riverine Wetlands	
Emergent (Tidal)	156
Beach/Bar (Nontidal)	1
Total Riverine Wetlands	157
Lacustrine Wetlands (Emergent)	23
TOTAL WETLANDS	16,156

Anne Arundel County had 106,827 acres of deepwater habitats: 106,505 acres of estuarine waters (including 553 acres of oligohaline waters), 93 acres of lacustrine waters, and 229 acres of riverine waters (102 tidal acres and 127 nontidal acres).

Baltimore City

Baltimore City had 250 acres of wetlands which represents only 0.4 percent of the City.

Estuarine Wetlands	
Nonvegetated	44
Emergent (Salt/Brackish)	8
Emergent (Oligohaline)	12
Total Estuarine Wetlands	64
Palustrine Wetlands	
Emergent (Nontidal)	36
Mixed Deciduous Shrub-Emergent (Nontidal)	1
Deciduous Forested (Nontidal)	26
Open Water (Nontidal)	92
Total Palustrine Wetlands	155
Riverine Wetlands	31
TOTAL WETLANDS	250

Baltimore City had 7,047 acres of deepwater habitats: 6,926 acres of estuarine waters (including 37 acres of oligohaline waters), 95 acres of lacustrine waters, and 26 acres of riverine waters (21 tidal acres and 5 nontidal acres).

Baltimore County

Baltimore County had 6,242 acres of wetlands, representing 1.6 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	261
Emergent (Salt/Brackish)	1,453
Emergent (Oligohaline)	736
Deciduous Scrub-Shrub	34
Deciduous Forested	7
Total Estuarine Wetlands	**2,491**
Palustrine Wetlands	
Emergent (Tidal)	18
Emergent (Nontidal)	650
Deciduous Scrub-Shrub (Tidal)	42
Deciduous Scrub-Shrub (Nontidal)	21
Mixed Deciduous Shrub-Emergent (Nontidal)	143
Deciduous Forested (Tidal)	272
Deciduous Forested (Nontidal)	1,348
Open Water (Nontidal)	890
Total Palustrine Wetlands	**3,384**
Riverine Wetlands	44
Lacustrine Wetlands	
Beach/Bar	188
Emergent	126
Unconsolidated Bottom (Open Water)	9
Total Lacustrine Wetlands	**323**
TOTAL WETLANDS	6,242

Baltimore County had 56,974 acres of deepwater habitats: 52,103 acres of estuarine waters (including 1,125 acres of oligohaline waters), 4,579 acres of lacustrine waters, and 292 acres of riverine waters (13 tidal acres and 279 nontidal acres).

Calvert County

Calvert County had 10,707 acres of wetlands. This amounts to 7.9 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	625
Emergent (Salt/Brackish)	1,151
Emergent (Oligohaline)	1,829
Deciduous Scrub-Shrub	11
Evergreen Forested	14
Total Estuarine Wetlands	**3,630**
Palustrine Wetlands	
Aquatic Bed	12
Emergent (Tidal)	167
Emergent (Nontidal)	176
Deciduous Scrub-Shrub (Tidal)	106
Deciduous Scrub-Shrub (Nontidal)	61
Mixed Deciduous Shrub-Emergent (Nontidal)	129
Deciduous Forested (Tidal)	879
Evergreen Forested (Tidal)	2
Deciduous Forested (Nontidal)	4,980*
Evergreen Forested (Nontidal)	9
Mixed Forested (Tidal)	23
Mixed Forested (Nontidal)	49
Dead Forested/Open Water (Nontidal)	106
Open Water (Nontidal)	378
Total Palustrine Wetlands	**7,077**
TOTAL WETLANDS	10,707

* Includes 70 acres in the Battle Creek floodplain where bald cypress is co-dominant.

Calvert County had 95,069 acres of deepwater habitats: 94,934 acres of estuarine waters (including 4,340 acres of oligohaline waters) and 135 acres of lacustrine waters.

Caroline County

Caroline County had 30,514 acres of wetlands. About 14.9 percent of the County is represented by wetlands.

Estuarine Wetlands	
Nonvegetated	240
Emergent (Salt/Brackish)	2
Emergent (Oligohaline)	1,879
Total Estuarine Wetlands	2,121
Palustrine Wetlands	
Emergent (Tidal)	343
Emergent (Nontidal)	432
Deciduous Scrub-Shrub (Tidal)	136
Deciduous Scrub-Shrub (Nontidal)	192
Evergreen Scrub-Shrub (Nontidal)	26
Mixed Deciduous Shrub-Emergent (Nontidal)	296
Deciduous Forested (Tidal)	1,189
Deciduous Forested (Nontidal)	17,014
Evergreen Forested (Nontidal)	325
Mixed Forested (Tidal)	5
Mixed Forested (Nontidal)	7,606
Dead Forested/Open Water (Nontidal)	17
Open Water (Nontidal)	446
Total Palustrine Wetlands	28,027
Riverine Wetlands	
Flat (Tidal)	68
Emergent (Tidal)	283
Total Riverine Wetlands	351
Lacustrine Wetlands	15
TOTAL WETLANDS	30,514

Caroline County had 3,157 acres of deepwater habitats: 2,390 acres of estuarine waters (including 2,384 acres of oligohaline waters), 146 acres of lacustrine waters, and 621 acres of riverine tidal waters.

Carroll County

Carroll County had 4,791 acres of wetlands. This represents 1.7 percent of the County.

Palustrine Wetlands	
Aquatic Bed	1
Emergent (Nontidal)	1,236
Deciduous Scrub-Shrub (Nontidal)	105
Mixed Deciduous Shrub-Emergent (Nontidal)	264
Deciduous Forested (Nontidal)	1,934
Dead Forested/Open Water (Nontidal)	14
Open Water (Nontidal)	675
Total Palustrine Wetlands	4,229
Riverine Wetlands	4
Lacustrine Wetlands	
Beach/Bar	271
Emergent	287
Total Lacustrine Wetlands	558
TOTAL WETLANDS	4,791

Carroll County had 1,860 acres of deepwater habitats: 1,501 acres of lacustrine waters and 359 acres of riverine waters.

Cecil County

Cecil County had 9,018 acres of wetlands, representing 3.9 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	601
Emergent (Oligohaline)	1,564
Deciduous Scrub-Shrub	17
Deciduous Forested	2
Total Estuarine Wetlands	2,184
Palustrine Wetlands	
Aquatic Bed	8
Emergent (Tidal)	656
Emergent (Nontidal)	1,066
Deciduous Scrub-Shrub (Tidal)	149
Deciduous Scrub-Shrub (Nontidal)	289
Mixed Deciduous Shrub-Emergent (Nontidal)	178
Deciduous Forested (Tidal)	283
Deciduous Forested (Nontidal)	2,985
Dead Forested/Open Water (Nontidal)	25
Open Water (Nontidal)	1,007
Total Palustrine Wetlands	6,646
Riverine Wetlands	
Flat (Tidal)	93
Emergent (Tidal)	39
Other (Nontidal)	18
Total Riverine Wetlands	150
Lacustrine Wetlands	38
TOTAL WETLANDS	9,018

Cecil County had 43,146 acres of deepwater habitats: 38,424 acres of estuarine oligohaline waters, 1,884 acres of lacustrine waters, and 2,838 acres of riverine waters.

Charles County

Charles County had 26,686 acres of wetlands which represents 9.2 percent of the County.

Estuarine Wetlands	
Nonvegetated	72
Emergent (Salt/Brackish)	1,171
Emergent (Oligohaline)	3,560
Deciduous Scrub-Shrub	105
Deciduous Forested	1
Total Estuarine Wetlands	4,909
Palustrine Wetlands	
Aquatic Bed	8
Emergent (Tidal)	187
Emergent (Nontidal)	484
Deciduous Scrub-Shrub (Tidal)	193
Deciduous Scrub-Shrub (Nontidal)	200
Mixed Deciduous Shrub-Emergent (Nontidal)	314
Deciduous Forested (Tidal)	1,063
Evergreen Forested (Tidal)	6
Deciduous Forested (Nontidal)	18,139
Evergreen Forested (Nontidal)	28
Mixed Forested (Tidal)	4
Mixed Forested (Nontidal)	148
Dead Forested/Open Water (Nontidal)	304
Open Water (Nontidal)	677
Total Palustrine Wetlands	21,755
Riverine Tidal Wetlands	22
TOTAL WETLANDS	26,686

Charles County had 117,573 acres of deepwater habitats: 112,921 acres of estuarine waters (including 45,231 acres of oligohaline waters), 235 acres of lacustrine waters, and 4,417 acres of riverine tidal waters.

Dorchester County

Dorchester County had 169,168 acres of wetlands. This amounts to 44.6 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	3,654
Emergent (Salt/Brackish)	76,940
Emergent (Oligohaline)	3,676
Deciduous Scrub-Shrub	424
Evergreen Scrub-Shrub	317
Deciduous Forested	460
Evergreen Forested	12,657
Dead Forested	2,401
Total Estuarine Wetlands	**100,529**
Palustrine Wetlands	
Aquatic Bed	4
Emergent (Tidal)	643
Emergent (Nontidal)	957
Mixed Emergent-Forested (Nontidal)	271
Deciduous Scrub-Shrub (Tidal)	689
Deciduous Scrub-Shrub (Nontidal)	344
Evergreen Scrub-Shrub (Tidal)	41
Evergreen Scrub-Shrub (Nontidal)	218
Mixed Deciduous Shrub-Emergent (Nontidal)	373
Deciduous Forested (Tidal)	8,906
Evergreen Forested (Tidal)	1,271
Deciduous Forested (Nontidal)	23,417
Evergreen Forested (Nontidal)	12,415
Mixed Forested (Tidal)	606
Mixed Forested (Nontidal)	17,282
Dead Forested/Open Water (Nontidal)	41
Open Water (Nontidal)	781
Total **Palustrine Wetlands**	68,259
Riverine Wetlands (Tidal Emergent)	285
Lacustrine Wetlands	
Emergent	24
Unconsolidated Bottom (Open Water)	71
Total Lacustrine Wetlands	95
TOTAL WETLANDS	169,168

Dorchester County had 267,128 acres of deepwater habitats: 265,726 acres of estuarine waters (including 6,380 acres of oligohaline waters), 388 acres of lacustrine waters, and 1,014 acres of riverine waters (921 tidal acres and 93 nontidal acres).

Frederick County

Frederick County had 7,325 acres of wetlands. About 1.7 percent of the County is represented by wetlands.

Palustrine Wetlands	
Aquatic Bed	338
Emergent (Nontidal)	1,789
Deciduous Scrub-Shrub (Nontidal)	126
Mixed Deciduous Shrub-Emergent (Nontidal)	279
Deciduous Forested (Nontidal)	3,775
Mixed Forested (Nontidal)	7
Dead Forested/Open Water (Nontidal)	4
Open Water (Nontidal)	925
Total Palustrine Wetlands	7,243
Riverine Wetlands	33
Lacustrine Wetlands	
Emergent	37
Unconsolidated Bottom (Open Water)	12
Total Lacustrine Wetlands	49
TOTAL WETLANDS	7,325

Frederick County had 3,113 acres of deepwater habitats: 212 acres of lacustrine waters and 2,901 acres of riverine waters.

Garrett County

Garrett County had 7,082 acres of wetlands. This represents 1.7 percent of the County.

Palustrine Wetlands	
Emergent (Nontidal)	1,458
Deciduous Scrub-Shrub (Nontidal)	1,779
Evergreen Scrub-Shrub (Nontidal)	2
Mixed Deciduous Shrub-Emergent (Nontidal)	1,137
Deciduous Forested (Nontidal)	1,013
Evergreen Forested (Nontidal)	488
Mixed Forested (Nontidal)	522
Dead Forested/Open Water (Nontidal)	10
Open Water (Nontidal)	659
Total Palustrine Wetlands	**7,068**
Riverine Wetlands	4
Lacustrine Wetlands	10
TOTAL WETLANDS	7,082

Garrett County had 6,126 acres of deepwater habitats: 5,253 acres of lacustrine waters and 873 of riverine waters.

Harford County

Harford County had 12,527 acres of wetlands, representing 4.4 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	93
Emergent (Salt/Brackish)	1,351
Emergent (Oligohaline)	5,168
Deciduous Scrub-Shrub	17
Deciduous Forested	20
Total Estuarine Wetlands	6,649
Palustrine Wetlands	
Emergent (Tidal)	47
Emergent (Nontidal)	775
Deciduous Scrub-Shrub (Tidal)	29
Deciduous Scrub-Shrub (Nontidal)	68
Mixed Deciduous Shrub-Emergent (Nontidal)	232
Deciduous Forested (Tidal)	369
Deciduous Forested (Nontidal)	3,475
Dead Forested/Open Water (Nontidal)	147
Open Water (Nontidal)	721
Total Palustrine Wetlands	5,863
Riverine Wetlands	11
Lacustrine Wetlands	4
TOTAL WETLANDS	12,527

Harford County had 56,878 acres of deepwater habitats: 52,901 acres of estuarine waters (including 37,031 acres of oligohaline waters), 1,783 acres of lacustrine waters, and 2,194 acres of riverine waters (1,072 tidal acres and 1,122 nontidal acres).

Howard County

Howard County had 3,117 acres of wetlands which represents 1.9 percent of the County.

Palustrine Wetlands	
Emergent (Nontidal)	313
Deciduous Scrub-Shrub (Nontidal)	57
Mixed Deciduous Shrub-Emergent (Nontidal)	300
Deciduous Forested (Nontidal)	1,935
Dead Forested/Open Water (Nontidal)	1
Open Water (Nontidal)	371
Total Palustrine Wetlands	2,977
Riverine Wetlands	26
Lacustrine Wetlands	
Emergent	6
Unconsolidated Shore	48
Unconsolidated Bottom (Open Water)	60
Total Lacustrine Wetlands	114
TOTAL WETLANDS	3,117

Howard County had 1,030 acres of deepwater habitats: 826 acres of lacustrine waters and 204 acres of riverine waters.

Kent County

Kent County had 15,313 acres of wetlands. This amounts to 8.6 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	258
Emergent (Salt/Brackish)	2,602
Emergent (Oligohaline)	749
Deciduous Scrub-Shrub	91
Deciduous Forested	4
Evergreen Forested	2
Total Estuarine Wetlands	3,706
Palustrine Wetlands	
Aquatic Bed	14
Emergent (Tidal)	37
Emergent (Nontidal)	467
Deciduous Scrub-Shrub (Tidal)	138
Deciduous Scrub-Shrub (Nontidal)	282
Mixed Deciduous Shrub-Emergent (Nontidal)	366
Deciduous Forested (Tidal)	259
Evergreen Forested (Tidal)	5
Deciduous Forested (Nontidal)	8,165
Evergreen Forested (Nontidal)	51
Mixed Forested (Tidal)	5
Mixed Forested (Nontidal)	257
Dead Forested/Open Water (Nontidal)	71
Open Water (Nontidal)	1,453
Total Palustrine Wetlands	11,570
Riverine Wetlands (Tidal Emergent)	19
Lacustrine Wetlands (Emergent)	18
TOTAL WETLANDS	15,313

Kent County had 77,785 acres of deepwater habitats: 77,367 acres of estuarine waters (including 14,483 acres of oligohaline waters), 373 acres of lacustrine waters, and 45 acres of riverine tidal waters.

Montgomery County

Montgomery County had 9,699 acres of wetlands. About 3.1 percent of the County is represented by wetlands.

Palustrine Wetlands	
Emergent (Nontidal)	1,321
Deciduous Scrub-Shrub (Nontidal)	257
Mixed Deciduous Shrub-Emergent (Nontidal)	715
Deciduous Forested (Nontidal)	6,425
Dead Forested/Open Water (Nontidal)	106
Open Water (Nontidal)	742
Total Palustrine Wetlands	9,566
Riverine Wetlands	
Rocky Shore	28
Unconsolidated Shore	3
Total Riverine Wetlands	31
Lacustrine Wetlands	
Emergent	14
Unconsolidated Bottom (Open Water)	24
Unconsolidated and Rocky Shores	64
Total Lacustrine Wetlands	**102**
TOTAL WETLANDS	9,699

Montgomery County had 6,225 acres of deepwater habitats: 1,470 acres of lacustrine waters, and 4,755 acres of riverine waters.

Prince Georges County

Prince Georges County had 19,516 acres of wetlands. This represents 6.3 percent of the County.

Estuarine Wetlands	
Emergent (Salt/Brackish)	14
Emergent (Oligohaline)	2,005
Total Estuarine Wetlands	2,019
Palustrine Wetlands	
Aquatic Bed	115
Emergent (Tidal)	665
Emergent (Nontidal)	720
Deciduous Scrub-Shrub (Tidal)	224
Deciduous Scrub-Shrub (Nontidal)	135
Evergreen Scrub-Shrub (Nontidal)	4
Mixed Deciduous Shrub-Emergent (Nontidal)	572
Deciduous Forested (Tidal)	916
Deciduous Forested (Nontidal)	12,961
Evergreen Forested (Nontidal)	2
Mixed Forested (Tidal)	3
Mixed Forested (Nontidal)	28
Dead Forested/Open Water (Nontidal)	117
Open Water (Nontidal)	847
Total Palustrine Wetlands	17,309
Riverine Wetlands	
Flat (Tidal)	13
Emergent (Tidal)	136
Other (Nontidal)	25
Total Riverine Wetlands	174
Lacustrine Wetlands	
Emergent	10
Unconsolidated Bottom (Open Water)	4
Total Lacustrine Wetlands	14
TOTAL WETLANDS	19,516

Prince Georges County had 8,463 acres of deepwater habitats: 2,226 acres of estuarine waters (including 2,199 acres of oligohaline waters), 285 acres of lacustrine waters, and 5,952 acres of riverine waters (5,892 tidal acres and 60 nontidal acres).

Queen Annes County

Queen Annes County had 32,511 acres of wetlands, representing 13.7 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	4,137
Emergent (Salt/Brackish)	3,558
Emergent (Oligohaline)	659
Deciduous Scrub-Shrub	99
Total Estuarine Wetlands	**8,453**
Palustrine Wetlands	
Aquatic Bed	5
Emergent (Tidal)	58
Emergent (Nontidal)	555
Deciduous Scrub-Shrub (Tidal)	127
Deciduous Scrub-Shrub (Nontidal)	149
Evergreen Scrub-Shrub (Nontidal)	4
Mixed Deciduous Shrub-Emergent (Nontidal)	235
Deciduous Forested (Tidal)	443
Evergreen Forested (Tidal)	16
Deciduous Forested (Nontidal)	20,071
Evergreen Forested (Nontidal)	31
Mixed Forested (Tidal)	24
Mixed Forested (Nontidal)	1,539
Dead Forested/Open Water (Nontidal)	81
Open Water (Nontidal)	702
Total Palustrine Wetlands	**24,040**
Riverine Wetlands (Tidal Emergent)	13
Lacustrine Wetlands	5
TOTAL WETLANDS	32,511

Queen Annes County had 89,823 acres of deepwater habitats: 89,552 acres of estuarine waters (including 953 acres of oligohaline waters), 200 acres of lacustrine waters, and 71 acres of riverine tidal waters.

St. Marys County

St. Marys County had 16,296 acres of wetlands which represents 6.8 percent of the County.

Esruarine Wetlands	
Nonvegetated	3,142
Emergent (Salt/Brackish)	2,285
Emergent (Oligohaline)	829
Deciduous Scrub-Shrub	170
Evergreen Scrub-Shrub	20
Evergreen Forested	137
Dead Forested	17
Total Estuarine Wetlands	**6,600**
Palustrine Wetlands	
Aquatic Bed	7
Emergent (Tidal)	55
Emergent (Nontidal)	312
Mixed Emergent/Forested (Nontidal)	13
Deciduous Scrub-Shrub (Tidal)	147
Deciduous Scrub-Shrub (Nontidal)	125
Evergreen Scrub-Shrub (Tidal)	7
Evergreen Scrub-Shrub (Nontidal)	7
Mixed Deciduous Shrub-Emergent (Nontidal)	58
Deciduous Forested (Tidal)	970
Evergreen Forested (Tidal)	90
Deciduous Forested (Nontidal)	6,318
Evergreen Forested (Nontidal)	141
Mixed Forested (Tidal)	30
Mixed Forested (Nontidal)	729
Dead Forested/Open Water (Nontidal)	43
Open Water (Nontidal)	619
Total Palustrine Wetlands	**9,671**
Lacustrine Wetlands	25
TOTAL WETLANDS	16,296

St. Marys County had 285,834 acres of deepwater habitats: 285,680 acres of estuarine waters (including 2,438 acres of oligohaline waters) and 154 acres of lacustrine waters.

Somerset County

Somerset County had 81,563 acres of wetlands. This amounts to 37.7 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	6,270
Emergent (Salt/Brackish)	53,743
Emergent (Oligohaline)	885
Deciduous Scrub-Shrub	468
Evergreen Scrub-Shrub	146
Deciduous Forested	360
Evergreen Forested	536
Total Estuarine Wetlands	62,408
Palustrine Wetlands	
Emergent (Tidal)	20
Emergent (Nontidal)	664
Deciduous Scrub-Shrub (Tidal)	23
Deciduous Scrub-Shrub (Nontidal)	120
Evergreen Scrub-Shrub (Nontidal)	55
Mixed Deciduous Shrub-Emergent (Nontidal)	31
Deciduous Forested (Tidal)	1,981*
Evergreen Forested (Tidal)	36
Deciduous Forested (Nontidal)	13,873
Evergreen Forested (Nontidal)	390
Mixed Forested (Tidal)	34
Mixed Forested (Nontidal)	1,569
Dead Forested/Open Water (Nontidal)	1
Open Water (Nontidal)	358
Total Palustrine Wetlands	19,155
TOTAL WETLANDS	81,563

*Includes 23 acres along the Pocomoke River where bald cypress is co-dominant.

Somerset County had 147,357 acres of deepwater habitats: 147,131 acres of estuarine waters (including 360 acres of oligohaline waters), 25 acres of lacustrine waters, and 201 acres of riverine tidal waters.

Talbot County

Talbot County had 19,967 acres of wetlands. About 12.0 percent of the County is represented by wetlands.

Estuarine Wetlands	
Nonvegetated	4,647
Emergent (Salt/Brackish)	2,458
Emergent (Oligohaline)	2,643
Deciduous Scrub-Shrub	29
Forested	4
Total Estuarine Wetlands	9,781
Palustrine Wetlands	
Aquatic Bed	7
Emergent (Tidal)	229
Emergent (Nontidal)	380
Deciduous Scrub-Shrub (Tidal)	200
Deciduous Scrub-Shrub (Nontidal)	64
Mixed Deciduous Shrub-Emergent (Nontidal)	164
Deciduous Forested (Tidal)	624
Evergreen Forested (Tidal)	4
Deciduous Forested (Nontidal)	4,842
Evergreen Forested (Nontidal)	318
Mixed Forested (Nontidal)	2,486
Dead Forested/Open Water (Nontidal)	10
Open Water (Nontidal)	665
Total Palustrine Wetlands	9,993
Riverine Wetlands	
Flat (Tidal)	12
Emergent (Tidal)	181
Total Riverine Wetlands	193
TOTAL WETLANDS	19,967

Talbot County had 123,787 acres of deepwater habitats: 123,497 acres of estuarine waters (including 4,989 acres of oligohaline waters), 49 acres of lacustrine waters, and 241 acres of riverine waters.

Washington County

Washington County had 2,110 acres of wetlands. This represents only 0.7 percent of the County.

Palustrine Wetlands	
Aquatic Bed	1
Emergent (Nontidal)	540
Deciduous Scrub-Shrub (Nontidal)	62
Mixed Deciduous Shrub-Emergent (Nontidal)	47
Deciduous Forested (Nontidal)	997
Dead Forested/Open Water (Nontidal)	1
Open Water (Nontidal)	453
Total Palustrine Wetlands	2,101
Riverine Wetlands	9
TOTAL WETLANDS	2,110

Washington County had 6,381 acres of deepwater habitats: 357 acres of lacustrine waters and 6,024 acres of riverine waters.

Wicomico County

Wicomico County had 37,761 acres of wetlands, representing 15.6 percent of the County's land area.

Estuarine Wetlands	
Nonvegetated	645
Emergent (Salt/Brackish)	7,249
Emergent (Oligohaline)	6,167
Deciduous Scrub-Shrub	23
Evergreen Scrub-Shrub	91
Forested	102
Total Estuarine Wetlands	14,277
Palustrine Wetlands	
Emergent (Tidal)	228
Emergent (Nontidal)	616
Deciduous Scrub-Shrub (Tidal)	71
Deciduous Scrub-Shrub (Nontidal)	312
Evergreen Scrub-Shrub (Nontidal)	89
Mixed Deciduous Shrub-Emergent (Nontidal)	96
Deciduous Forested (Tidal)	1,937
Evergreen Forested (Tidal)	90
Deciduous Forested (Nontidal)	14,136*
Evergreen Forested (Nontidal)	512
Mixed Forested (Tidal)	133
Mixed Forested (Nontidal)	4,459
Open Water (Nontidal)	462
Total Palustrine Wetlands	23,141
Riverine Wetlands	
Flat (Tidal)	47
Emergent (Tidal)	274
Total Riverine Wetlands	321
Lacustrine Wetlands (Open Water)	22
TOTAL WETLANDS	37,761

* Includes 8 acres of bald cypress-dominated wetlands.

Wicomico County had 14,357 acres of deepwater habitats: 13,420 acres of estuarine waters (includes 2,715 acres of oligohaline waters), 529 acres of lacustrine waters, and 408 acres of riverine waters (398 tidal acres and 10 nontidal acres).

Worcester County

Worcester County had 59,486 acres of wetlands which represents 19.6 percent of the County.

Marine Wetlands (Beach/Bar)	731
Estuarine Wetlands	
Nonvegetated	1,086
Emergent (Salt/Brackish)	16,661
Emergent (Oligohaline)	812
Deciduous Scrub-Shrub	13
Evergreen Scrub-Shrub	382
Total Estuarine Wetlands	18,954
Palustrine Wetlands	
Emergent (Tidal)	70
Emergent (Nontidal)	1,024
Deciduous Scrub-Shrub (Tidal)	8
Deciduous Scrub-Shrub (Nontidal)	622
Evergreen Scrub-Shrub (Nontidal)	183
Mixed Deciduous Shrub-Emergent (Nontidal)	99
Deciduous Forested (Tidal)	8,310*
Evergreen Forested (Tidal)	801
Deciduous Forested (Nontidal)	24,033
Evergreen Forested (Nontidal)	541
Mixed Forested (Tidal)	308
Mixed Forested (Nontidal)	3,037
Dead Forested/Open Water (Nontidal)	6
Open Water (Nontidal)	561
Total Palustrine Wetlands	39,603
Riverine Wetlands (Tidal Emergent)	198
TOTAL WETLANDS	59,486

* Includes 27 acres of bald cypress-dominated wetlands in Cypress Swamp and along the Pocomoke River.

Worcester County had 72,133 acres of deepwater habitats: 70,898 acres of estuarine waters (includes 122 acres of oligohaline waters), 271 acres of lacustrine waters, and 964 acres of riverine waters (938 tidal acres and 26 nontidal acres).

Physiographic Region Totals

Wetland acreage summaries are provided for each of six physiographic regions found in Maryland: (1) Coastal Plain, (2) Fall Zone, (3) Piedmont, (4) Blue Ridge, (5) Valley and Ridge, and (6) Appalachian Plateau Region (Figure 3-9). Acreage data presented are based on wetlands and deepwater habitats mapped as polygons on NWI maps excluding marine open water (Atlantic Ocean); they also do not include acreage of linear map features (i.e., streams and wetlands mapped as a dashed line.)

Coastal Plain

The Coastal Plain occupies about 54 percent of Maryland's land surface area and possesses about 94 percent of the state's wetland resources. Wetlands represent about 16 percent of this region's "land" area. Wetland density is about 104 acres per square mile. More than 1.5 million acres of deepwater habitats occur in this region and its vicinity due to the presence of Chesapeake Bay which divides the Coastal Plain in two sections—the Eastern Shore and the Western Shore.

Marine Wetlands (Beaches)	731
Estuarine Wetlands	
Nonvegetated	26,516
Emergent (Salt/Brackish)	172,346
Emergent (Oligohaline)	33,469
Deciduous Scrub-Shrub	1,534
Evergreen Scrub-Shrub	956
Deciduous Forested	856
Evergreen Forested	13,448
Dead Forested	2,417
Total Estuarine Wetlands	**251,542**
Palustrine Wetlands	
Aquatic Bed	184
Emergent (Tidal)	3,780
Emergent (Nontidal)	9,116
Mixed Emergent/Forested (Nontidal)	239
Deciduous Scrub-Shrub (Tidal)	2,478
Deciduous Scrub-Shrub (Nontidal)	3,054
Evergreen Scrub-Shrub (Nontidal)	599
Mixed Deciduous Shrub-Emergent (Nontidal)	3,382
Deciduous Forested (Tidal)	28,821
Evergreen Forested (Tidal)	2,320
Deciduous Forested (Nontidal)	186,343
Evergreen Forested (Nontidal)	14,778
Mixed Forested (Tidal)	1,176
Mixed Forested (Nontidal)	38,498
Dead Forested/Open Water (Nontidal)	1,014
Open Water (Nontidal)	9,827
Total Palustrine Wetlands	**305,609**
Riverine Wetlands	
Flat/Unconsolidated Shore (Tidal)	241
Emergent (Tidal)	1,597
Other (Nontidal)	56
Total Riverine Wetlands	**1,894**
Lacustrine Wetlands	263
TOTAL WETLANDS	560,039

Estuarine Waters	
Salt/Brackish Waters	1,341,746
Oligohaline Waters	164,014
Total Estuarine Waters	**1,505,760**
Riverine Waters	
Tidal Waters	14,770
Nontidal Waters	289
Total Riverine Waters	**15,059**
Lacustrine Waters	3,380
TOTAL DEEPWATER HABITATS	1,524,199*

* Most of these deepwater habitats are contiguous to the Coastal Plain in association with Chesapeake Bay and its tributaries.

Fall Zone

The Fall Zone represents only 3 percent of Maryland's land surface area. Only 0.2 percent of the state's wetlands are found here. Wetlands occupy over 1,400 acres which amounts to less than 1 percent of this area's "land" mass. Wetland density is 5 acres per square mile. Almost 1,800 acres of deepwater habitats exist in this region.

Palustrine Wetlands	
Emergent (Tidal)	21
Emergent (Nontidal)	117
Deciduous Scrub-Shrub (Tidal)	4
Deciduous Scrub-Shrub (Nontidal)	35
Mixed Deciduous Shrub-Emergent (Nontidal)	35
Deciduous Forested (Tidal)	75
Deciduous Forested (Nontidal)	670
Dead Forested/Open Water (Nontidal)	2
Open Water (Nontidal)	431
Total Palustrine Wetlands	**1,390**
Riverine Wetlands	31
TOTAL WETLANDS	1,421

Lacustrine Waters	457
Riverine Waters	
Tidal Waters	1,189
Nontidal Waters	134
Total Riverine Waters	**1,323**
TOTAL DEEPWATER HABITATS	1,780

Piedmont

The Piedmont region encompasses about 25 percent of Maryland's land surface area. This area contains about 4.6 percent of the state's wetland resources. Wetlands account for over 27,000 acres. This figure amounts to about 1.7 percent of this region's land area. Wetland density is 11 acres per square mile. Nearly 22,000 acres of deepwater habitats occur in the region.

Palustrine Wetlands	
Aquatic Bed	340
Emergent (Nontidal)	5,083
Deciduous Scrub-Shrub (Nontidal)	540
Mixed Deciduous Shrub-Emergent (Nontidal)	1,722
Deciduous Forested (Tidal)	4
Deciduous Forested (Nontidal)	14,661
Dead Forested/Open Water (Nontidal)	126
Open Water (Nontidal)	3,633
Total Palustrine Wetlands	**26,109**
Lacustrine Wetlands	
Emergent	470
Beach/Bar and Unconsolidated Shore	564
Other	117
Total Lacustrine Wetlands	**1,151**
Riverine Wetlands	121
TOTAL WETLANDS	27,381

Lacustrine Waters	11,432
Riverine Waters	
Tidal Waters	954
Lower Perennial	6,889
Upper Perennial	1,266
Unknown Perennial	1,142
Total Riverine Waters	**10,251**
TOTAL DEEPWATER HABITATS	21,683

Blue Ridge

The Blue Ridge physiographic region covers only 3 percent of Maryland's land area and possesses about 0.3 percent of the state's wetlands. Wetlands occupy just under 2,000 acres which represent only 1 percent of the area. Wetland density is about 6 acres per square mile. Almost 2,000 acres of deepwater habitats occur in this region.

Palustrine Wetlands	
Emergent (Nontidal)	312
Deciduous Scrub-Shrub (Nontidal)	51
Mixed Deciduous Shrub-Emergent (Nontidal)	36
Deciduous Forested (Nontidal)	1,104
Mixed Forested (Nontidal)	7
Open Water (Nontidal)	374
Total Palustrine Wetlands	**1,884**
Riverine Wetlands	17
TOTAL WETLANDS	1,901

Lacustrine Waters	95
Riverine Waters	
Lower Perennial	18
Upper Perennial	608
Unknown Perennial	1,238
Total Riverine Waters	**1,864**
TOTAL DEEPWATER HABITATS	1,959

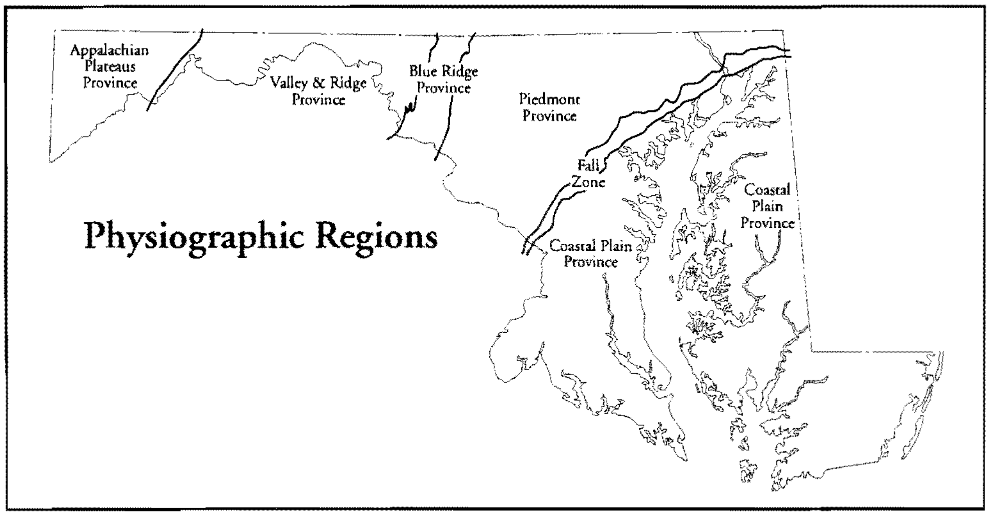

Figure 3-9. Physiographic regions of Maryland.

Valley and Ridge

The Valley and Ridge province occupies about 7 percent of Maryland. Only 0.4 percent of the state's wetlands occur in the region. Wetlands total over 2,300 acres which amounts to about 0.5 percent of the land area. Wetland density is about 3 acres per square mile. Almost 7,500 acres of deepwater habitats are present in this region.

Palustrine Wetlands	
Aquatic Bed	1
Emergent (Nontidal)	566
Deciduous Scrub-Shrub (Nontidal)	101
Mixed Deciduous Shrub-Emergent (Nontidal)	52
Deciduous Forested (Nontidal)	993
Evergreen Forested (Nontidal)	2
Dead Forested/Open Water (Nontidal)	13
Open Water (Nontidal)	588
Total Palustrine Wetlands	2,316
Riverine Wetlands	11
TOTAL WETLANDS	2,327
Lacustrine Waters	515
Riverine Waters	
Lower Perennial	1,862
Upper Perennial	179
Unknown Perennial	4,929
Total Riverine Waters	6,970
TOTAL DEEPWATER HABITATS	7,485

Appalachian Plateaus

The Appalachian Plateaus region in western Maryland covers about 8 percent of the state's land surface. The region contains about 1.2 percent of the state's wetland resources. Almost 7,400 acres of wetlands occur in this region, accounting for about 1.5 percent of its land area. Wetland density is roughly 9 acres per square mile. Over 6,000 acres of deepwater habitats are also present, mostly lacustrine waters associated with Deep Creek Lake.

Palustrine Wetlands	
Emergent (Nontidal)	1,488
Deciduous Scrub-Shrub (Nontidal)	1,852
Evergreen Scrub-Shrub (Nontidal)	2
Mixed Deciduous Shrub-Emergent (Nontidal)	1,176
Deciduous Forested (Nontidal)	1,074
Evergreen Forested (Nontidal)	537
Mixed Forested (Nontidal)	529
Dead Forested/Open Water (Nontidal)	10
Open Water (Nontidal)	704
Total Palustrine Wetlands	7,372
Lacustrine Wetlands	10
Riverine Wetlands	7
TOTAL WETLANDS	7,389
Lacustrine Waters	5,258
Riverine Waters (Upper Perennial)	906
TOTAL DEEPWATER HABITATS	6,164

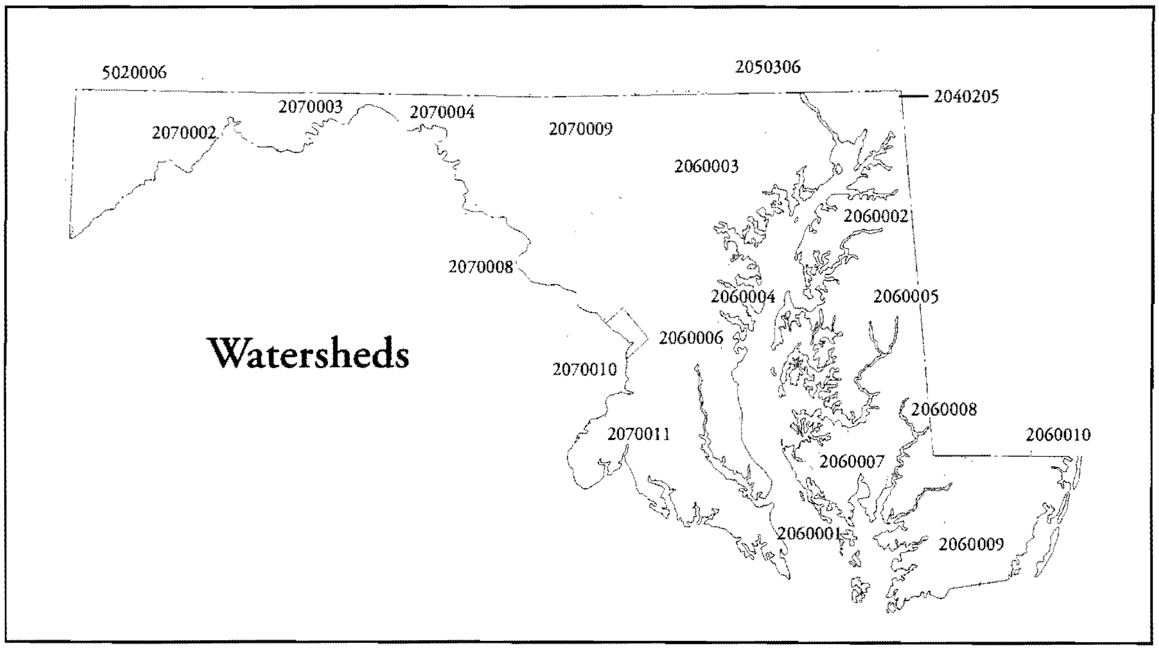

Figure 3-10. Maryland's watersheds based on U.S. Geological Survey hydrologic units. Refer to text for major rivers within each hydro unit.

Watershed Totals

The following section summarizes the wetlands inventory results for Maryland's watersheds defined by U.S. Geological Survey hydrologic units (U.S. Geological Survey 1974). Using this system, 23 "watersheds" are present in Maryland (Figure 3-10; on previous page). Names have been assigned to these hydrologic units based on the major rivers draining each geographical area; hydrounit number is also given for each watershed. Data presented are for polygons shown on NWI maps and do not include acreage of the narrow streams and wetlands mapped as linear features or wetlands and waterways that were too small to depict on the NWI maps. The Potomac River Watershed is the state's largest. It includes many smaller watersheds (e.g., hydrounit numbers 2070002, 2070003, 2070004, 2070008, 2070009, 20700010, 20700011).

Christina Watershed (U.S.G.S. Hydrologic Unit 2040205)

Palustrine Wetlands	
Emergent (Nontidal)	1
Deciduous Forested (Nontidal)	56
Open Water (Nontidal)	18
TOTAL WETLANDS	75

Susquehanna Watershed (U.S.G.S. Hydrologic Unit 2050306)

Palustrine Wetlands	
Emergent (Tidal)	21
Emergent (Nontidal)	172
Deciduous Scrub-Shrub (Tidal)	2
Deciduous Scrub-Shrub (Nontidal)	9
Mixed Deciduous Shrub-Emergent (Nontidal)	56
Deciduous Forested (Tidal)	11
Deciduous Forested (Nontidal)	403
Open Water (Nontidal)	379
Total Palustrine Wetlands	**1,053**
Riverine Wetlands	
Tidal Nonvegetated	1
Nontidal Emergent	2
Nontidal Nonvegetated	23
Total Riverine Wetlands	**26**
TOTAL WETLANDS	1,079

Lacustrine Waters	3,117
Riverine Waters	
Tidal Waters	2,331
Nontidal Waters	2,109
Total Riverine Waters	**4,440**
TOTAL DEEPWATER HABITATS	7,557

Chesapeake Bay Shoreline Watershed (U.S.G.S. Hydrologic Unit 2060001)

Estuarine Wetlands	
Nonvegetated	6,363
Emergent (Salt/Brackish)	21,053
Emergent (Oligohaline)	1,422
Deciduous Scrub-Shrub	149
Evergreen Scrub-Shrub	23
Deciduous Forested	21
Evergreen Forested	456
Dead Forested	8
Total Estuarine Wetlands	**29,495**
Palustrine Wetlands	
Emergent (Tidal)	29
Emergent (Nontidal)	137
Mixed Emergent Forested (Nontidal)	21
Deciduous Scrub-Shrub (Tidal)	68
Deciduous Scrub-Shrub (Nontidal)	94
Evergreen Scrub-Shrub (Nontidal)	2
Mixed Deciduous Shrub-Emergent (Nontidal)	79
Deciduous Forested (Tidal)	105
Evergreen Forested (Tidal)	15
Deciduous Forested (Nontidal)	351
Evergreen Forested (Nontidal)	278
Mixed Forested (Nontidal)	134
Dead Forested/Open Water (Nontidal)	3
Open Water (Nontidal)	190
Total Palustrine Wetlands	**1,506**
TOTAL WETLANDS	31,001

Estuarine Waters	
Salt/Brackish Waters	684,030
Oligohaline Waters	36,310
Total Estuarine Waters	**720,340**
Riverine Tidal Waters	389
TOTAL DEEPWATER HABITATS	720,729

Chester, Sassafras, Elk, Wye, and Miles Watersheds (U.S.G.S. Hydrologic Unit 2060002)

Estuarine Wetlands	
Nonvegetated	3,546
Emergent (Salt/Brackish)	4,791
Emergent (Oligohaline)	2,997
Deciduous Scrub-Shrub	111
Deciduous Forested	7
Evergreen Forested	5
Total Estuarine Wetlands	**11,457**
Palustrine Wetlands	
Aquatic Bed	32
Emergent (Tidal)	660
Emergent (Nontidal)	2,044
Deciduous Scrub-Shrub (Tidal)	365
Deciduous Scrub-Shrub (Nontidal)	614
Evergreen Scrub-Shrub (Nontidal)	4
Mixed Deciduous Shrub-Emergent (Nontidal)	712
Deciduous Forested (Tidal)	979
Evergreen Forested (Tidal)	12
Deciduous Forested (Nontidal)	28,235
Evergreen Forested (Nontidal)	105
Mixed Forested (Tidal)	29
Mixed Forested (Nontidal)	1,916
Dead Forested/Open Water (Nontidal)	106
Open Water (Nontidal)	2,992
Total Palustrine Wetlands	38,805
Riverine Wetlands	
Tidal Flats	92
Tidal Emergent	71
Total Riverine Wetlands	163
Lacustrine Wetlands	
Emergent	18
Nonvegetated	37
Total Lacustrine Wetlands	55
TOTAL WETLANDS	50,480
Estuarine Waters	
Salt/Brackish Waters	52,118
Oligohaline Waters	42,554
Total Estuarine Waters	94,672
Lacustrine Waters	1,072
Riverine Tidal Waters	294
TOTAL DEEPWATER HABITATS	96,038

Patapsco, Gunpowder, and Bush Watersheds (U.S.G.S. Hydrologic Unit 2060003)

Estuarine Wetlands	
Nonvegetated	362
Emergent (Salt/Brackish)	2,456
Emergent (Oligohaline)	4,554
Deciduous Scrub-Shrub	60
Deciduous Forested	26
Total Estuarine Wetlands	7,458
Palustrine Wetlands	
Aquatic Bed	1
Emergent (Tidal)	124
Emergent (Nontidal)	1,966
Deciduous Scrub-Shrub (Tidal)	74
Deciduous Scrub-Shrub (Nontidal)	135
Mixed Deciduous Shrub-Emergent (Nontidal)	538
Deciduous Forested (Tidal)	639
Deciduous Forested (Nontidal)	6,534
Mixed Forested (Nontidal)	1
Dead Forested/Open Water (Nontidal)	154
Open Water (Nontidal)	1,981
Total Palustrine Wetlands	**12,147**
Riverine Wetlands	
Tidal Emergent	2
Nontidal	102
Total Riverine Wetlands	**104**
Lacustrine Wetlands	
Nonvegetated	471
Emergent	413
Total Lacustrine Wetlands	**884**
TOTAL WETLANDS	20,593
Estuarine Waters	
Salt/Brackish Waters	52,041
Oligohaline Waters	13,563
Total Estuarine Waters	65,604
Lacustrine Waters	6,249
Riverine Waters	
Tidal Waters	21
Nontidal Waters	492
Total Riverine Waters	513
TOTAL DEEPWATER HABITATS	72,366

Severn and Magothy Watersheds (U.S.G.S. Hydrologic Unit 2060004)

Estuarine Wetlands	
Nonvegetated	1,414
Emergent (Salt/Brackish)	2,376
Emergent (Oligohaline)	440
Deciduous Scrub-Shrub	72
Total Estuarine Wetlands	**4,302**
Palustrine Wetlands	
Aquatic Bed	8
Emergent (Tidal)	175
Emergent (Nontidal)	180
Deciduous Scrub-Shrub (Tidal)	148
Deciduous Scrub-Shrub (Nontidal)	91
Mixed Deciduous Shrub-Emergent (Nontidal)	146
Deciduous Forested (Tidal)	589
Evergreen Forested (Tidal)	3
Deciduous Forested (Nontidal)	5,458
Evergreen Forested (Nontidal)	5
Mixed Forested (Tidal)	23
Mixed Forested (Nontidal)	99
Dead Forested/Open Water (Nontidal)	87
Open Water (Nontidal)	493
Total Palustrine Wetlands	**7,505**
TOTAL WETLANDS	11,807

Estuarine Waters	
Salt/Brackish Waters	87,474
Oligohaline Waters	358
Total Estuarine Waters	**87,832**
Lacustrine Waters	131
TOTAL DEEPWATER HABITATS	87,963

Choptank Watershed (U.S.G.S. Hydrologic Unit 2060005)

Estuarine Wetlands	
Nonvegetated	5,151
Emergent (Salt/Brackish)	18,375
Emergent (Oligohaline)	5,485
Deciduous Scrub-Shrub	224
Evergreen Scrub-Shrub	95
Deciduous Forested	32
Evergreen Forested	5,685
Dead Forested	462
Total Estuarine Wetlands	**35,509**
Palustrine Wetlands	
Aquatic Bed	1
Emergent (Tidal)	642
Emergent (Nontidal)	995
Mixed Emergent/Forested (Nontidal)	15
Deciduous Scrub-Shrub (Tidal)	505
Deciduous Scrub-Shrub (Nontidal)	268
Evergreen Scrub-Shrub (Nontidal)	174
Mixed Deciduous Shrub-Emergent (Nontidal)	481
Deciduous Forested (Tidal)	2,088
Evergreen Forested (Tidal)	725
Deciduous Forested (Nontidal)	22,914
Evergreen Forested (Nontidal)	7,651
Mixed Forested (Tidal)	18
Mixed Forested (Nontidal)	11,797
Dead Forested/Open Water (Nontidal)	120
Open Water (Nontidal)	1,182
Total Palustrine Wetlands	**49,576**
Riverine Wetlands	
Tidal Flats	80
Tidal Emergent	469
Total Riverine Wetlands	**549**
Lacustrine Nonvegetated Wetlands	21
TOTAL WETLANDS	85,655

Estuarine Waters	
Salt/Brackish Waters	91,802
Oligohaline Waters	11,580
Total Estuarine Waters	**103,382**
Lacustrine Waters	138
Riverine Tidal Waters	876
TOTAL DEEPWATER HABITATS	104,396

Patuxent Watershed (U.S.G.S. Hydrologic Unit 2060006)

Estuarine Wetlands	
Nonvegetated	119
Emergent (Salt/Brackish)	752
Emergent (Oligohaline)	4,559
Deciduous Scrub-Shrub	22
Evergreen Forested	16
Total Estuarine Wetlands	5,468
Palustrine Wetlands	
Aquatic Bed	128
Emergent (Tidal)	845
Emergent (Nontidal)	1,253
Deciduous Scrub-Shrub (Tidal)	428
Deciduous Scrub-Shrub (Nontidal)	276
Evergreen Scrub-Shrub (Nontidal)	8
Mixed Deciduous Shrub-Emergent (Nontidal)	1,048
Deciduous Forested (Tidal)	1,795
Deciduous Forested (Nontidal)	20,490
Evergreen Forested (Nontidal)	9
Mixed Forested (Tidal)	3
Mixed Forested (Nontidal)	98
Dead Forested/Open Water (Nontidal)	161
Open Water (Nontidal)	1,555
Total Palustrine Wetlands	28,097
Riverine Wetlands	
Tidal Emergent	178
Nontidal	8
Total Riverine Wetlands	186
Lacustrine Wetlands	
Nonvegetated	183
Emergent	38
Total Lacustrine Wetlands	221
TOTAL WETLANDS	33,972
Estuarine Waters	
Salt/Brackish Waters	21,597
Oligohaline Waters	9,540
Total Estuarine Waters	31,137
Lacustrine Waters	1,623
Riverine Waters	
Tidal Waters	273
Nontidal Waters	236
Total Riverine Waters	509
TOTAL DEEPWATER HABITATS	33,269

Blackwater, Transquaking, and Chicamacomico Watersheds (U.S.G.S. Hydrologic Unit 2060007)

Estuarine Wetlands	
Nonvegetated	918
Emergent (Salt/Brackish)	57,329
Emergent (Oligohaline)	3,270
Scrub-Shrub	429
Forested	9,018
Total Estuarine Wetlands	70,964
Palustrine Wetlands	
Aquatic Bed	3
Emergent (Tidal)	591
Emergent (Nontidal)	857
Mixed Emergent/Forested (Nontidal)	191
Deciduous Scrub-Shrub (Tidal)	563
Deciduous Scrub-Shrub (Nontidal)	350
Evergreen Scrub-Shrub (Nontidal)	100
Mixed Deciduous Shrub-Emergent (Nontidal)	250
Deciduous Forested (Tidal)	4,526
Evergreen Forested (Tidal)	544
Deciduous Forested (Nontidal)	21,860
Evergreen Forested (Nontidal)	5,013
Mixed Forested (Tidal)	361
Mixed Forested (Nontidal)	11,454
Dead Forested/Open Water (Nontidal)	1
Open Water (Nontidal)	537
Total Palustrine Wetlands	47,201
Riverine Tidal Emergent Wetlands	255
Lacustrine Wetlands	
Nonvegetated	93
Emergent	24
Total Lacustrine Wetlands	117
TOTAL WETLANDS	118,537
Estuarine Waters	
Salt/Brackish Waters	46,694
Oligohaline Waters	1,587
Total Estuarine Waters	48,281
Lacustrine Waters	661
Riverine Waters	
Tidal Waters	799
Nontidal Waters	10
Total Riverine Waters	809
TOTAL DEEPWATER HABITATS	49,751

Nanticoke Watershed (U.S.G.S. Hydrologic Unit 2060008)

Estuarine Wetlands	
Nonvegetated	581
Emergent (Salt/Brackish)	9,377
Emetgent (Oligohaline)	6,105
Scrub-Shrub	126
Forested	230
Total Estuarine Wetlands	16,419
Palustrine Wetlands	
Emergent (Tidal)	192
Emergent (Nontidal)	501
Deciduous Scrub-Shrub (Tidal)	52
Deciduous Scrub-Shrub (Nontidal)	239
Evergreen Scrub-Shrub (Nontidal)	69
Mixed Deciduous Shrub-Emergent (Nontidal)	155
Deciduous Forested (Tidal)	5,992
Evergreen Forested (Tidal)	90
Deciduous Forested (Nontidal)	12,849
Evergreen Forested (Nontidal)	743
Mixed Forested (Tidal)	365
Mixed Forested (Nontidal)	8,171
Dead Forested/Open Water (Nontidal)	17
Open Water (Nontidal)	451
Total Palustrine Wetlands	29,886
Riverine Wetlands	
Tidal Flats	47
Tidal Emergent	299
Total Riverine Wetlands	346
TOTAL WETLANDS	46,651
Estuarine Waters	
Salt/Brackish Waters	12,811
Oligohaline Waters	3,671
Total Estuarine Waters	16,482
Lacustrine Waters	291
Riverine Tidal Waters	610
TOTAL DEEPWATER HABITATS	17,383

Pocomoke Watershed (U.S.G.S. Hydrologic Unit 2060009)

Estuarine Wetlands	
Nonvegetated	3,914
Emergent (Salt/Brackish)	35,982
Emergent (Oligohaline)	1,149
Scrub-Shrub	610
Forested	606
Total Estuarine Wetlands	42,261
Palustrine Wetlands	
Emergent (Tidal)	91
Emergent (Nontidal)	1,286
Deciduous Scrub-Shrub (Tidal)	31
Deciduous Scrub-Shrub (Nontidal)	678
Evergreen Scrub-Shrub (Nontidal)	214
Mixed Deciduous Shrub-Emergent (Nontidal)	119
Deciduous Forested (Tidal)	10,282
Evergreen Forested (Tidal)	833
Deciduous Forested (Nontidal)	37,534
Evergreen Forested (Nontidal)	634
Mixed Forested (Tidal)	343
Mixed Forested (Nontidal)	4,374
Dead Forested/Open Water (Nontidal)	4
Open Water (Nontidal)	576
Total Palustrine Wetlands	56,999
Riverine Tidal Emergent Wetlands	198
TOTAL WETLANDS	99,458
Estuarine Waters	
Salt/Brackish Waters	33,946
Oligohaline Waters	248
Total Estuarine Waters	34,194
Lacustrine Waters	190
Riverine Waters	
Tidal Waters	1,138
Nontidal Waters	26
Total Riverine Waters	1,164
TOTAL DEEPWATER HABITATS	35,548

Chincoteague Bay Watershed (U.S.G.S. Hydrologic Unit 2060010)

Marine Wetlands	731
Estuarine Wetlands	
Nonvegetated	1,086
Emergent	16,539
Scrub-Shrub	334
Total Estuarine Wetlands	**17,959**
Palustrine Wetlands	
Emergent (Nontidal)	430
Deciduous Scrub-Shrub (Nontidal)	129
Evergreen Scrub-Shrub (Nontidal)	21
Mixed Deciduous Shrub-Emergent (Nontidal)	20
Deciduous Forested (Tidal)	9
Deciduous Forested (Nontidal)	4,584
Evergreen Forested (Nontidal)	163
Mixed Forested (Nontidal)	388
Dead Forested/Open Water (Nontidal)	2
Open Water (Nontidal)	375
Total Palustrine Wetlands	**6,121**
TOTAL WETLANDS	24,811
Estuarine Waters	70,757
Lacustrine Waters	129
TOTAL DEEPWATER HABITATS	70,886

Savage, Wills, and North Branch Potomac Watersheds (U.S.G.S. Hydrologic Unit 2070002)

Palustrine Wetlands	
Emergent (Nontidal)	241
Deciduous Scrub-Shrub (Nontidal)	293
Mixed Deciduous Shrub-Emergent (Nontidal)	197
Deciduous Forested (Nontidal)	293
Evergreen Forested (Nontidal)	75
Mixed Forested (Nontidal)	145
Dead Forested/Open Water (Nontidal)	1
Open Water (Nontidal)	320
Total Palustrine Wetlands	**1,565**
Riverine Nontidal Wetlands	9
Lacustrine Nonvegetated Wetlands	3
TOTAL WETLANDS	1,577
Lacustrine Waters	935
Riverine Waters	1,355
TOTAL DEEPWATER HABITATS	2,290

Town Creek, North Branch Potomac, Fifteen Mile Creek, Cacapon, and Sideling Hill Creek Watersheds (U.S.G.S. Hydrologic Unit 2070003)

Palustrine Wetlands	
Emergent (Nontidal)	11
Deciduous Scrub-Shrub (Nontidal)	16
Mixed Deciduous Shrub-Emergent (Nontidal)	2
Deciduous Forested (Nontidal)	66
Dead Forested/Open Water (Nontidal)	11
Open Water (Nontidal)	95
Total Palustrine Wetlands	**201**
Riverine Nontidal Wetlands	5
TOTAL WETLANDS	206
Riverine Waters	1,439
TOTAL DEEPWATER HABITATS	1,439

Antietam, Conococheague, and Licking Creek Watersheds (U.S.G.S. Hydrologic Unit 2070004)

Palustrine Wetlands	
Aquatic Bed	1
Emergent (Nontidal)	527
Deciduous Scrub-Shrub (Nontidal)	56
Mixed Deciduous Shrub Emergent (Nontidal)	46
Deciduous Forested (Nontidal)	826
Dead Forested/Open Water (Nontidal)	1
Open Water (Nontidal)	413
Total Palustrine Wetlands	**1,870**
Riverine Nontidal Wetlands	5
TOTAL WETLANDS	1,875
Lacustrine Waters	357
Riverine Waters	5,434
TOTAL DEEPWATER HABITATS	5,791

Catoctin and Seneca Watersheds (U.S.G.S. Hydrologic Unit 2070008)

Palustrine Wetlands	
Emergent (Nontidal)	1,305
Deciduous Scrub-Shrub (Nontidal)	213
Mixed Deciduous Shrub-Emergent (Nontidal)	449
Deciduous Forested (Nontidal)	5,885
Mixed Forested (Nontidal)	2
Dead Forested/Open Water (Nontidal)	110
Open Water (Nontidal)	713
Total Palustrine Wetlands	**8,677**
Riverine Nontidal Wetlands	49
Lacustrine Wetlands	
Nonvegetated	9
Emergent	14
Total Lacustrine Wetlands	23
TOTAL WETLANDS	8,749
Lacustrine Waters	833
Riverine Waters	6,912
TOTAL DEEPWATER HABITATS	7,745

Monocacy Watershed (U.S.G.S. Hydrologic Unit 2070009)

Palustrine Wetlands	
Aquatic Bed	339
Emergent (Nontidal)	2,384
Deciduous Scrub-Shrub (Nontidal)	157
Mixed Deciduous Shrub-Emergent (Nontidal)	408
Deciduous Forested (Nontidal)	3,944
Mixed Forested (Nontidal)	5
Dead Forested/Open Water (Nontidal)	7
Open Water (Nontidal)	1,086
Total Palustrine Wetlands	**8,330**
Riverine Nontidal Wetlands	11
Lacustrine Wetlands	
Emergent	37
Nonvegetated	12
Total Lacustrine Wetlands	49
TOTAL WETLANDS	**8,390**
Lacustrine Waters	218
Riverine Waters	1,472
TOTAL DEEPWATER HABITATS	1,690

Anacostia, Rock Creek, Mattawoman Creek, Piscataway Creek, Port Tobacco Creek, Paint Branch, and Indian Creek Watersheds (U.S.G.S. Hydrologic Unit 2070010)

Estuarine Nonvegetated Wetlands	2
Palustrine Wetlands	
Aquatic Bed	6
Emergent (Tidal)	199
Emergent (Nontidal)	370
Deciduous Scrub-Shrub (Tidal)	61
Deciduous Scrub-Shrub (Nontidal)	114
Mixed Deciduous Shrub-Emergent (Nontidal)	285
Deciduous Forested (Tidal)	367
Deciduous Forested (Nontidal)	4,913
Mixed Forested (Nontidal)	22
Dead Forested/Open Water (Nontidal)	21
Open Water (Nontidal)	490
Total Palustrine Wetlands	**6,848**
Riverine Wetlands	
Tidal Flats	22
Tidal Emergent	126
Nontidal	25
Total Riverine Wetlands	**173**
Lacustrine Nonvegetated Wetlands	9
TOTAL WETLANDS	7,032
Estuarine Oligohaline Waters	7,092
Lacustrine Waters	293
Riverine Waters	
Tidal Waters	10,135
Nontidal Waters	14
Total Riverine Waters	**10,149**
TOTAL DEEPWATER HABITATS	17,534

Youghiogheny and Casselman Watersheds (U.S.G.S. Hydrologic Unit 5020006)

Palustrine Wetlands	
Emergent (Nontidal)	1,245
Deciduous Scrub-Shrub (Nontidal)	1,530
Evergreen Scrub-Shrub (Nontidal)	4
Mixed Deciduous Shrub-Emergent (Nontidal)	949
Deciduous Forested (Nontidal)	916
Evergreen Forested (Nontidal)	415
Mixed Forested (Nontidal)	377
Dead Forested/Open Water (Nontidal)	10
Open Water (Nontidal)	511
Total Palustrine Wetlands	5,957
Lacustrine Nonvegetated Wetlands	7
TOTAL WETLANDS	5,964
Lacustrine Waters	4,535
Riverine Waters	536
TOTAL DEEPWATER HABITATS	5,071

Wicomico, St. Marys, and Lower Potomac Watersheds (U.S.G.S. Hydrologic Unit 2070011)

Estuarine Wetlands	
Nonvegetated	2,914
Emergent (Salt/Brackish)	3,107
Emergent (Oligohaline)	3,489
Scrub-Shrub	237
Forested	152
Total Estuarine Wetlands	**9,899**
Palustrine Wetlands	
Aquatic Bed	7
Emergent (Tidal)	150
Emergent (Nontidal)	733
Mixed Emergent/Forested (Nontidal)	13
Deciduous Scrub-Shrub (Tidal)	173
Deciduous Scrub-Shrub (Nontidal)	284
Evergreen Scrub-Shrub (Nontidal)	7
Mixed Deciduous Shrub-Emergent (Nontidal)	412
Deciduous Forested (Tidal)	1,420
Evergreen Forested (Tidal)	95
Deciduous Forested (Nontidal)	24,356
Evergreen Forested (Nontidal)	171
Mixed Forested (Tidal)	35
Mixed Forested (Nontidal)	858
Dead Forested/Open Water (Nontidal)	346
Open Water (Nontidal)	1,150
Total Palustrine Wetlands	30,210
Lacustrine Nonvegetated Wetlands	25
TOTAL WETLANDS	40,134
Estuarine Waters	
Salt/Brackish Waters	218,872
Oligohaline Waters	37,603
Total Estuarine Waters	256,475
Lacustrine Waters	388
TOTAL DEEPWATER HABITATS	256,863

Summary

The NWI Project has completed an inventory of Maryland's wetlands using aerial photointerpretation methods. Detailed wetland maps and a digital wetland map database have been produced for the entire state. Roughly 600,000 acres of wetland and 1.6 million acres of deepwater habitat were inventoried in Maryland. Thus, about 9.5 percent of the state is represented by wetland. About 94 percent of the state's wetlands are found on the Coastal Plain—Maryland's Eastern Shore. Dorchester County alone accounted for 28 percent of the state's wetlands.

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Wetland Formation and Hydrology

Introduction

Wetlands are usually found in depressions, along the shores of waterbodies such as lakes, rivers, ponds, and estuaries, and on broad flats with poor drainage, and at the toes of slopes. Some wetlands occur on the slopes themselves where they are associated with groundwater seepage (springs) or with surface water drainageways. Historical events and present hydrologic conditions have acted in concert to create and maintain a diversity of wetlands in Maryland. Human activities have recently become more important to wetland formation and hydrology. Rising sea level attributed to global warming may have serious impacts on coastal wetlands and adjacent lowlands. This chapter is a generalized overview of wetland formation and hydrology processes as they relate to Maryland. It is, therefore, not a comprehensive treatment of these complex subjects. General differences between Maryland's inland and coastal wetlands in terms of their formation and hydrology are presented. References have been cited for more detailed descriptions. An excellent recent review of wetland formation processes is found in Mausbach and Richardson (1994), while Stone and Stone (1994) provide a good overview of the relationship between wetlands and groundwater for the average citizen.

Wetland Formation

Many events have led to the creation of wetlands throughout Maryland. The formation of floodplains along major rivers was responsible for the establishment of many wetlands. The Eastern Shore possesses the majority of the state's wetlands. Current events, such as rising sea level and erosion and accretion processes, continue to build, shape, and even destroy wetlands. Construction of ponds, impoundments, and reservoirs also may create wetlands, but often involve wetland destruction as well.

Nontidal Wetland Formation

Nontidal wetlands form in low, flat or depressional places and in areas of groundwater discharge, such as seepage slopes and toes of slopes. Winter (1988) cites two chief factors responsible for wetland formation: (1) topographic controls and (2) geologic controls. The former include depressions, broad flats, and discontinuities in the slope of the water table and of the land surface (e.g., groundwater seepage or surface breakouts of the water table). Geologic controls result from subsurface stratigraphy, with soil stratigraphy and the stratigraphy of the geologic deposits being most important. Geologic deposits are particularly important in creating wetlands on slopes. They include thin soils over shallow bedrock, rock strata with permeable layers overlying impermeable rocks, intrusive rock layer in permeable rock, and geologic faults where impermeable layers lie downslope of confined permeable rocks (Stone and Stone 1994). Topographic position combined with certain soils and underlying geology operate to promote wetland formation. Proximity to existing waterbodies (e.g., rivers and lakes) is also important for the establishment of wetlands dependent on surface water.

Many wetlands have formed on floodplains (areas of accretion—sediment build-up) along most rivers and large streams in the state (Figure 4-1). They are the principal wetland type on the Western Shore and in the Piedmont. On the Western Shore, extensive floodplain wetlands occur along the Patuxent River, Mattawoman Creek, Zekiah Swamp Run, and Piscataway Creek. These wetlands are also common along the Potomac River and its tributaries in Montgomery County. Floodplain forested wetlands are also typical of the major watercourses on the Eastern Shore, such as the Pocomoke and Nanticoke Rivers, Marshyhope Creek, and tributaries of the Choptank and Chester Rivers, in particular. In mature floodplains, wetlands are found on the inner floodplain terrace behind the natural levees. The levees are composed of coarser materials and are better drained than the inner floodplain that is composed of silts and clays and generally has poor drainage. Early stages of floodplain development are characterized by extensive marshes bordering streams, while later stages develop as sedimentation increases wetland surface elevations to levels favoring the establishment of shrub and forested wetlands (Nichols 1915). Some floodplain marshes and meadows may persist due to either extended flooding periods that preclude the establishment of tree species or periodic mowing or grazing. Braided streams occur in areas of accretion. More sediment enters these streams than they can carry (Mausbach and Richardson 1994). Floodplains formed along these streams

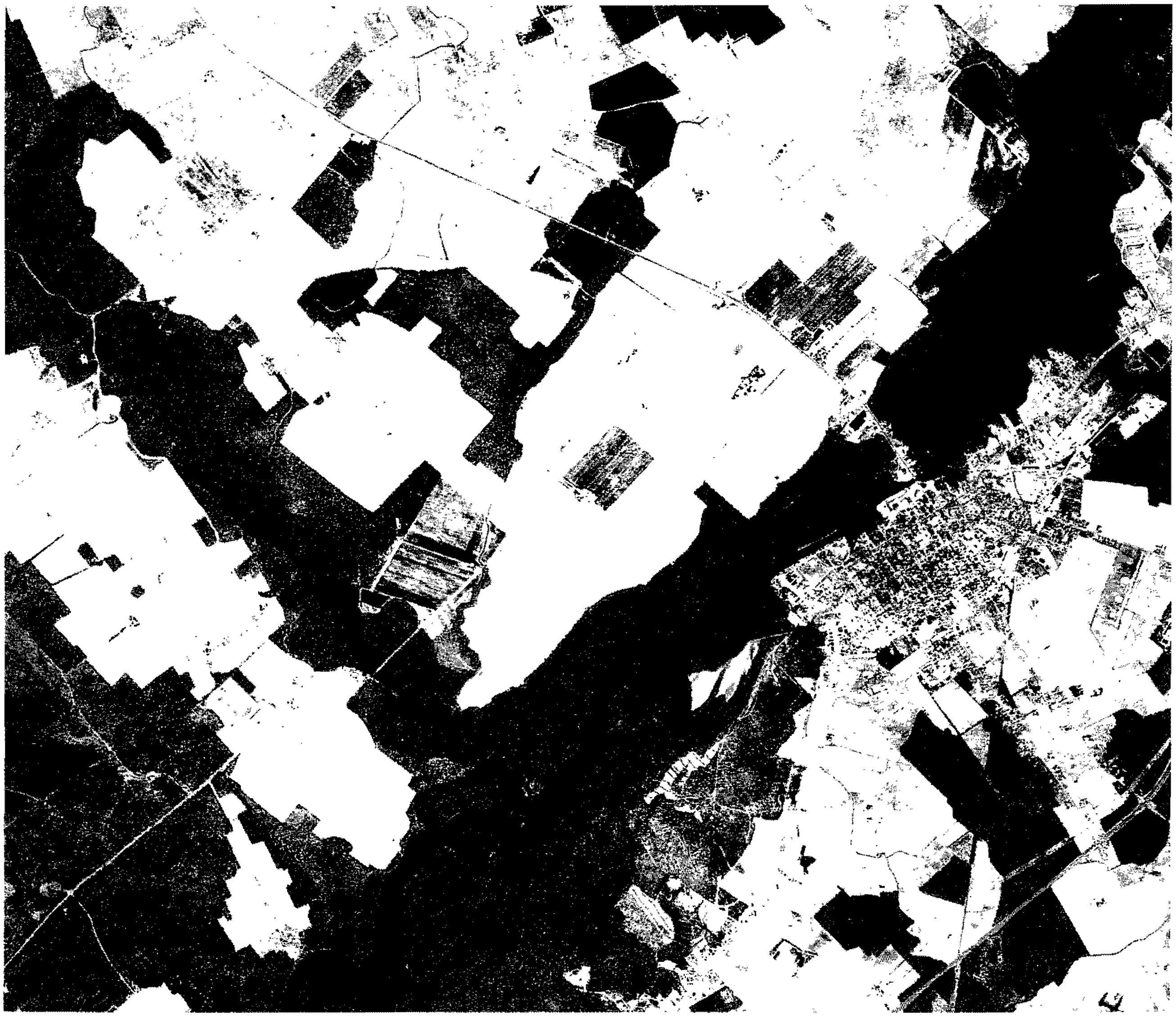


Figure 4-1. Extensive wetlands have formed along many of Maryland's rivers. The most extensive floodplain swamps are along rivers on the Eastern Shore.

are frequently flooded as the channel water often moves out of the shallow streambeds.

The relatively flat terrain of the lower Coastal Plain has favored the establishment of extensive nontidal wetlands on the Eastern Shore and to a much lesser extent on small portions of the Western Shore (e.g., Shady Side). This physiographic region is characterized by broad flats (called interstream divides or interfluves) between streams. These flats often have poor drainage, since drainage outlets do not exist or are poorly defined. The majority of nontidal wetlands on the Coastal Plain in the eastern United States may be associated with this landscape. The presence of clayey soils, either in the upper part of the soil or as a confining layer below, also enhances wetland formation. The clays restrict percolation causing water to saturate the soil for extended periods and even to pond on the land surface for variable periods in places. On this landscape, areas near streams tend to be better drained, due to greater slopes that facilitate runoff and drainage. The broad flats dominated by forested wetlands commonly called "flatwoods" are, therefore, often surrounded by upland.

On the Eastern Shore, a rather unique type of wetland has developed that has been given various names: potholes, Carolina bays, Delmarva bays, whale wallows and Maryland basins (Stolt 1986). These wetlands are circular to elliptic depressions with distinct sandy rims, although they may also be irregularly shaped. These potholes or bays are most abundant in Caroline and Queen Annes Counties, but can

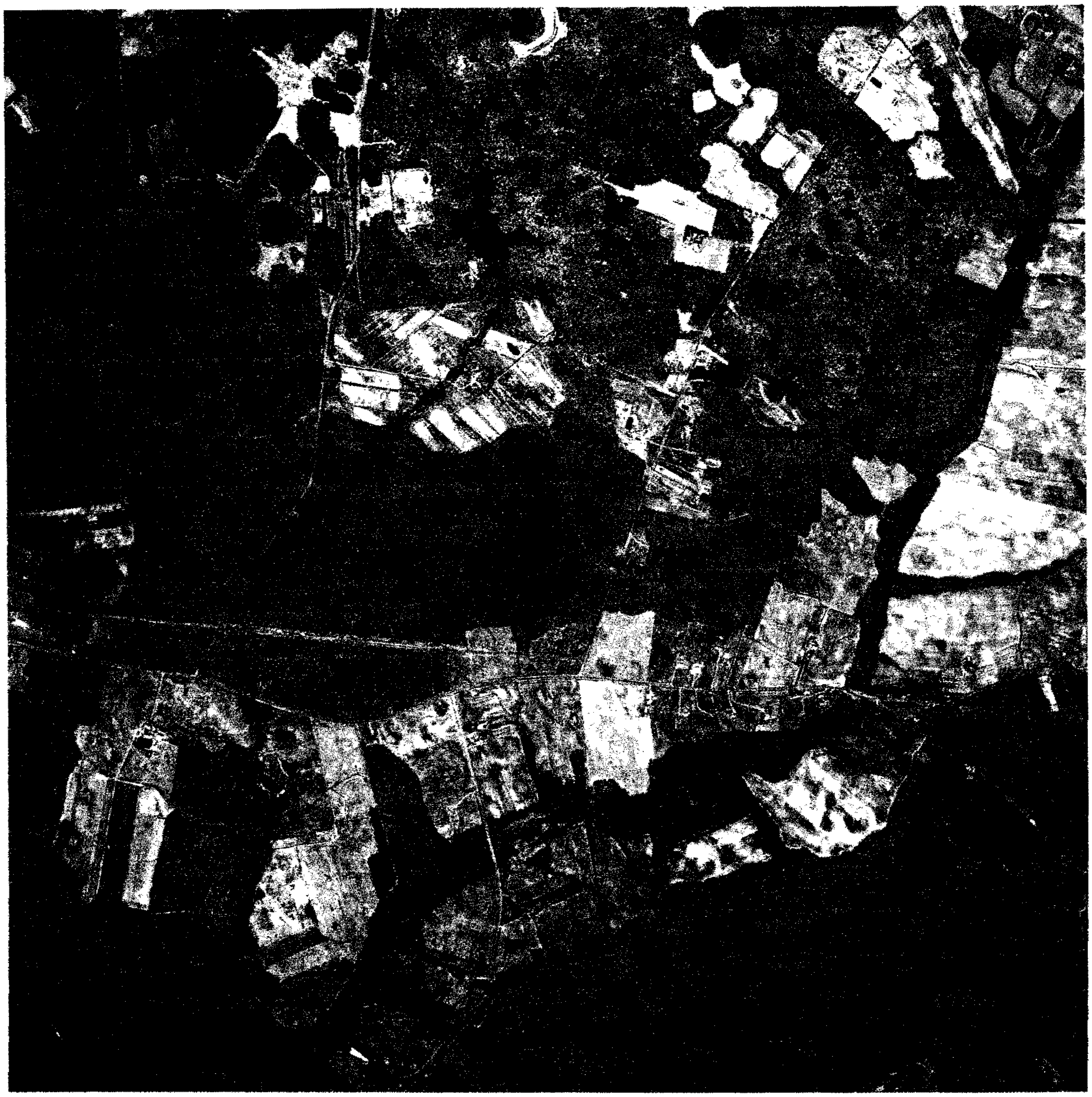


Figure 4-2. Hundreds of small pothole-like depressional wetlands pockmark the landscape in Caroline and Queen Annes Counties near the Maryland-Delaware border. These wetlands are called by various names including Delmarva bays, Carolina bays, and potholes.

be found throughout the Eastern Shore.They are particularly concentrated in the region from Millington to Goldsboro (Figure 4-2). These wetlands have been estimated to be 16-21,000 years old. Theories of their origin are numerous and include: (1) artesian springs, (2) meteorites, (3) coastal processes (segmented lagoon closure), (4) shallow waterbodies in dune fields or interfluves, (5) periglacial frost basins, and (6) fish spawning areas. During the "Ice Age" that ended 10-18,000 years ago, the Delmarva Peninsula was tundra (taiga) with pine barrens and peat bogs being the major plant communities (Sirkin *et al.* 1977). Since this time, the "bays" or pothole depressions have filled in with organic matter and fine-textured silts. The latter materials were probably wind-borne loess from the Susquehanna River and Chesapeake Bay area. Stolt (1986) believes that some of the potholes or bays were wet depressions or paleo-depressions prior to evolving into "bays." They originated as either wet spots in interdunal areas or as blowouts in sandy barrens. Wind and wave-generated processes have acted upon these depressions to give them their present-day shape and character.

According to Fenwick and Boone (1984), most peat-dominated wetlands in western Maryland have formed at or near the headwaters of streams. Some peatlands, such as the Glades in Garrett County, may be so extensive as to form the headwaters for two or more streams.

Historically, the activities of beaver were instrumental in creating wetlands. By constructing dams, beaver blocked drainages, causing water levels to rise and flood existing wetlands as well as adjacent low-lying uplands. Increased flooding killed the existing vegetation and allowed more flood-tolerant wetland plants to become established and hydric soils to develop on former uplands. Beaver were extirpated by trapping in the 1700s and 1800s. Reintroductions have led to an increase in beaver populations and their influence on wetlands since the 1930s (Fenwick and Boone 1984). Beaver activity is particularly widespread in Garrett County, where emergent wetlands were created and are being maintained by beaver.

Human activities have become increasingly important in wetland creation. Construction of farm ponds, sedimentation/detention ponds, shallow water impoundments, recreational ponds and lakes, and reservoirs may unintentionally create vegetated wetlands to some extent, although natural wetlands may be altered or destroyed by these projects. As farm ponds mature, they may become silted in and overgrown with wetland vegetation including aquatic plants and emergent (herbaceous) plants. Shrub and forested wetlands may eventually become established in man-made basins as wetland surfaces rise due to increased sedimentation and accumulation of organic material. Wetland vegetation may also develop along the shorelines of the larger man-made waterbodies (e.g., reservoirs and impoundments). Unfortunately, water levels in reservoirs are usually unstable, being subjected to drastic drawdowns in summer. This leaves many acres of exposed shores unsuitable for establishment of a viable wetland plant community. A host of annual herbs may, however, colonize such sites. More stable water levels would, however, promote formation of wetlands dominated by perennial herbaceous and woody species along shorelines. Wetlands have been unintentionally created in some areas by highways and roads that directly block former drainageways or that have undersized culverts causing a rise in local water levels. In other cases, wetlands may be purposely created to mitigate unavoidable losses of natural wetlands by various construction projects or to create waterfowl habitat. The U.S. Fish and Wildlife Service and the State of Maryland have initiated programs to restore lost or altered wetlands in Maryland.

Tidal Wetland Formation

Coastal wetlands are dominant features along Maryland's tidal shorelines. They have formed much differently than the nontidal wetlands. During the "Ice Age" that occurred more than 15,000 years ago, much of the world's ocean waters were stored in the form of glacial ice. At that time, sea level was as much as 425 feet lower than present levels (Wolfe 1977). As the glaciers melted (deglaciation), water was released back into the oceans, thereby raising sea levels. As sea level rose, barrier islands migrated landward and river valleys were submerged. Coastal marshes behind these barrier islands were submerged along with other low-lying areas, but other coastal wetlands eventually reformed behind the barrier islands when they finally stabilized about 3,000 to 4,000 years ago (Griffin and Rabenhorst 1989).

Most of Maryland's coastal marshes have developed along tidal rivers and estuarine embayments (Figure 4-3). Along Chesapeake Bay and various coastal rivers, such as the Choptank, Chester, Patuxent, Potomac, and Nanticoke Rivers, coastal wetlands have formed in areas of sedimentation. Sediments are transported by rivers and streams flowing seaward as well as by inflowing ocean currents. When the river meets the sea, sediments begin to settle out of suspension forming deltas and bars at the river's mouth and intertidal flats in protected areas. Sedimentation also takes place further upstream when tidal currents slow, as during slack water periods. The rate and extent of sedimentation depend on the original size and age of the estuary, present erosion rate upstream, and deposition by the river and marine tides and currents (Reid 1961). Initially, mud and silt are deposited to form tidal flats in shallow areas. As elevations exceed mean sea level, smooth cordgrass (*Spartina alterniflora*), spatterdock (*Nuphar luteum*), or other plants (depending on salinities) become established, forming the low or regularly flooded marsh. The presence of this vegetation further slows the velocity of flooding waters, causing more sedimentation. Marsh vegetation also produces organic matter that is incorporated into the soil, forming organic soils (sulfihemists) in areas of highest accumulation. Marsh accretion rates in Maryland's Chesapeake Bay marshes were found to range between 0.14 and 0.3 inches per year (Griffin and Rabenhorst 1989). The marshes they studied appeared to be keeping pace with rising sea level. Sediments continue to build up to a level where erosion and deposition are in relative equilibrium. The high or irregularly flooded salt marsh begins to form where the substrate rises above the mean high water mark. For coastal wetlands, there are certain periods of rapid or heavier sedimentation. For example, the clearing of forests and creation of farmland significantly increases the

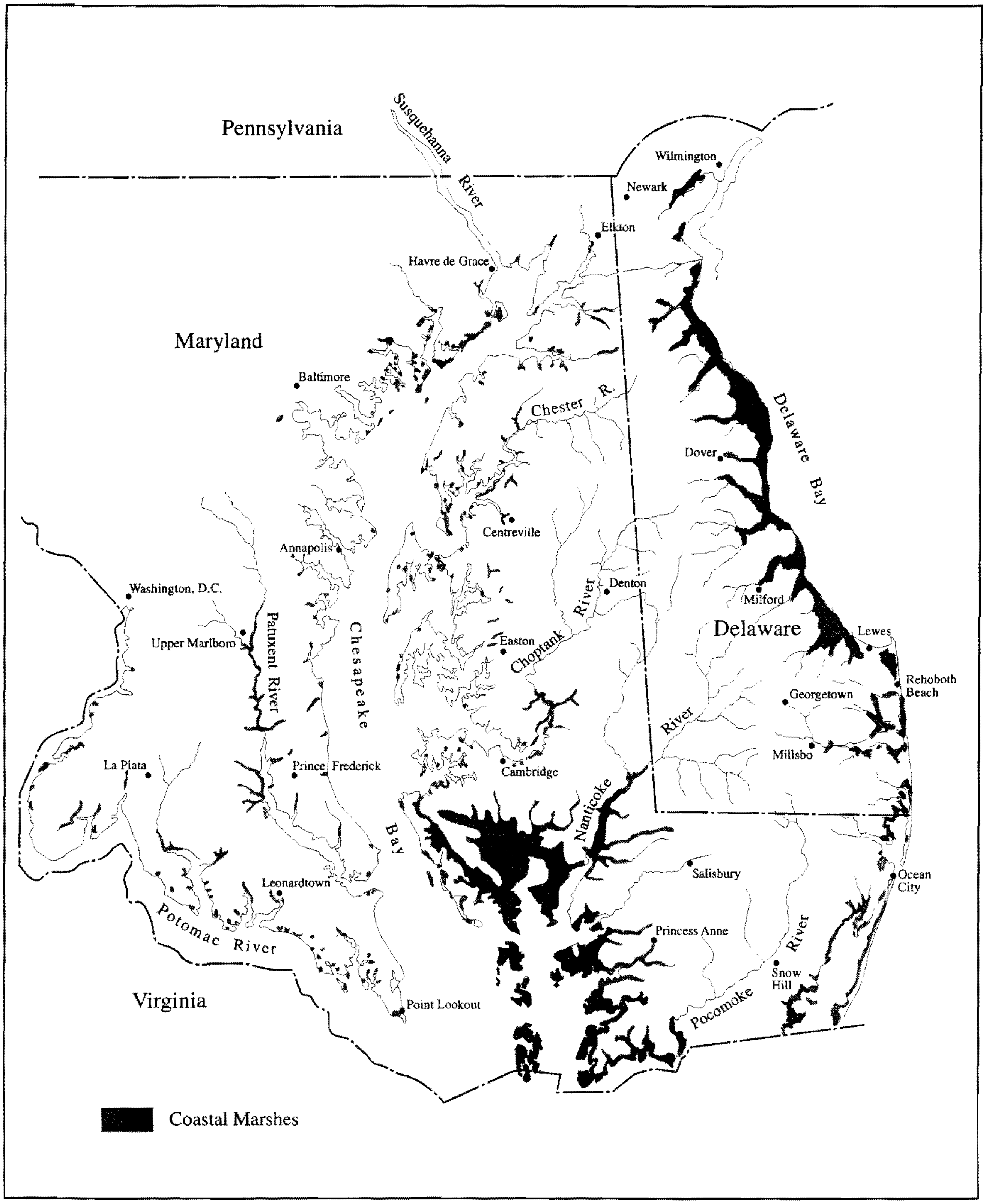


Figure 4-3. Tidal marshes are abundant along the many sheltered embayments associated with Chesapeake Bay and along major tidal tributaries.

amount of potentially erodable soil in a watershed. Brush (1989) reported that land clearing since the colonial period has been responsible for releasing much sediment into Chesapeake Bay, leading to the development and rapid expansion of tidal marshes. This situation has also been reported for tidal marshes along the Delaware River (Orson *et al.* 1990). Rising sea level, severe storms, and long-term shifts in regional climates may significantly affect the amount of sediment available for tidal marsh formation and maintenance.

Chesapeake Bay is a classic example of a "drowned" river valley, and it is the largest such area in the United States. Coastal wetlands have formed along the Bay itself, since the Bay is protected from the full force of the Atlantic Ocean. Other coastal wetlands in Maryland have formed behind Assateague and Fenwick Islands which protect Chincoteague and Assawoman Bays from ocean forces.

Tidal marshes are still forming along the Maryland coast in areas of accretion. In addition to natural formation, man is helping re-establish tidal marshes through the use of dredged material from navigation projects in several areas. Sandy material has been used to restore/create a 7-acre smooth cordgrass-salt hay grass tidal marsh at Eastern Neck National Wildlife Refuge in Kent County. This project and others like it provide shoreline protection for eroding marshes and uplands and create wildlife habitat, while finding a productive use of dredged material from channel maintenance projects (Figure 4-4). Other wetland restoration/creation projects include a 50-acre site at Barren Island National Wildlife Refuge (Dorchester County), 800 acres at Poplar Island (Talbot County), a site at Bodkin Island (Queen Annes County), and a 7-acre site at Smith Island (Somerset County) (John Gill, pers. comm.). The State of Maryland encourages tidal marsh creation for shoreline stabilization in lieu of building structures like bulkheads and rip-rap.

Rising sea level has recently transformed former nontidal freshwater wetlands and low-lying uplands into coastal marshes. Former agricultural fields cultivated before the Civil War are now covered by 10 inches of salt marsh peat

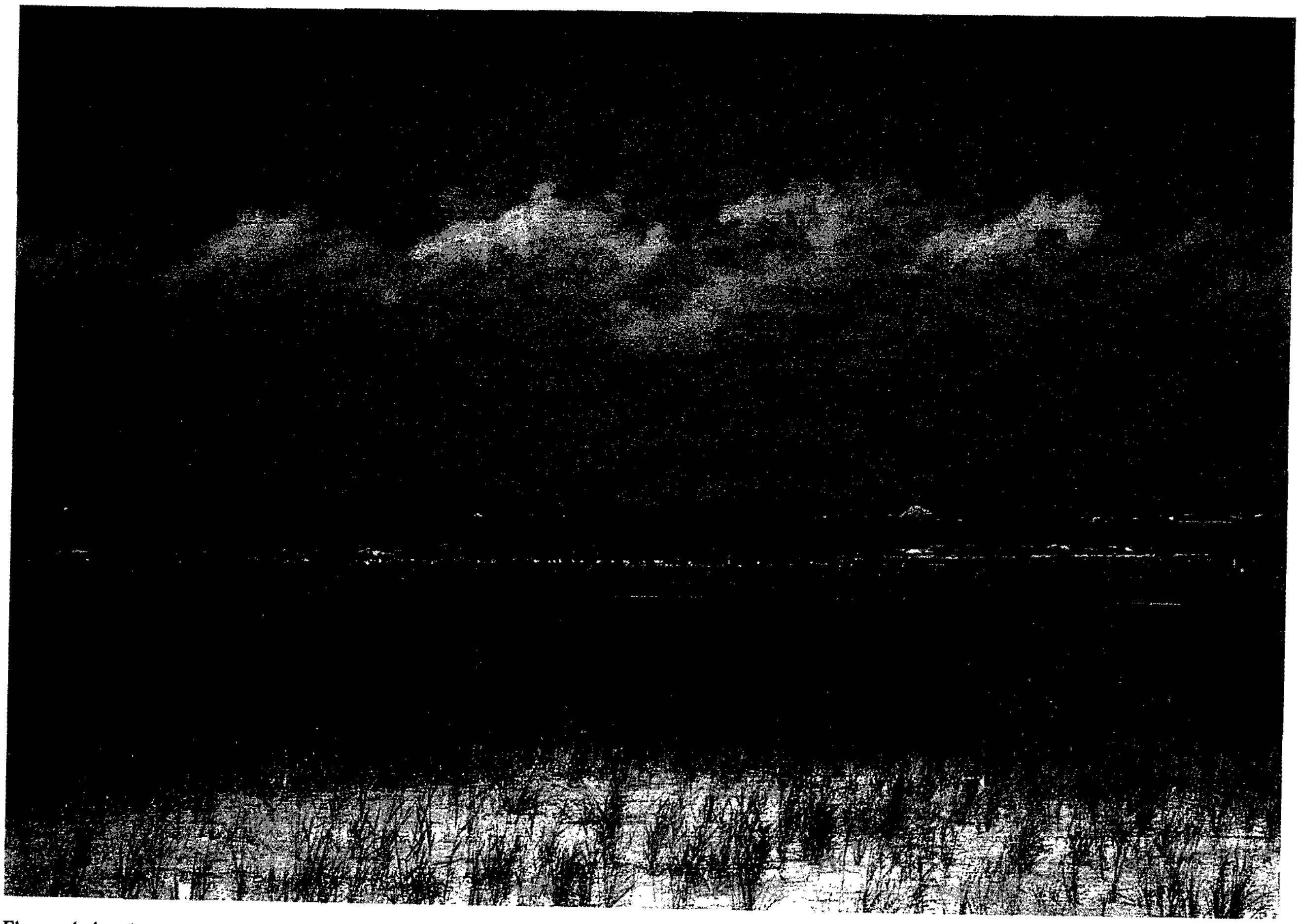


Figure 4-4. Estuarine wetland constructed on dredged material. (John Gill photo)

(Darmody 1975). Examples of salt marsh transgression are widespread on the lower Eastern Shore, where salt marsh vegetation can be found beneath loblolly pines. These "estuarine forests" represent former pine flatwoods that are now subject to periodic tidal flooding. Further evidence of submergence of low-lying areas may be found in coastal marshes where dead snags of loblolly pines and buried Atlantic white cedar stumps may be present. There are many examples of the former on the bayside of the lower Eastern Shore, e.g., at Blackwater National Wildlife Refuge (Dorchester County) and at the Monie Bay Estuarine Reserve (Somerset County).

Today, sea level continues to rise along the U.S. coastline at average rates between four and ten inches per century, with local variations (Hicks *et al.* 1983). The "greenhouse effect" and projected global warming could lead to further melting of polar ice in Greenland and the Antarctic and of mountain glaciers. This, coupled with coastal subsidence, could raise sea levels 3.0 to 5.7 feet (3.7 feet most likely) by the year 2100 (Titus and Seidel 1986). Such an increase would have profound effects on Maryland's coastal wetlands as well as other low-lying areas in the coastal zone.

Wetland Hydrology

The presence of water from stream or lake flooding, surface water runoff, groundwater discharge, or tides is the driving force creating and maintaining wetlands. Hydrology determines the nature of the soils and the types of plants and animals living in wetlands. An accurate assessment of hydrology requires extensive knowledge of the frequency and duration of flooding, water table fluctuations, and ground water relationships. This information can only be gained through intensive and long-term studies. There are, however, ways to recognize broad differences in wetland hydrology or water regime. At certain times of the year, such as in winter, during spring floods, or at high tides in coastal areas, hydrology is apparent, since water is on the surface or soils are saturated to the surface in many wetlands. Yet, for much of the year, such obvious evidence is lacking in most wetlands. At these times, less conspicuous signs of flooding may be observed, including: (1) water marks on vegetation, (2) water-transported debris on plants or collected around their bases, and (3) water-stained leaves on the ground (Tiner 1988). These and other signs, such as wetland vegetation, help us recognize hydrologic differences between wetlands and help

Table 4-1. Tidal ranges of mean and spring tides and mean tide level at various locations in Maryland. (U.S. Department of Commerce 1987)

Location	Mean Tide Range (ft)	Spring Tide Range (ft)	Mean Tide Level (ft)
Atlantic Ocean at Ocean City (Fishing Pier)	3.5	4.2	1.7
Isle of Wight Bay at Ocean City	2.2	2.7	1.1
Chincoteague Bay at Public Landing	0.4	0.5	0.2
Pocomoke River at Shelltown	2.4	2.9	1.2
Pocomoke River at Pocomoke City	1.6	2.0	0.8
Wicomico River at Salisbury	3.0	3.6	1.5
Nanticoke River at Vienna	2.2	2.6	1.1
Choptank River at Cambridge	1.6	1.7	0.8
Choptank River at Greensboro	2.5	2.9	1.2
Chester River at Love Point	1.1	1.3	0.6
Chester River at Millington	2.0	2.3	1.0
Elk River at Town Point Wharf	2.1	2.4	1.0
Susquehanna River at Havre de Grace	1.8	1.9	0.9
Patapsco River at Fort McHenry	1.1	1.3	0.6
Severn River at Cedar Point	0.7	0.8	0.4
Patuxent River at Solomons Island	1.2	1.3	0.6
Patuxent River at Benedict	1.6	1.9	0.8
Patuxent River at Nottingham	2.5	2.9	1.2
Patuxent River at Hills Bridge	2.4	2.8	1.2
Mattawoman Creek at Deep Point	1.6	1.8	0.8
Potomac River at Piney Point	1.4	1.6	0.7
Potomac River at Indian Head	1.8	2.0	0.9
Potomac River at Washington, D.C.	2.8	3.0	1.4

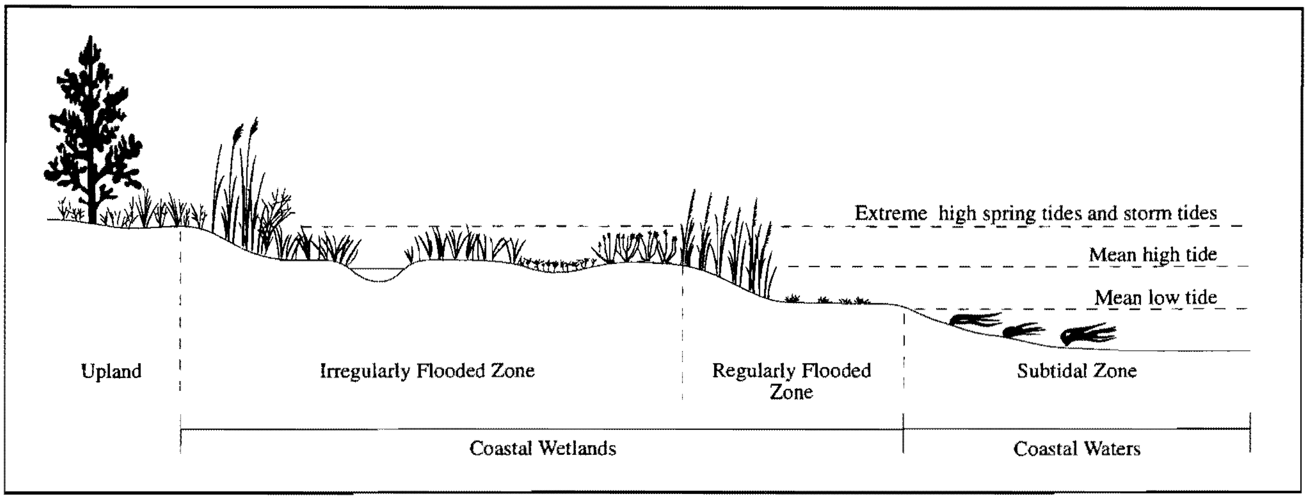


Figure 4-5. Hydrology of a tidal wetland, showing different zones of flooding. The regularly flooded zone is flooded at least once daily by the tides, while the irregularly flooded zone is flooded less often.

separate wetlands from uplands in spite of an apparent lack of water during much of the growing season (Federal Interagency Committee for Wetland Delineation 1989).

The Service's wetland classification system (Cowardin *et al.* 1979) includes water regime modifiers to describe hydrologic characteristics. Two groups of water regimes are identified: (1) tidal and (2) nontidal. Tidal water regimes are driven by oceanic tides, while nontidal regimes are largely influenced by surface water runoff and groundwater discharge.

Tidal Wetland Hydrology

In coastal areas, ocean-driven tides are the dominant hydrologic force affecting wetlands. Along the Atlantic coast, tides are semidiurnal and symmetrical with a period of 12 hours and 25 minutes. In other words, there are roughly two high tides and two low tides each day. Since the tides are largely controlled by the position of the moon relative to the sun, the highest and lowest tides (i.e., "spring tides") usually occur during full and new moons. Coastal storms can also cause extreme high and low tides. These storm tides may flood low-lying uplands adjacent to coastal wetlands. Prolonged periods of strong winds can have a great impact on the normal tidal range in large coastal bays. Table 4-1 shows examples of varying tidal ranges along the Maryland coast.

In coastal wetlands, differences in hydrology (tidal flooding) create two readily identifiable zones: (1) regularly flooded zone and (2) irregularly flooded zone (Figure 4-5). The regularly flooded zone is alternately flooded and exposed at least once daily by the tides. It includes both the "low marsh" and intertidal mud and sand flats which are typically flooded and exposed twice a day. Above the regularly flooded zone, the marsh is less frequently flooded (less than once a day) by the tides. This irregularly flooded zone or "high marsh" is exposed to the air for variable periods. The majority of this zone is usually flooded only for brief periods, being flooded mainly during spring and storm tides. The upper margins of the high marsh may be flooded only during storm tides which are more frequent in winter.

Table 4-2. Examples of plant indicators of the predominant tidal regimes for Maryland's estuarine wetlands. These species are generally good indicators of tidal flooding regimes.

Water Regime	Indicator Plants
Regularly Flooded	Smooth Cordgrass–tall form *(Spartina alterniflora)* Spatterdock *(Nuphar luteum)* Pickerelweed *(Pontederia cordata)* Arrow Arum *(Peltandra virginica)* Soft-stemmed Bulrush *(Scirpus validus)*
Irregularly Flooded	Salt Hay Grass *(Spartina patens)* Salt Grass *(Distichlis spicata)* Smooth Cordgrass–short form *(S. alterniflora)* Black Needlerush *(Juncus roemerianus)* Big Cordgrass *(Spartina cynosuroides)* Switchgrass *(Panicum virgatum)* Olney Three-square *(Scirpus americanus)* High-tide Bush *(Iva frutescens)* Groundsel-bush *(Baccharis halimifolia)* Wax Myrtle *(Myrica cerifera)*

Estuarine plants have adapted to these differences in hydrology (Adams 1963; Nixon 1982) and certain plants are good indicators of different water regimes (Table 4-2). The tall form of smooth cordgrass (*Spartina alterniflora*) has been shown to be a reliable indicator of the low marsh or the landward extent of mean high tide (Kennard *et al.* 1983).

Nontidal Wetland Hydrology

Beyond the influence of the tides, two hydrologic forces regulate water levels or soil saturation in wetlands: (1) surface water runoff and (2) groundwater discharge. Surface water runs off from the land and either collects in depressional wetlands or enters rivers and lakes during snowmelt or rainfall periods and for some time after. Elevated river levels may cause water to overflow into adjacent floodplains (Figure 4-6). Groundwater discharges into depressional wetlands when directly connected to the water table or into sloping wetlands in "spring" or "seepage" areas (Figure 4-7). An individual wetland may exist due to surface water runoff or groundwater discharge or both sources. Figures 4-8 through 4-11 show the general patterns of groundwater flow in several regions of Maryland. The role of hydrology in maintaining freshwater wetlands is discussed by Gosselink and Turner (1978).

Freshwater rivers and streams usually experience greatest flooding in winter and early spring, with maximum flooding usually occurring in March and April. Major flooding is frequently associated with frozen soil, snowmelt (in certain watersheds), and/or heavy rains. Inundation of floodplain wetlands may result more from the overflow of backwater streams rather than from overbanking flooding from the mainstem river (Buchholz 1981). Backwater stream levees are lower in elevation and are easily breached by rising waters. Minor drainage within the floodplain may, therefore, significantly affect flooding and drainage patterns.

Water tables fluctuate markedly during the year in most nontidal wetlands (Figure 4-12). From winter to mid-spring, the water table is at or near the surface in most wetlands and water may pond or flood the wetland surface in places for variable periods. From late fall to spring, water availability exceeds water losses through evapotranspiration due to decreased plant activity and low air temperatures. With increasing air temperature and initiation of plant growth (e.g., leaf-out) in May and June, the water table usually begins to drop, reaching its low point between late August and October. Longer days, increasing air temperatures, increasing evapotranspiration, and other factors are responsible for the consistent lowering of the water table from spring through summer. With lower temperatures from late fall through winter, water from precipitation accumulates causing water tables to rise in the soil until spring. This cycle is generally repeated from year to year, with variations due to rainfall amounts and seasonal distribution. Fanning and Reybold (1968) found that poorly drained soils (Elkton, Othello, and Fallsington) on the Eastern Shore followed this pattern. For these soils, the water table was at or near the surface from

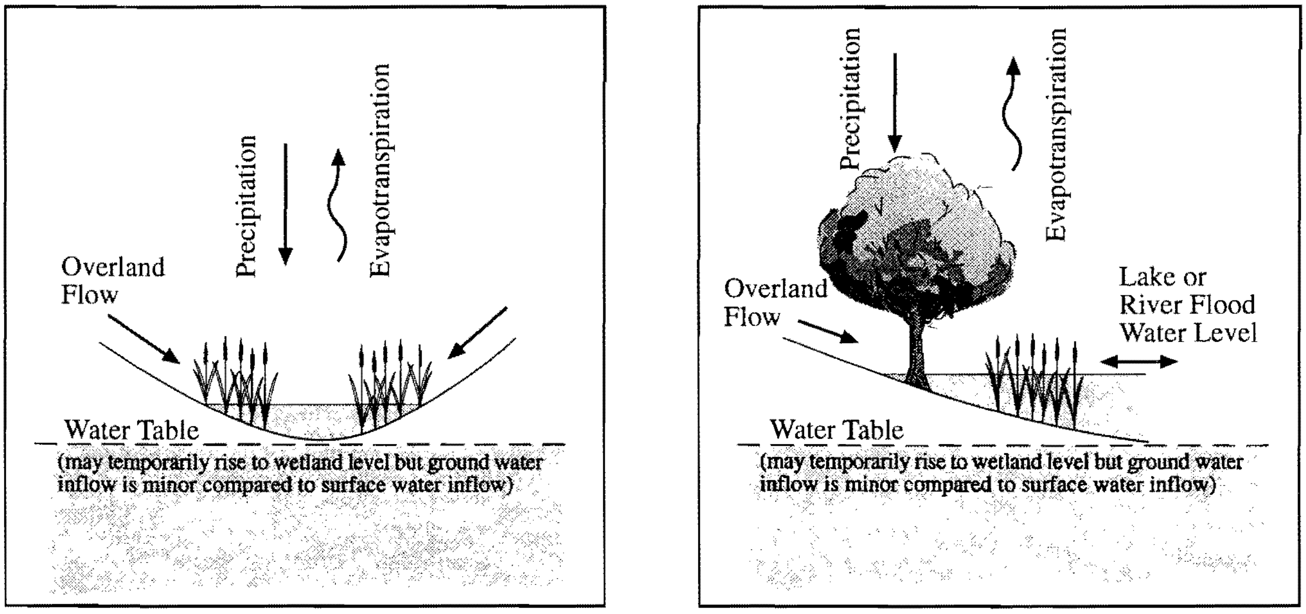


Figure 4-6. Hydrology of surface water wetlands. (Redrawn from Novitski 1982)

mid-winter through early spring, while from summer to late fall, the water tables remained at or below the 5-foot depth.

Standing water may be present in depressional, floodplain, or lakeshore wetlands for variable periods during the growing season. When flooding or ponding is brief (usually two weeks or less), the wetland is considered temporarily flooded. These wetlands may be flooded for a week or less during spring, with saturated soil conditions lasting somewhat longer. The duration of these conditions is probably related to soil texture and stratigraphy. During the summer, the water table may drop to three feet or more below the surface in these wetlands. This situation is prevalent along floodplains throughout the state and on interstream divides on the Eastern Shore. Flooding for longer periods is described by three common water regimes: (1) seasonally flooded, (2) semipermanently flooded, and (3) permanently flooded (Cowardin *et al.* 1979). A seasonally flooded wetland typically has standing water visible for more than two weeks during the growing season, but usually by summer, such water is absent. When not flooded, however, the water table remains within 1.5 feet of the surface for significant periods in the wetter of the seasonally flooded wetlands. A semipermanently flooded wetland remains flooded throughout the growing season in most years. Only during dry periods (e.g., droughts) does the surface of these wetlands become exposed to air, yet, even then, the water table typically occurs at or very near the surface. The wettest wetlands are permanently flooded and they include open waterbodies where depth is less than 6.6 feet, e.g., ponds and shallow portions of lakes, rivers, and streams. These shallow open water wetlands often support aquatic bed vegetation, with emergent vegetation occurring along the periodically flooded shorelines or in very shallow water.

Some types of wetlands are almost entirely influenced by groundwater discharge or near surface water flow. Many of these wetlands occur in central and western Maryland on considerable slopes in association with springs (i.e., points of active groundwater discharge), which are commonly called "seeps." Their soils may be saturated to the surface for much of the growing season, while others are saturated during the spring and the non-growing season (seasonal seeps). The water regime is, therefore, classified as saturated. Other saturated wetlands include "bogs" where former deepwater basins have become completely filled in naturally by decayed plant material and are now colonized by wetland herbs and/or woody plants. In these situations, the organic soil is virtually continuously saturated. On the Eastern Shore, many wetlands exist due to seasonal high water tables from mid-winter through early spring. They are never inundated or have surface water ponding only in low spots. These wetlands are mapped as saturated types, but the hydrology is best described as "seasonally saturated," since saturation has marked seasonal periodicity. (*Note:* Many wetlands mapped as temporarily flooded include considerable acreage of these seasonally saturated types, but many of these wetlands do not appear on the original NWI maps for the lower Eastern Shore because they were difficult to photointerpret.)

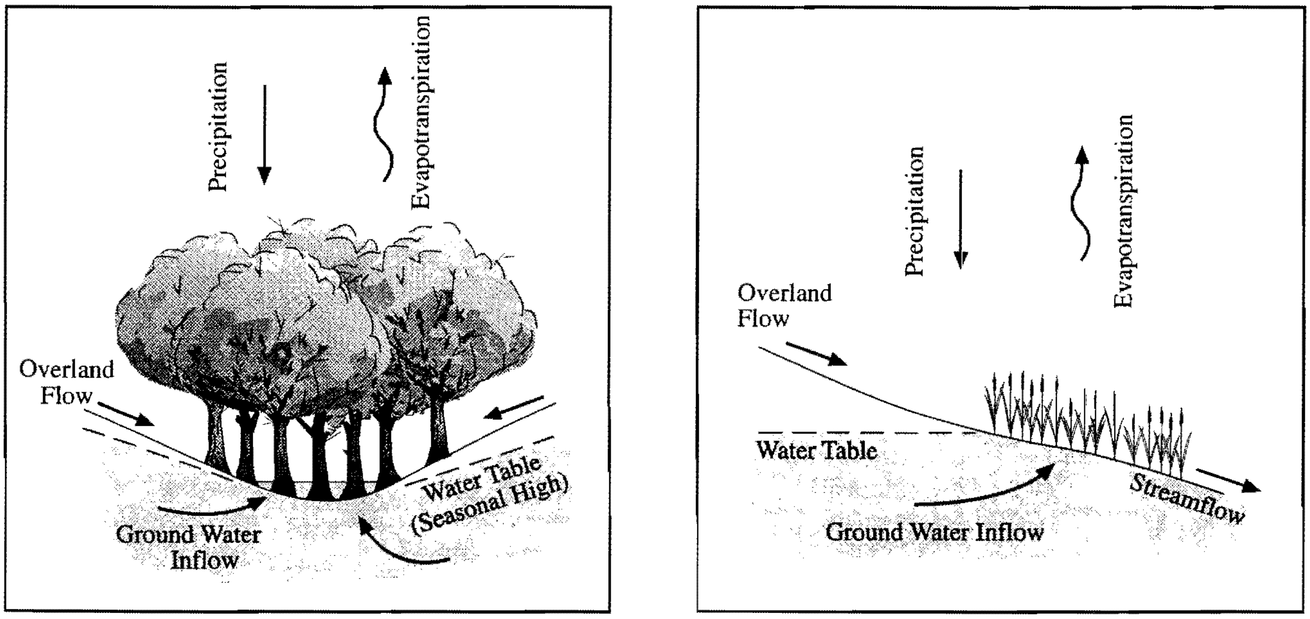


Figure 4-7. Hydrology of groundwater wetlands. (Redrawn from Novitski 1982)

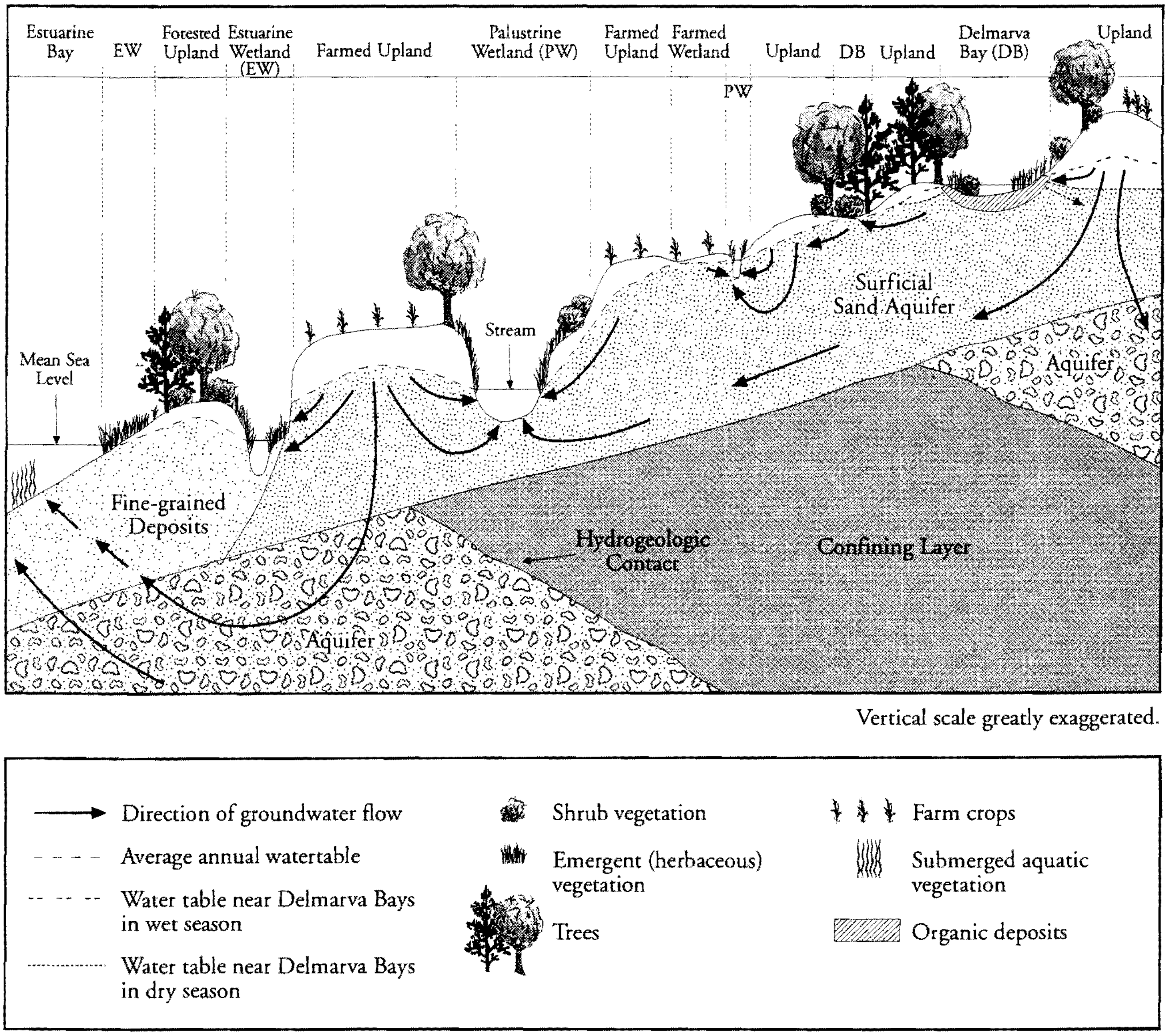


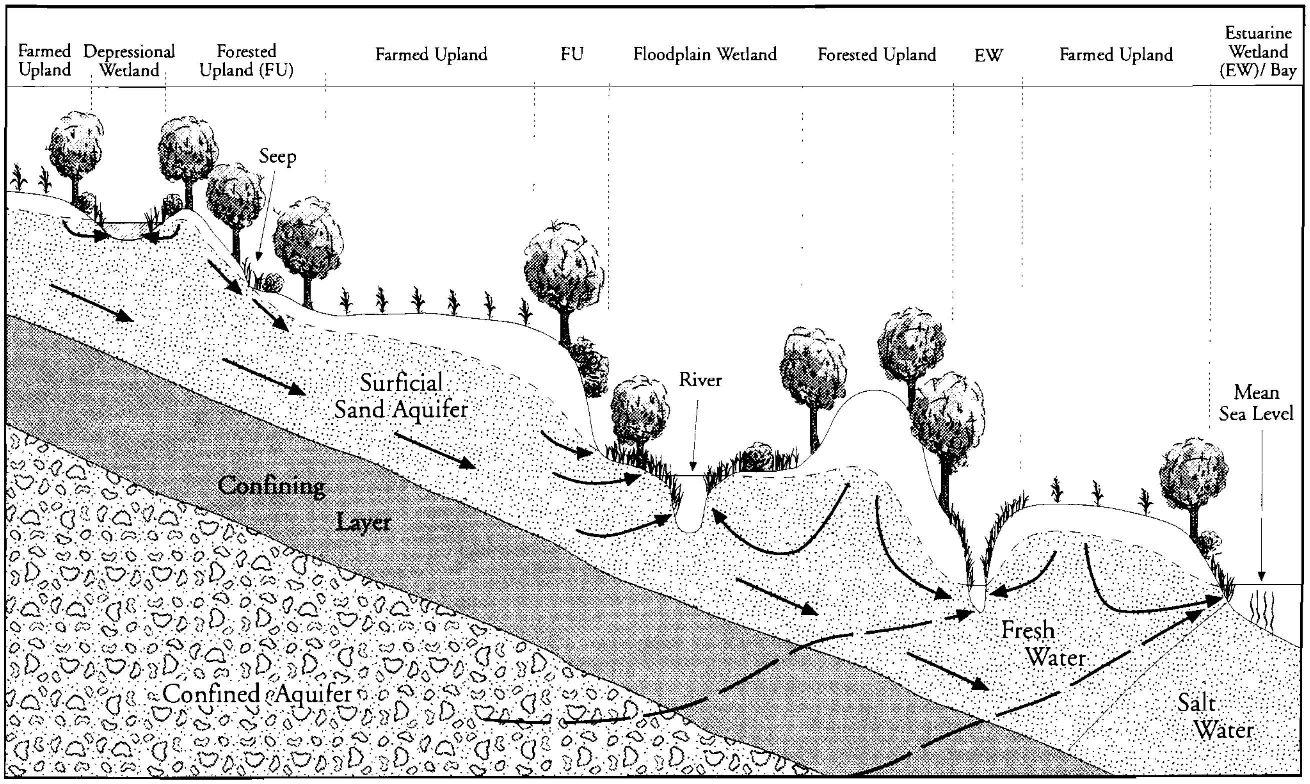
Figure 4-8. Generalized patterns of groundwater flow on the Lower Coastal Plain (Eastern Shore). (Redrawn from illustration by Martha Hayes, U.S. Geological Survey)

The acreage of Maryland's nontidal wetlands arranged by water regime is given in Table 4-3. The temporarily flooded wetland type (which includes many seasonally saturated wetlands) is most common. Common indicator plants of nontidal water regimes are presented in Table 4-4. Hydrologic conditions, e.g., water table fluctuation, flooding, and soil saturation, for each of Maryland's hydric soils are summarized in the following chapter.

For more detailed information on wetland hydrology, the reader is referred to the sources listed in the References that follow. Some of the most current information can be found in Kusler and Brooks (1988), Novitski (1989), and Stone and Stone (1994).

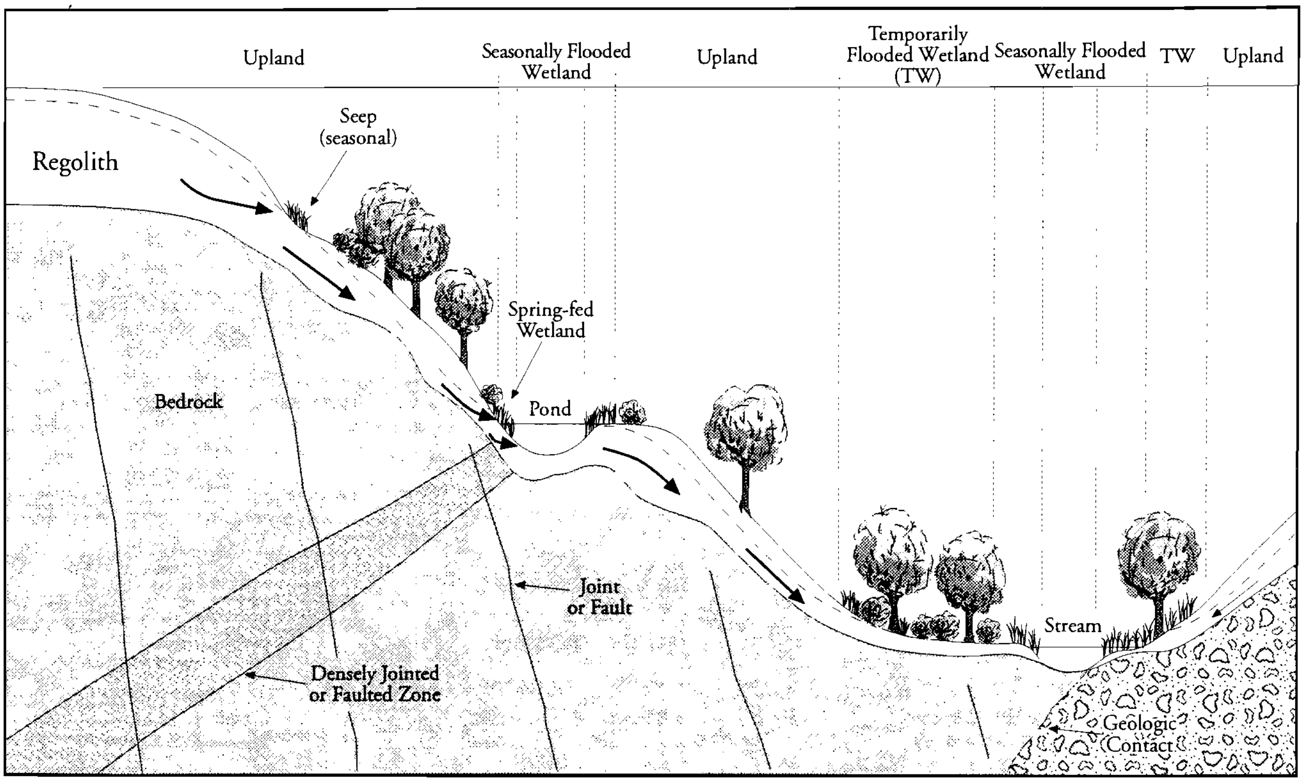
Table 4-3. The extent of Maryland's nontidal palustrine wetlands grouped by water regime.

Water Regime	Wetland Acreage
Temporarily Flooded	185,014
Saturated	712
Intermittently Flooded	3,684
Seasonally Flooded	68,747
Seasonally Flooded/Saturated	26,964
Semipermanently Flooded	4,125
Permanently Flooded	13,478
Artificial	1,206



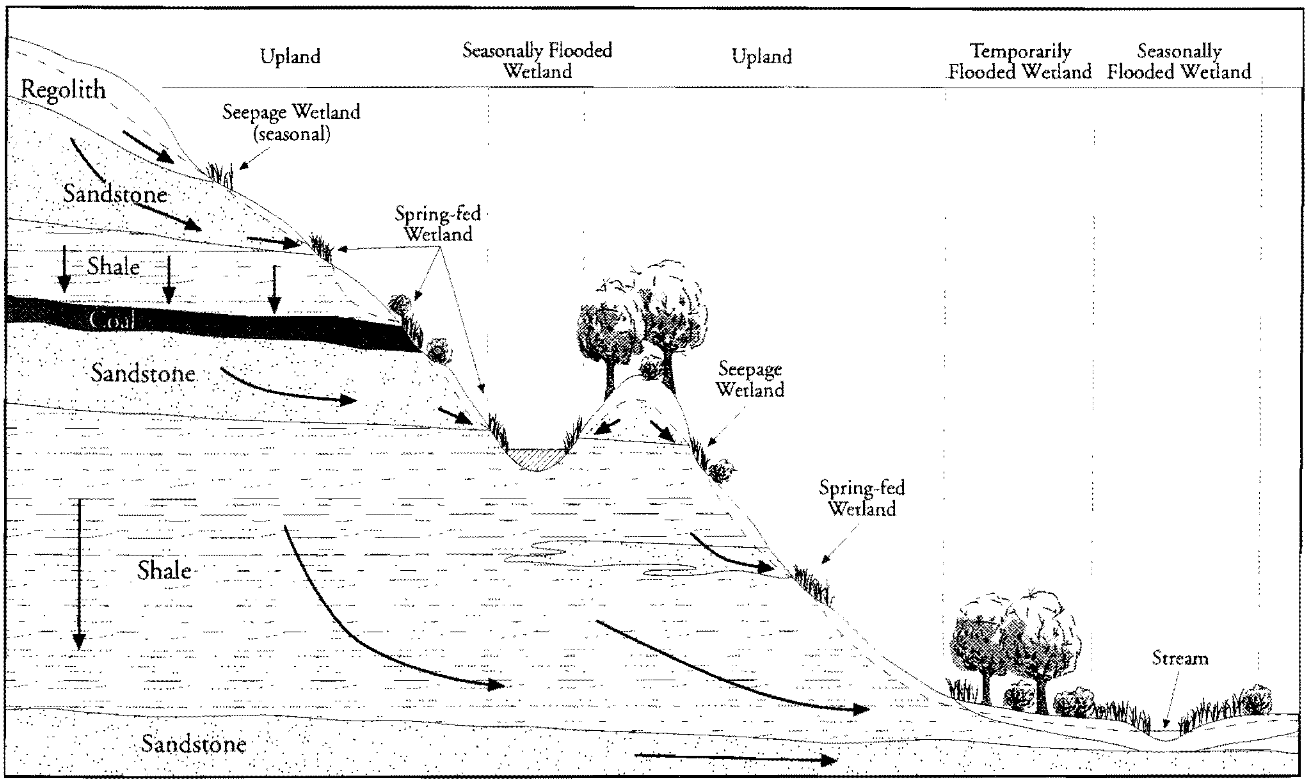
Vertical scale greatly exaggerated.

Figure 4-9. Generalized patterns of groundwater flow on the Upper Coastal Plain (Western Shore). (Redrawn from illustration by Martha Hayes, U.S. Geological Survey)



Vertical scale greatly exaggerated.

Figure 4-10. Generalized groundwater flow patterns in central Maryland. (Redrawn from illustration by Martha Hayes, U.S. Geological Survey)



Vertical scale greatly exaggerated.

Figure 4-11. Generalized patterns of groundwater flow in the Appalachian Plateaus (western Maryland). (Redrawn from illustration by Martha Hayes, U.S. Geological Survey)

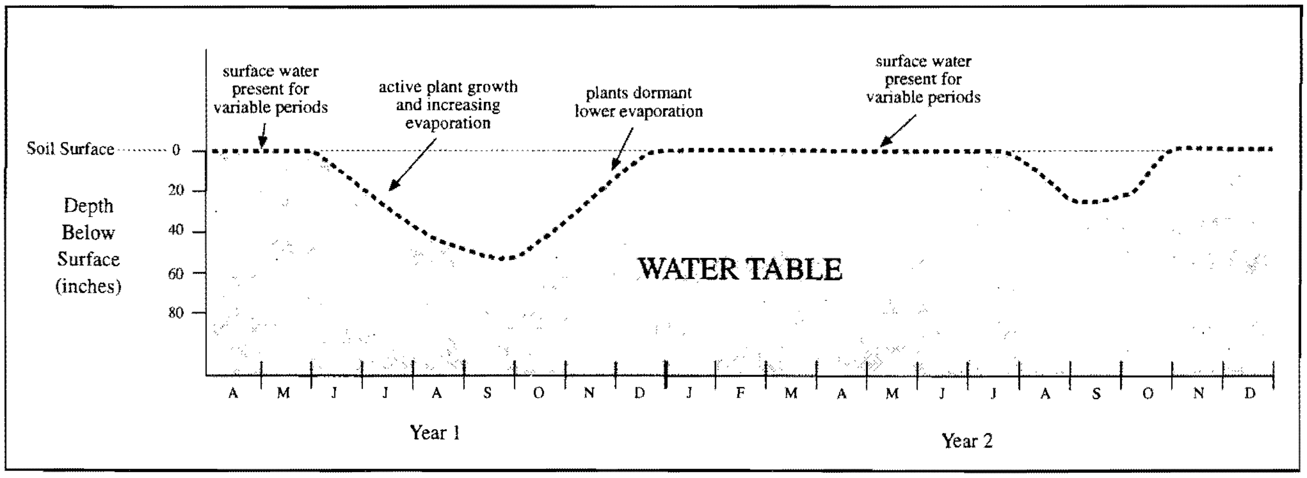


Figure 4-12. Example of water table fluctuations in a seasonally flooded wetland (adapted from Lyford 1964). In general, the water table is at or near the surface through winter and early spring, drops markedly through summer, and rises through fall. The water table fluctuates seasonally, annually, and even daily.

Table 4-4. Examples of plants that may be useful indicators of certain nontidal water regimes.

Water Regime	Indicator Plants
Permanently Flooded	Spatterdock (*Nuphar luteum*) White Water Lily (*Nymphaea odorata*) Water-milfoils (*Myriophyllum* spp.) Coontail (*Ceratophyllum demersum*) Bushy Pondweeds (*Najas* spp.) Pondweeds (*Potamogeton* spp.)
Semipermanently Flooded	Arrow Arum (*Peltandra virginica*) Bur-reeds (*Sparganium* spp.) Wild Rice (*Zizania aquatica*) Pickerelweed (*Pontederia cordata*) Arrowheads (*Sagittaria* spp.) Water-willow or Swamp Loosestrife (*Decodon verticillatus*) Buttonbush (*Cephalanthus occidentalis*)
Seasonally Flooded	Water Pepper (*Polygonum hydropiper*) Lizard's Tail (*Saururus cernuus*) Rice Cutgrass (*Leersia oryzoides*) Nodding Beggar-ticks (*Bidens cernua*) Sweet Flag (*Acorus calamus*) Broad-leaved Cattail (*Typha latifolia*) Fringed Sedge (*Carex crinita*) Bladder Sedge (*Carex intumescens*) Bugleweeds (*Lycopus* spp.) Marsh Fern (*Thelypteris thelypteroides*) Net-veined Chain Fern (*Woodwardia areolata*) Virginia Meadowbeauty (*Rhexia virginica*) Tearthumbs (*Polygonum arifolium* and *P. sagittatum*) Swamp Milkweed (*Asclepias incarnata*) Boneset (*Eupatorium perfoliatum*) Bluejoint (*Calamagrostis canadensis*) Spike-rushes (*Eleocharis* spp.) Bushy St. John's-wort (*Hypericum densiflorum*) Marsh St. John's-wort (*Triadenum virginicum*) Narrow-leaved Meadowsweet (*Spiraea alba*) Peat Mosses (*Sphagnum* spp.) Turtlehead (*Chelone glabra*) Skunk Cabbage (*Symplocarpus foetidus*) Fowl Manna-grass (*Glyceria striata*) Swamp Azalea (*Rhododendron viscosum*)
Seasonally Flooded (*continued*)	Common Winterberry (*Ilex verticillata*) Virginia Sweet-spires (*Itea virginica*) Sweet Bay (*Magnolia virginiana*) River Birch (*Betula nigra*) Black Willow (*Salix nigra*) Atlantic White Cedar (*Chamaecyparis thyoides*) Swamp Black Gum (*Nyssa sylvatica biflora*) Overcup Oak (*Quercus lyrata*) Swamp Cottonwood (*Populus heterophylla*) Climbing Hempweed (*Mikania scandens*)
Temporarily Flooded	White Avens (*Geum canadense*) Honewort (*Cryptotaenia canadensis*) Virginia Knotweed (*Polygonum virginicum*) Garlic Mustard (*Alliaria petiolata*) White Grass (*Leersia virginica*) Wood Nettle (*Laportea canadense*) Indian Mock-strawberry (*Duchesnia indica*) Field Garlic (*Allium vineale*) Rough-stemmed Goldenrod (*Solidago rugosa*) Pawpaw (*Asimina triloba*) Sycamore (*Platanus occidentalis*) Eastern Cottonwood (*Populus deltoides*) Bitternut Hickory (*Carya cordiformis*) Black Walnut (*Juglans nigra*) Black Locust (*Robinia pseudoacacia*) Box Elder (*Acer negundo*) Tulip Poplar (*Liriodendron tulipifera*) American Beech (*Fagus grandifolia*) Silver Maple (*Acer saccharinum*) White Oak (*Quercus alba*) American Holly (*Ilex opaca*)
Saturated (Permanently)	Northern Pitcher Plant (*Sarracenia purpurea*) Round-leaved Sundew (*Drosera rotundifolia*) White Beak-rush (*Rhynchospora alba*)

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Hydric Soils of Maryland

Introduction

The predominance of undrained hydric soil is a key attribute for identifying wetlands (Cowardin *et al.* 1979; Environmental Laboratory 1987; Federal Interagency Committee for Wetland Delineation 1989). In general, there is excellent agreement between hydric soils and hydrophytic vegetation, with a few exceptions (Scott *et al.* 1989). Hydric soils develop in certain landscape positions (landforms), such as depressions, floodplains, toes of slopes, drainageways, seepage slopes, and along the margins of coastal and inland waterbodies. Knowledge of hydric soils and their properties is particularly useful in distinguishing the drier wetlands from uplands, where the more typical wetland plants are less common or absent. This chapter focuses on the characteristics of hydric soils, in general, and on the distribution and extent of Maryland's hydric soils. Plates 1 through 6 show some examples of hydric and nonhydric soils in Maryland. Tiner (1988) describes general characteristics and field recognition of Maryland's hydric soils and presents numerous color plates of these as well as some nonhydric soils.

Definition of Hydric Soil

Hydric soils have been defined by the U.S.D.A. Soil Conservation Service (1987) as follows: "A hydric soil is a soil that is saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions in the upper part." This definition describes soils that are saturated with water at or near the soil surface and virtually lacking free oxygen and reduced for a significant period of the growing season and soils that are ponded or frequently flooded for long or very long periods during the growing season. Table 5-1 lists the 1991 national criteria for hydric soils. Table 5-2 summarizes information on flooding and seasonal high water tables associated with Maryland's hydric soils. (*Note: Tables 5-2 through 5-5 are located at the end of this chapter.*)

Soils that were formerly wet, but are now completely or effectively drained, do not meet the hydric soil criteria and are not considered wetlands, according to the Service's wetland classification system (Cowardin *et al.* 1979) and the interagency Federal wetland delineation manual (Federal

Table 5-1. National technical criteria for hydric soils. (U.S.D.A. Soil Conservation Service 1991)

1. All Histosols except Folists, or
2. Soils in Aquic suborder, Aquic subgroups, Albolls suborder, Salorthids great group, Pell great groups of Vertisols, Pachic subgroups, or Cumulic subgroups that are:
   a. somewhat poorly drained and have a frequently occurring water table at less than 0.5 foot (ft) from the surface for a significant period (usually more than 2 weeks) during the growing season, or
   b. poorly drained or very poorly drained and have either:
      (1) a frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils,
      (2) a frequently occurring water table at less than 1.0 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
      (3) a frequently occurring water table at less than 1.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

Interagency Committee for Wetland Delineation 1989). These soils should, however, be checked in the field to verify that drainage measures will remain functional under normal or design conditions. Where failure of a drainage system results, such soils often revert to hydric conditions (i.e., wetland hydrology is restored). This condition must be determined on a site-specific basis.

Soils that were not naturally wet, but are now subject to periodic flooding or soil saturation for specific management purposes (e.g., waterfowl impoundments) or flooded by accident (e.g., highway-created impoundments) meet the hydric soils criteria (see Criteria 3 and 4 in Table 5-1). Hydrophytes are usually present in these created wetlands. Better-drained soils that are frequently flooded for short intervals (usually less than one week) during the growing season, or are saturated for less than two weeks during the growing season are not considered hydric soils.

Major Categories of Hydric Soils

Hydric soils are separated into two major categories on the basis of soil composition: (1) organic soils (*Histosols*) and (2) mineral soils. In general, soils having 20 percent or more organic material by weight in the upper 16 inches are considered organic soils, while soils with less organic content and higher contents of sand, silt, and clay are mineral soils. For a technical definition, the reader is referred to *Soil Taxonomy* (Soil Survey Staff 1975).

Accumulation of organic matter results from prolonged anaerobic soil conditions associated with long periods of inundation and/or soil saturation during the growing season. These saturated conditions impede aerobic decomposition (or oxidation) of the bulk organic materials, such as leaves, stems and roots, and encourage their accumulation as peat or muck over time. Consequently, most organic soils are characterized as "very poorly drained" soils (Table 5-3). Organic soils typically form in waterlogged depressions and in low-lying areas along streams and coastal waters where flooding is frequent.

Organic soil materials can be further subdivided into three groups based on the fraction of identifiable plant material in the soil: (1) muck (*Saprists*) where two-thirds or more of the fibers are decomposed and less than one-third is identifiable, (2) peat (*Fibrists*) with less than one-third decomposed and greater than two-thirds identifiable, and (3) mucky peat or peaty muck (*Hemists*) where between one-third and two-thirds is both decomposed and identifiable (Plate 1). A fourth group of organic soils—*Folists*—occur in boreal and tropical mountainous areas, but they do not develop under hydric conditions. Folists do not occur in Maryland. All organic soils, with the exception of the Folists, are hydric soils. For more information on organic soils, the reader is referred to *Histosols: Their Characteristics, Classification, and Use* (Aandahl *et al.* 1974).

Where organic matter does not accumulate thicker than 18 inches, mineral soils have developed (Plates 2 through 6). Varying proportions of sand, silt, and clay characterize these soils. Some mineral soils do, however, have thick organic surface layers of muck or peat (e.g., histic epipedons) which result from abundance of soil moisture due to heavy seasonal rainfall and/or a high water table (Ponnamperuma 1972). Soils found in many pothole or Delmarva bay wetlands on the Eastern Shore have histic epipedons (Stolt 1986). Mineral soils exhibit a wide range of properties related to differences in parent material, climate, topography, age, and other factors. Differences in landscape position create a variety of natural soil drainage conditions that have a profound effect on soil properties as illustrated in Figure 5-1. Hydric mineral soils have standing water for significant periods and/or are saturated at or near the surface for extended periods during the growing season. These soils are also wet for long periods during the non-growing season. They may be inundated by river overflow, tidal action, direct precipitation, or surface water runoff. Soil saturation results from low-lying topographic position, groundwater seepage, or presence of a slowly permeable layer (e.g., clay, confining bed, fragipan or hardpan), or direct connection to the underlying water table.

The duration and depth of soil saturation (i.e., seasonal high water table) are essential criteria for identifying hydric soils and wetlands. Hydric soils are saturated for prolonged periods during the year. Anaerobic and reduced conditions are typically present at or near the surface for two weeks or more during the growing season in most years in soils meeting the national technical criteria for hydric soils (U.S.D.A. Soil Conservation Service 1991). Soil morphology features are widely used to indicate long-term soil moisture (Bouma 1983). Fanning and others (1972) found a good correlation between certain soil morphology and water tables in Worcester County. The three most widely recognized features reflecting soil wetness are gleying, mottling, and accumulation of organic matter (peat or muck).

Gleyed soils are predominantly neutral gray in color (low chroma colors—chroma 2 or less) and occasionally greenish or bluish gray. Fanning and Reybold (1968) noted that poorly drained coastal plain soils could be recognized in summer by their gray-colored subsoils. Mottled soils are distinguished

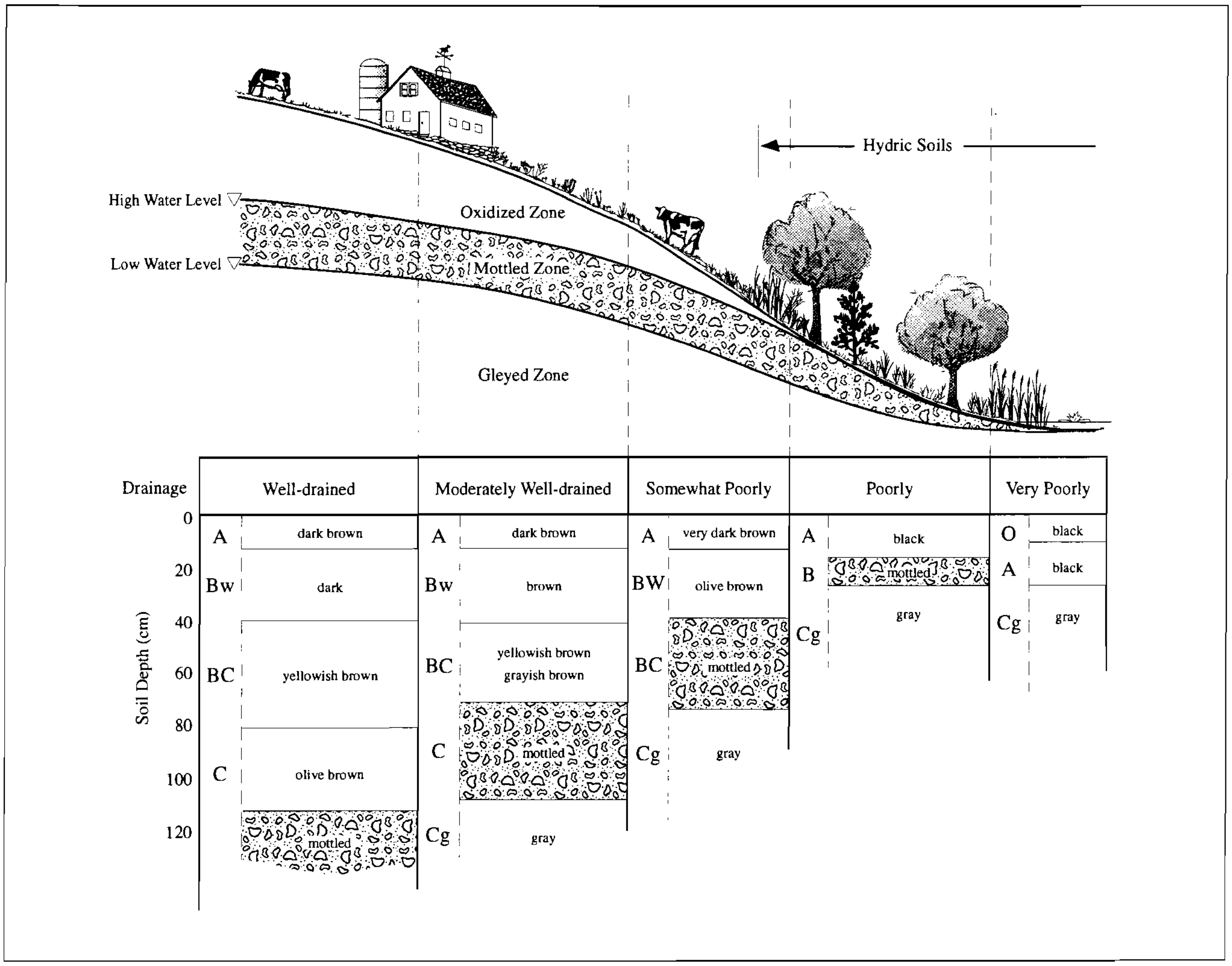

Figure 5-1. Soil properties usually change with landscape position, with wetter soils downslope. Note that the mottled zone associated with the seasonal high water table reaches the surface at the lowest elevations. (Redrawn from Tiner and Veneman 1989)

by spots or blotches different in shade or color from the soil's predominant color (matrix color). Gleyed soils in Maryland have soil profiles or horizons that are predominantly chroma 2 or less and may contain up to 40 percent high chroma colors. In gleyed soils, the distinctive colors result from a process known as gleization. Prolonged saturation of mineral soil converts iron from its stable, oxidized (ferric) form to its mobile, reduced (ferrous) state. These reduced compounds may be completely removed from the soil resulting in gleying (Veneman *et al.* 1976). Mineral soils that are always saturated are uniformly gleyed throughout the saturated area. Soils gleyed to the surface layer are hydric soils. These soils often show evidence of oxidation only along root channels (i.e., oxidized rhizospheres).

Mineral soils that are alternately saturated and oxidized (aerated) during the year are usually mottled in the part of the soil that is seasonally wet. The abundance, size, and color of the mottles usually reflect the duration of the saturation period and may indicate whether or not the soil is hydric. Mineral soils that are predominantly gray directly below the A-horizon with brown or yellow mottles are usually anaerobic and reduced for long periods during the growing season and are classified as hydric. Soils that are predominantly brown or yellow with gray (low chroma) mottles are reduced for shorter periods and are usually not hydric. If gray mottles extend to within six inches of the surface *and* a low chroma matrix occurs within 18 inches of the soil surface, the soil is probably hydric. Mineral soils that are never reduced are usually bright-colored and are not mottled. Realize, however, that in some hydric soils, mottles may not be visible due to masking by organic matter (Parker *et al.* 1984). Vepraskas (1992) provides a detailed technical review of the formation and characteristics of soils with "aquic moisture regimes"—those soils that are saturated and reduced, and exhibit redoximorphic features.

It is important to note that the gleization and mottle formation processes are strongly influenced by the activity of certain soil microorganisms. These microorganisms reduce iron when the soil environment is anaerobic, that is, when virtually no free oxygen is present, and when the soil contains organic matter. Organic carbon serves as an energy source for these organisms. If the soil conditions are such that free oxygen is present, organic matter is absent, or temperatures are too low (below freezing) to sustain microbial activity, gleization will not proceed and mottles will not form, even though the soil may be saturated for prolonged periods of time (Diers and Anderson 1984). Consequently, some hydric soils do not exhibit strong evidence of gleying and mottling. This is particularly true for sandy soils. Recently flooded, formerly nonhydric soils do not show strong indicators of gleying or mottling, since it takes a long time to develop the characteristic low chroma colors. Sandy soils, red parent material soils, and others can be hydric but not exhibit evidence of gleying due to basic lack of reducible iron or inherently iron-rich soil, but not due to water levels.

Lists of Hydric Soils and Hydric Soil Map Units

To help the Service clarify its wetland definition, the U.S.D.A. Soil Conservation Service (SCS) agreed to develop a national list of hydric soils. Work on the list began in the late 1970s. The list underwent a few revisions prior to its most recent printing in 1991. The national hydric soils list is reviewed annually and updated and republished as needed. Copies of amendments can be obtained from SCS.

The national list summarizes (in tabular form) certain characteristics of each designated hydric soil. Soils are listed by series name. Series listed are only those soils that meet the hydric soils criteria. Other series, not on the list, may have hydric members, but these series are not typically hydric. In addition, newly described series may not be on the list. Therefore, the list should be used with caution.

County hydric soil lists produced by SCS are most helpful. These lists contain hydric soil map units plus nonhydric soil map units that may have hydric soil inclusions. These lists are helpful in reviewing soil survey reports for potential wetlands.

Maryland's Hydric Soils

In Maryland, more than 60 soil series have been identified as hydric soils. These series are typically very poorly drained or poorly drained soils. Table 5-2 lists these soils along with selected hydrologic characteristics. For detailed descriptions of each series, refer to individual county soil surveys or contact the SCS State Office for a copy of the official soil descriptions. These descriptions provide the range of morphological soil properties associated within each series, the landscape position of these soils, and other characteristics. Examples of Maryland's hydric soils and nonhydric soils are shown in Plates 1-6.

Recent SCS soil mapping in Maryland has identified map units containing about 1.4 million acres in which there are "potential" hydric soils (Table 5-4). This represents about 22 percent of the state's land surface area. In Maryland, somewhat poorly drained soils were not usually separated from the poorly drained soils in soil mapping nor were drained phases separated from undrained soils. Consequently, the total acreage of "potential" hydric soils is actually much higher than the true acreage of hydric soils associated with wetlands in the state (Jim Brown, pers. comm.). This has been a major source of confusion for determining the acreage of wetlands (including farmed wetlands) for Maryland, leading some people to erroneously report that there are 1.4 million acres of wetlands in Maryland today. Updates of soil surveys on the Eastern Shore are differentiating drained and undrained phases of series. For the latest information on Maryland's hydric soils, contact the SCS State Office.

County Acreage of Hydric Soils

Hydric soils are most abundant in counties on the Eastern Shore. Table 5-5 outlines acreages of "potential" hydric soils for each county. Dorchester had the most acreage with over 250,000 acres, representing nearly 60 percent of the county. Worcester, Somerset, and Wicomico Counties had more than 100,000 acres of "potential" hydric soils. Percent of the county covered by each map unit is designated. Remember that these figures *do not* translate directly to wetland acreage, since drained phases and acreages not meeting the hydric soil criteria are not separated. These figures represent acreage of "potential" hydric soils and, thereby, overestimate wetland acreage.

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Table 5-2. Maryland's hydric soils and their hydrology (source: U.S.D.A. Soil Conservation Service 1993). (*Note:* A plus sign (+) under depth of seasonal high water table means that x feet of surface water ponds on the soil from precipitation or adjacent runoff; flooding is flowing water derived from overbank flows, tides, or runoff, whereas ponding is standing water in a closed depression.)

	Seasonal High Water Table		Flooding		
Series* *(Subgroup)	***Depth (ft)***	***Months***	***Frequency*[1]**	***Duration*[2]**	***Month***
Aden (Aeric Ochraqualfs)	0-1.0	Dec-Mar	None - Occasional	Long	Dec-Mar
Andover (Typic Fragiaquults)	0-0.5	Oct-Jun	None		
Andover, Stony (Typic Fragiaquults)	0-0.5	Oct-Jun	None		
Armagh (Typic Ochraquults)	0-0.5	Oct-Jun	None		
Armagh, Stony (Typic Ochraquults)	0-0.5	Oct-June	None		
Atkins (Typic Fluvaquents)	0-1.0	Nov-Jun	Common	V Brief	Sep-Jul
Atsion (Aeric Haplaquods)	0-1.0	Nov-Jun	None - Rare		
Atsion, Tide Flooded (Aeric Haplaquods)	0-1.0	Jan-Dec	Frequent	V Brief	Jan-Dec
Axis (Typic Sulfaquents)	+1-1.0	Jan-Dec	Frequent	V Brief	Jan-Dec
Backbay (Histic Humaquepts)	+1-0	Jan-Dec	Frequent	V Long	Jan-Dec
Baile (Typic Ochraquults)	0-0.5	Nov-Apr	None		
Bayboro (Umbric Paleaquults)	0-1.0	Nov-May	None		
Bayboro, Ponded (Umbric Paleaquults)	+1-1.0	Nov-May	None		
Berryland (Typic Haplaquods)	+0.5-0.5	Oct-Jun	Rare - Frequent	Brief - Long	Mar-Jun
Bestpitch (Terric Sulfihemists)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec
Bibb (Typic Fluvaquents)	0.5-1.0	Dec-Apr	Common	Brief - Long	Dec-May
Bladen (Typic Albaquults)	0-1.0	Dec-May	None		
Bladen, Ponded (Typic Albaquults)	+1-1.0	Dec-May	None		
Bowmansville (Aeric Fluvaquents)	0-1.5	Sep-May	Common	Brief	Nov-Jun
Brinkerton (Typic Fragiaqualfs)	0-0.5	Oct-May	None		

Table 5-2. (continued)

	Seasonal High Water Table		Flooding		
Series (Subgroup)	*Depth (ft)*	*Months*	*Frequency*[1]	*Duration*[2]	*Months*
Brinkerton (Typic Fragiaqualfs)	0-0.5	Oct-May	None		
Brinkerton, Stony (Typic Fragiaqualfs)	0-0.5	Oct-May	None		
*Chewacla (Fluvaquentic Dystrochrepts)	0.5-1.5	Nov-Apr	Frequent	Long	Nov-Apr
Chicone (Thapto-Histic Fluvaquents)	+1-0.5	Nov-Jun	Frequent	Brief	Jan-Dec
Cokesbury (Typic Fragiaquults)	0-1.0	Sep-Jun	None		
Colemantown (Typic Ochraquults)	0-1.0	Oct-Jun	Occasional	V Brief	Sep-Apr
Croton (Typic Fragiaqualfs)	0-0.5	Nov-May	None		
Croton, Stony (Typic Fragiaqualfs)	0-0.5	Nov-May	None		
Dunning (Fluvaquentic Haplaquolls)	0-0.5	Jan-Apr	Rare - Common	Brief	Dec-May
Elkins, Drained (Humaqueptic Fluvaquents)	0-1.5	Nov-Jun	Occasional	Brief	Nov-Apr
Elkins, Ponded (Humaqueptic Fluvaquents)	+2-0.5	Jan-Dec	Frequent	V Long	Sep-Jun
Elkton (Typic Ochraquults)	0-1.0	Nov-May	None		
Elkton, Very Wet (Typic Ochraquults)	+1-0.5	Jan-Dec	None		
Fallsington (Typic Ochraquults)	0-1.0	Dec-May	None		
Freetown (Typic Medisaprists)	0-1.0	Jan-Dec	None		
Guthrie (Typic Fragiaquults)	0.5-1.0	Jan-Apr	None - Common	Brief	Jan-Apr
Guthrie, Ponded (Typic Fragiaquults)	+2-1.0	Dec-May	None - Rare		
Hatboro (Typic Fluvaquents)	0-0.5	Oct-May	Common	V Brief	Nov-May
Honga (Terric Sulfihemists)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec
Hurlock (Typic Ochraquults)	0-1.0	Dec-May	None		
Hyde (Typic Umbraquults)	0-1.5	Nov-May	None - Rare		
Ipswich (Typic Sulfihemists)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec

Table 5-2. (continued)

	Seasonal High Water Table		Flooding		
Series (Subgroup)	*Depth (ft)*	*Months*	*Frequency*[1]	*Duration*[2]	*Months*
Ipswich, Low Salt (Typic Sulfihemists)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec
Johnston (Cumulic Humaquepts)	+1-1.5	Nov-Jun	Common	Brief - Long	Nov-Jul
Kentuck (Typic Umbraquults)	+1-0.5	Dec-Jun	None		
Kingsland (Typic Medihemists)	0-0.5	Jan-Dec	Common	V Long	Jan-Dec
Kinkora (Typic Ochraquults)	0-0.5	Nov-May	Rare		
Lantz (Mollic Ochraqualfs)	0-0.5	Nov-May	Rare		
#Lenoir (Aeric Paleaquults)	1.0-2.5	Dec-May	Frequent	Long	Dec-Jun
Leon (Aeric Haplaquods)	0.5-1.5	Mar-Sep	None		
Leon, Flooded (Aeric Haplaquods)	0-1.0	Mar-Sep	Rare - Common	Brief - Long	Mar-Sep
Leonardtown (Typic Fragiaquults)	0-1.0	Nov-Mar	None		
Levy (Typic Hydraquents)	+2-+1	Jan-Dec	Frequent	V Long	Jan-Dec
Lickdale (Humic Haplaquepts)	0-0.5	Nov-May	None		
Lickdale, Stony (Humic Haplaquepts)	0-0.5	Nov-May	None		
Loysville (Typic Fragiaqualfs)	0-0.5	Dec-Mar	None		
Manahawkin (Terric Medisaprists)	+1-0	Oct-Jul	Frequent	Long	Jan-Mar
Markes (Typic Ochraqualfs)	0-0.5	Sep-May	None		
Matunuck (Typic Sulfaquents)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec
Melvin (Typic Fluvaquents)	0-1.0	Dec-May	Common	Brief - Long	Dec-May
Melvin, Cool (Typic Fluvaquents)	0-1.0	Dec-May	Common	Brief	Dec-May
Melvin, Ponded (Typic Fluvaquents)	+2-0.5	Jan-Dec	Frequent	V Long	Sep-Jun
Nanticoke (Typic Hydraquents)	+1-0.5	Jan-Dec	Frequent	V Brief	Jan-Dec
Nolo (Typic Fragiaquults)	0-0.5	Sep-Jun	None		

Table 5-2. (continued)

	Seasonal High Water Table		Flooding		
Series (Subgroup)	*Depth (ft)*	*Months*	*Frequency*[1]	*Duration*[2]	*Months*
Nolo, Stony (Typic Fragiaquults)	0-0.5	Sep-Jun	None		
Osier (Typic Psammaquents)	0-0.5	Nov-Mar	None - Rare		
Osier, Flooded (Typic Psammaquents)	0-1.0	Nov-Mar	Common	Brief	Dec-Apr
Osier, Ponded (Typic Psammaquents)	+1-1.0	Nov-Mar	None		
Othello (Typic Ochraquults)	0-1.0	Jan-May	None		
Othello, Very Wet (Typic Ochraquults)	+1-0.5	Jan-Jun	None		
Plummer (Grossarenic Paleaquults)	0-1.0	Dec-Jul	None		
Plummer, Ponded (Grossarenic Paleaquults)	+2-1.0	Dec-Jul	None		
Pocomoke, Drained (Typic Umbraquults)	0-1.5	Dec-May	None		
Pocomoke, Ponded (Typic Umbraquults)	+1-0	Nov-Jun	None		
Pone (Typic Umbraquults)	+1-0.5	Dec-Jun	None		
Portsmouth (Typic Umbraquults)	0-1.0	Nov-May	None - Rare		
Puckum (Typic Medisaprists)	+1-0	Jan-Dec	Frequent	Brief	Jan-Dec
Purdy (Typic Ochraquults)	+1-1.0	Nov-Jun	None		
Rappahannock (Terric Sulfihemists)	+2-0.5	Jan-Dec	Frequent	V Brief	Jan-Dec
Roanoke (Typic Ochraquults)	0-1.0	Nov-May	None - Frequent	Brief	Nov-Jun
Roanoke, Ponded (Typic Ochraquults)	+3-0	Oct-Jul	Frequent	V Long	Oct-Jul
Robertsville (Typic Fragiaqualfs)	0-1.0	Dec-May	None - Common	Brief	Dec-Apr
Rutlege (Typic Humaquepts)	0-0.5	Dec-May	None - Common	Brief	Dec-May
Rutlege, Ponded (Typic Humaquepts)	+2-1.0	Dec-May	None		
Shrewsbury (Typic Ochtaquults)	0-1.0	Oct-Jun	None		
*St. Johns (Typic Haplaquods)	0 0.5	Jun Oct	None		

Table 5-2. (continued)

	Seasonal High Water Table		Flooding		
Series (Subgroup)	*Depth (ft)*	*Months*	*Frequency*[1]	*Duration*[2]	*Months*
*St. Johns, Depressional (Typic Haplaquods)	+2-1.0	Jun-Apr	None		
Sunken (Typic Ochraqualfs)	+1-0	Jan-Dec	Occasional	V Brief	Jan-Dec
Swansea (Terric Medisaprists)	0-1.0	Jan-Dec	None		
Transquaking (Typic Sulfihemists)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec
Warners (Fluvaquentic Haplaquolls)	+0.5-0.5	Nov-Jun	Frequent	Long	Nov-Jun
Warners, Nonflooded (Fluvaquentic Haplaquolls)	0-0.5	Nov-Jun	None		
Warners, Ponded (Fluvaquentic Haplaquolls)	+0.5-1.0	Nov-May	None		
Watchung (Typic Ochraqualfs)	0-1.0	Dec-Jun	None		
Watchung, Stony (Typic Ochraqualfs)	0-1.0	Dec-Jun	None		
Wehadkee (Typic Fluvaquents)	0-1.0	Nov-May	Common	Brief - Long	Nov-Jun
Westbrook (Terric Sulfihemists)	+1-0	Jan-Dec	Frequent	V Brief	Jan-Dec
Worsham (Typic Ochraquults)	0-1.0	Nov-Apr	None		

'Some phases of this soil are not frequently flooded for long duration.

*Some phases of this series are not hydric.

[1]Frequent flooding—more than 50 times in 100 years; Occasional—5 to 50 times in 100 years; Rare—1 to 5 times in 100 years (Common flooding—combination of Frequent and Occasional).

[2]Very Long duration—more than 30 days; Long—7 to 30 days; Brief—2 to 7 days; Very Brief—4 to 48 hours. (Source: Soil Survey Division Staff 1993)

Table 5-3. Definitions of the classes of natural soil drainage associated with wetlands. (Soil Survey Staff 1951)

Class	Definition
Somewhat poorly drained	Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained	Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained	Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Table 5-4. Approximate acreage of Maryland's hydric soils. Percent of the county covered by each is also designated. (*Caution:* These figures do not translate directly to wetland acreage, since drained phases and acreages not meeting hydric soil criteria are not separated from actual hydric soils; therefore, these figures overestimate wetland acreage.)

County	Hydric Soil Types	Acres	Soils in County
Allegany	Alluvial Land	3,760	1.4
	Atkins	1,630	0.6
	Lickdale	150	0.1
	Loysville	300	0.1
	Melvin	150	0.1
	Nolo	1,070	0.4
	Robertsville	240	0.1
	Armagh (inclusion)	N/A	N/A
	Subtotal	7,300	2.8
Anne Arundel	Bibb	11,000	3.8
	Coastal Beaches	280	0.1
	Colemantown	2,120	0.8
	Elkton	7,860	2.7
	Fallsington	1,870	0.6
	Hatboro	1,100	0.4
	Mixed Alluvial Land	4,850	1.7
	Osier	390	0.1
	Othello	4,040	1.4
	Shrewsbury	1,830	0.7
	Swamp	65	0.0
	Tidal Marsh	3,400	1.2
	Leonardtown (inclusion)	N/A	N/A
	Subtotal	38,805	13.5
Baltimore	Alluvial Land	5,170	1.3
	Baile	3,850	1.0
	Dunning	630	0.2
	Elkton	930	0.3
	Fallsington	1,520	0.3
	Hatboro	4,160	1.0
	Lenoir	3,580	0.9
	Leonardtown	560	0.1
	Melvin	1,540	0.4
	Othello	820	0.2
	Pocomoke	110	0.0
	Swamp	180	0.0
	Tidal Marsh	2,320	0.6
	Watchung	1,980	0.5
	Bibb (inclusion)	N/A	N/A
	Subtotal	27,350	6.8
Calvert	Coastal Beaches	288	0.2
	Elkton	537	0.3
	Fallsington	386	0.2
	Mixed Alluvial Land	8,152	5.3
	Othello	1,887	1.2
	Swamp	130	0.1
	Tidal Marsh	2,890	1.9
	Subtotal	14,270	9.2

Table 5-4. (continued)

County	Hydric Soil Types	Acres	Soils in County
Caroline	Bayboro	786	0.4
	Bibb	240	0.1
	Elkton	1,679	0.8
	Fallsington	40,996	19.8
	Johnston	3,396	1.6
	Mixed Alluvial Land	2,595	1.3
	Muck	168	0.1
	Othello	435	0.2
	Plummer	492	0.2
	Pocomoke	13,394	6.5
	Portsmouth	96	0.1
	Swamp	1,906	0.9
	Tidal Marsh	2,775	1.3
	Subtotal	68,958	33.3
Carroll	Baile	6,092	2.1
	Bowmansville	544	0.2
	Hatboro	6,258	2.2
	Melvin	270	0.1
	Croton (inclusion)	N/A	N/A
	Subtotal	13,164	4.6
Cecil	Baile	4,526	1.8
	Elkton	3,940	1.6
	Fallsington	3,142	1.2
	Hatboro	3,724	1.5
	Leonardtown	1,270	0.5
	Mixed Alluvial Land	4,336	1.8
	Othello	2,131	0.8
	Tidal Marsh	1,688	0.7
	Watchung	693	0.3
	Subtotal	25,450	10.2
Charles	Alluvial Land	1,740	0.6
	Bibb	22,040	7.1
	Coastal Beaches	60	0.0
	Elkton	12,810	4.1
	Fallsington	2,299	0.7
	Leonardtown	5,350	1.7
	Osier	379	0.1
	Othello	11,450	3.7
	Swamp	3,810	1.2
	Tidal Marsh	6,380	2.0
	Subtotal	66,318	21.2
Dorchester	Bayboro	5,467	1.2
	Bibb	196	0.1
	Coastal Beaches	212	0.1
	Elkton	73,874	17.5
	Fallsington	22,600	5.3
	Johnston	962	0.2
	Mixed Alluvial Land	2,019	0.5
	Othello	38,601	9.1
	Plummer	665	0.2

Table 5-4. (continued)

County	Hydric Soil Types	Acres	Soils in County
Dorchester (cont'd)	Pocomoke	6,509	1.5
	Portsmouth	1,641	0.4
	Rutlege	1,778	0.4
	Swamp	17,413	4.1
	Tidal Marsh	81,692	19.3
	Subtotal	253,629	59.9
Frederick	Bowmansville	580	0.1
	Croton	4,132	1.0
	Guthrie	131	0.0
	Lantz	1,597	0.4
	Roanoke	980	0.2
	Watchung	359	0.1
	Wehadkee	6,643	1.6
	Worsham	2,558	0.6
	Melvin (inclusion)	N/A	N/A
	Robertsville (inclusion)	N/A	N/A
	Subtotal	16,980	4.0
Garrett	Alluvial Land	4,330	1.0
	Armagh	880	0.2
	Atkins	4,970	1.2
	Brinkerton and Andover complex	18,410	4.4
	Elkins	350	0.1
	Lickdale	2,850	0.7
	Nolo	1,480	0.3
	Peat	400	0.1
	Purdy	300	0.1
	Swamp	34,900	8.3
	Subtotal	68,870	16.4
Harford	Alluvial Land	2,520	0.8
	Baile	2,190	0.8
	Elkton	740	0.3
	Fallsington	190	0.1
	Hatboro	4,000	1.4
	Kinkora	380	0.1
	Leonardtown	440	0.1
	Othello	410	0.1
	Swamp	140	0.1
	Tidal Marsh	1,030	0.3
	Watchung	6,260	2.1
	Subtotal	18,300	6.2
Howard	Baile	3,318	2.0
	Elkton	94	0.1
	Fallsington	356	0.2
	Hatboro	3,381	2.1
	Kinkora	144	0.1
	Leonardtown	480	0.3
	Mixed Alluvial Land	416	0.3
	Watchung	555	0.3
	Bibb (inclusion)	N/A	N/A
	Subtotal	8,744	5.4

Table 5-4. (continued)

County	Hydric Soil Types	Acres	Soils in County
Kent	Axis	373	0.2
	Bibb and Bibb variant	7,746	4.0
	Elkton	5,924	3.0
	Fallsington	4,699	2.5
	Ipswich	440	0.2
	Kingsland	422	0.2
	Othello	9,645	5.0
	Westbrook	1,751	0.9
	Beaches	208	0.1
	Subtotal	31,208	16.1
Montgomery	Bowmansville	2,343	0.7
	Calvert	460	0.1
	Croton	2,009	0.6
	Leonardtown	151	0.0
	Melvin	1,226	0.4
	Mixed Alluvial Land	149	0.1
	Roanoke	260	0.1
	Watchung	690	0.2
	Wehadkee	10,984	3.4
	Worsham	10,772	3.3
	Subtotal	29,044	8.9
Prince Georges	Bibb	19,210	6.0
	Colemantown	235	0.1
	Elkton	475	0.1
	Fallsington	1,952	0.6
	Hatboro	1,239	0.4
	Hyde	180	0.1
	Johnston	574	0.2
	Leonardtown	5,961	1.9
	Mixed Alluvial Land	3,129	1.0
	Othello	1,441	0.4
	Plummer and Rutlege complex	128	0.0
	Shrewsbury	3,129	1.0
	Swamp	1,204	0.4
	Tidal Marsh	2,790	0.9
	Osier (inclusion)	N/A	N/A
	Subtotal	41,647	13.1
Queen Annes	Bayboro	1,274	0.5
	Bibb	337	0.1
	Bladen	381	0.1
	Elkton	19,002	12.7
	Fallsington	32,607	12.7
	Johnston	3,421	1.3
	Mixed Alluvial Land	6,857	2.7
	Othello	9,828	3.9
	Plummer	90	0.0
	Pocomoke	6,626	2.6
	Portsmouth	434	0.2
	Swamp	275	0.1
	Tidal Marsh	5,797	2.3
	Subtotal	86,929	39.2

Table 5-4. (continued)

County	Hydric Soil Types	Acres	Soils in County
St. Marys	Alluvial Land, wet	1,469	0.6
	Beaches	518	0.2
	Bibb	12,569	4.8
	Elkton	5,569	2.1
	Fallsington	2,371	0.9
	Leonardtown	257	0.1
	Othello	22,798	8.7
	Tidal Marsh	4,027	1.5
	Subtotal	49,578	18.9
Somerset	Fallsington	14,733	6.1
	Johnstown	1,851	0.8
	Mixed Alluvial Land	416	0.2
	Muck and Peat	1,598	0.7
	Othello	65,764	27.5
	Plummer	310	0.1
	Pocomoke	8,668	3.6
	Portsmouth	15,026	6.3
	St. John's	100	0.0
	Swamp	3,421	1.4
	Tidal Marsh	54,986	23.0
	Beaches	583	0.2
	Subtotal	167,456	69.9
Talbot	Elkton	25,209	12.1
	Fallsington	9,448	4.5
	Mixed Alluvial Land	4,893	2.3
	Othello	17,777	8.5
	Plummer	99	0.1
	Pocomoke	419	0.2
	Portsmouth	358	0.2
	Tidal Marsh	6,122	2.9
	Subtotal	64,325	30.8
Washington	Atkins	1,164	0.4
	Brinkerton	236	0.1
	Dunning and Melvin complex	1,896	0.6
	Melvin	146	0.1
	Warners	1,646	0.6
	Wehadkee	183	0.1
	Nolo (inclusion)	N/A	N/A
	Purdy (inclusion)	N/A	N/A
	Lantz (inclusion)	N/A	N/A
	Subtotal	5,271	1.9
Wicomico	Bayboro	2,615	1.0
	Elkton	14,915	5.9
	Fallsington	27,672	11.0
	Leon	1,080	0.4
	Mixed Alluvial Land	4,483	1.8
	Muck	5,476	2.2
	Othello	17,783	7.0
	Plummer	6,004	2.4
	Pocomoke	27,214	10.8

Table 5-4. (continued)

County	Hydric Soil Types	Acres	Soils in County
Wicomico (cont'd)	Portsmouth	2,563	1.0
	Rutlege	2,580	1.0
	St. John's	2,307	0.9
	Swamp	90	0.0
	Tidal Marsh	14,184	5.6
	Beaches	199	0.1
	Subtotal	129,165	51.1
Worcester	Elkton	1,635	0.4
	Fallsington	40,790	10.9
	Leon	2,820	0.8
	Mixed Alluvial Land	6,655	1.8
	Muck	13,905	3.7
	Othello	50,135	13.4
	Plummer	8,980	2.4
	Pocomoke	26,445	7.0
	Portsmouth	7,730	2.0
	Rutlege	5,235	1.4
	St. John's	3,150	0.8
	Tidal marsh	19,270	5.2
	Subtotal	186,750	49.8

Table 5-5. Acreage of "potential" hydric soils in Maryland by county based on recent SCS soil mapping. (*Note:* These figures are much higher than the actual extent of wetlands, since many soils have been effectively drained and soil mapping included nonhydric somewhat poorly drained soils within poorly drained hydric soil map units.)

County	Potential Hydric Acreage	Percent of County
Allegany	7,300	(2.8)
Anne Arundel	38,805	(13.5)
Baltimore	27,350	(6.8)
Calvert	14,270	(9.2)
Caroline	68,958	(33.3)
Carroll	13,164	(4.6)
Cecil	25,450	(10.2)
Charles	66,318	(21.2)
Dorchester	253,629	(59.9)
Frederick	16,980	(4.0)
Garrett	68,870	(16.4)
Harford	18,300	(6.2)
Howard	8,744	(5.4)
Kent	31,208	(16.1)
Montgomery	29,044	(8.9)
Prince Georges	41,647	(13.1)
Queen Annes	86,929	(39.2)
St. Marys	49,578	(18.9)
Somerset	167,456	(69.9)
Talbot	64,325	(30.8)
Washington	5,271	(1.9)
Wicomico	129,165	(51.1)
Worcester	186,750	(49.8)
State Total	1,419,511	

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
	1,644

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

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

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

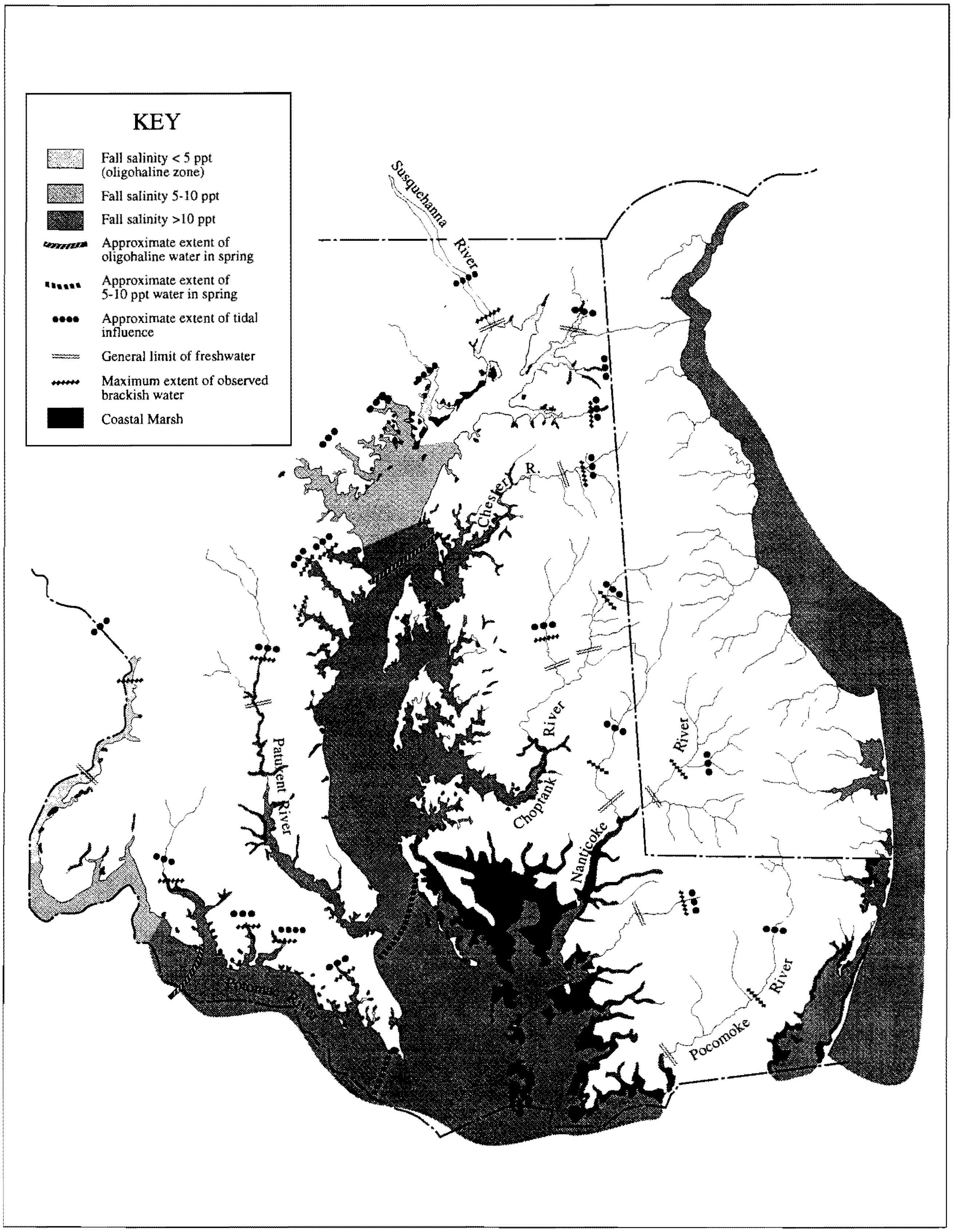

Figure 6-1. General distribution of Maryland's estuarine and tidal fresh marshes and spring and fall salinity zones in Chesapeake Bay and its major tributaries. (Compiled from Tiner 1987, Webb and Heidel 1970, and White 1990)

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 *Micranthemem 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 lilaeopsis (*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.

1

2

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Plate 1. Hydric organic soil from western Maryland. (Ralph Tiner photo)

Plate 2. Hydric mineral soil with thick organic surface layer, found in central Maryland. (Ralph Tiner photo)

Plate 3. Poorly drained hydric mineral soil on the Eastern Shore. Note dominant gray (low chroma) colors and brighter yellowish mottles. (Ralph Tiner photo)

Plate 4. Somewhat poorly drained nonhydric mineral soil on the Eastern Shore. Gray layer is too deep to be considered hydric. (Ralph Tiner photo)

Plate 5. Moderately well-drained nonhydric soil on the Coastal Plain. (John Carey photo)

Plate 6. Well drained nonhydric soil in central Maryland. (Ralph Tiner photo)

Plate 7. Estuarine emergent wetland at Point Lookout (St. Marys County). Note the dead and dying pine caused by salt stress from rising sea level and coastal subsidence. (Drew Koslow photo)

Plate 8. Brackish marsh (estuarine emergent wetland) at Kent Island (Queen Annes County). (Ralph Tiner photo)

Plate 9. Oligohaline (slightly brackish) estuarine marsh along the Nanticoke River (Wicomico County). (Ralph Tiner photo)

Plate 10. Seasonally flooded palustrine forested wetland on the Eastern Shote. (Ralph Tiner photo)

Plate 11. Seasonally flooded mixed deciduous-loblolly pine swamp on the lower Eastern Shore. (Ralph Tiner photo)

Plate 12. Forested pothole wetland near Millington (Kent County). (Ralph Tiner photo)

Plate 13. Wet flatwood on the Eastern Shore (seasonally saturated and/or temporarily flooded palustrine forest). (Ralph Tiner photo)

Plate 14. Seneca Swamp, a bottomland palustrine forested wetland in Montgomery County. (R. Harrison Wiegand photo)

Plate 15. A palustrine deciduous forested wetland in Frederick County (Radenour Swamp). Note skunk cabbage and the yellow flowering marsh marigold in this spring photo. (R. Harrison Wiegand photo)

Plate 16. Wet meadows (palustrine emergent wetlands) are common in central and western Maryland. This one exhibits the natural floral diversity characteristic of many of these wetlands. (Ralph Tiner photo)

Plate 17. Scrub-shrub wetland in western Maryland (Garrett County). (Ralph Tiner photo)

Plate 18. Finzel Swamp, showing an area dominated by highbush blueberry (Garrett County). (David Burke photo)

Plate 19. Bluejoint meadow in the morning, a dominant palustrine emergent wetland type in western Maryland (Garrett County). (Ralph Tiner photo)

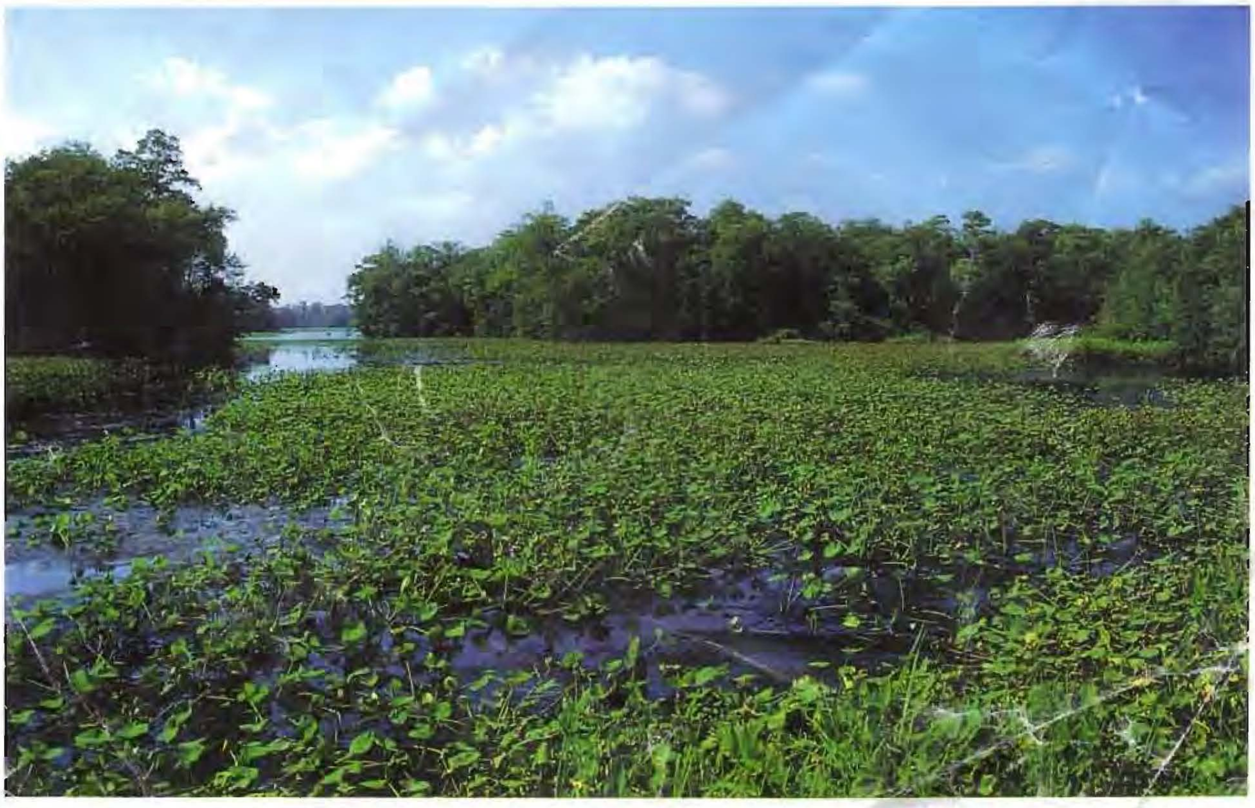

Plate 20. Tidal fresh marsh (riverine tidal emergent wetland) along Nassawango Creek (Worcester County). This marsh is dominated by spatterdock, a nonpersistent emergent hydrophyte. (Ralph Tiner photo)

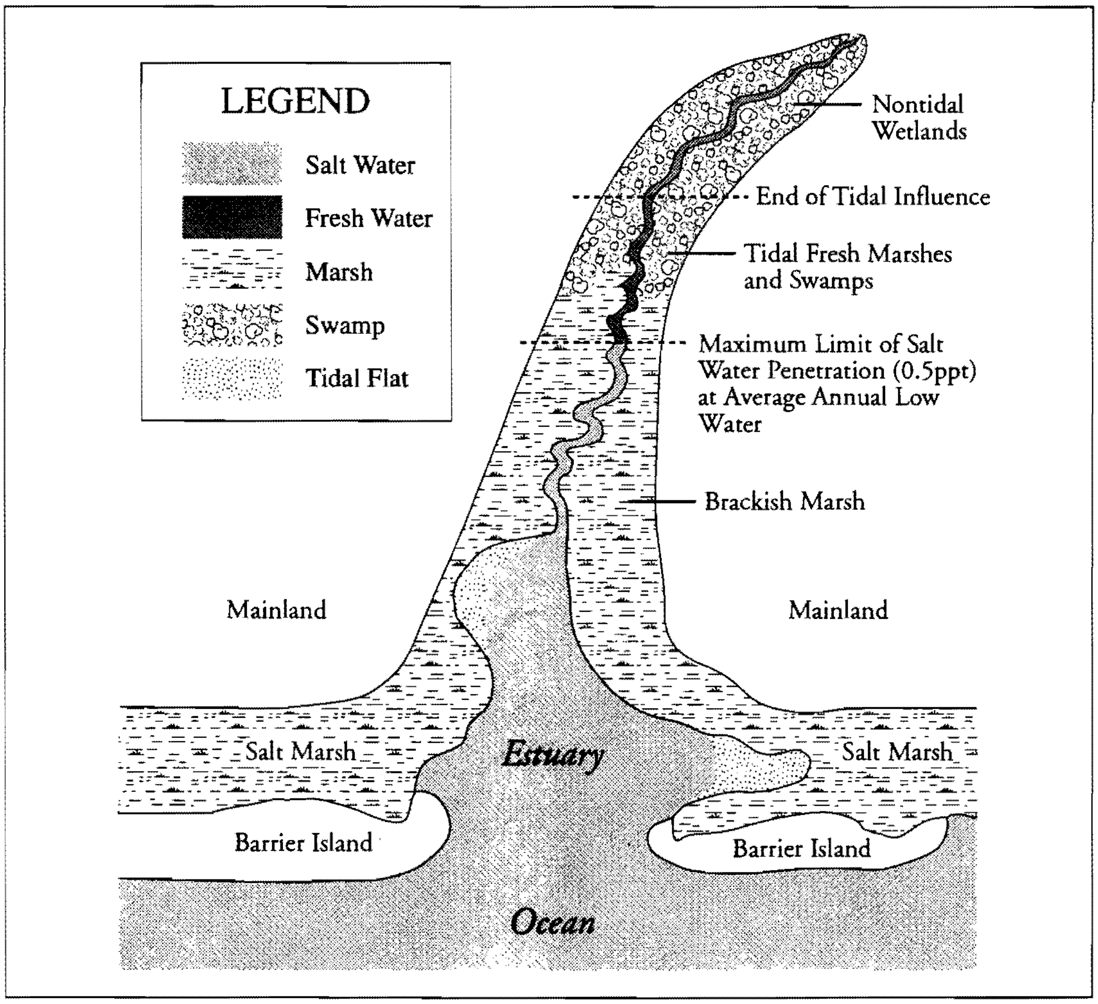

Figure 6-2. General location of different types of tidal wetlands in the estuary. (Redrawn from Tiner 1993)

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 fimbristylis (*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 fimbristylis, 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

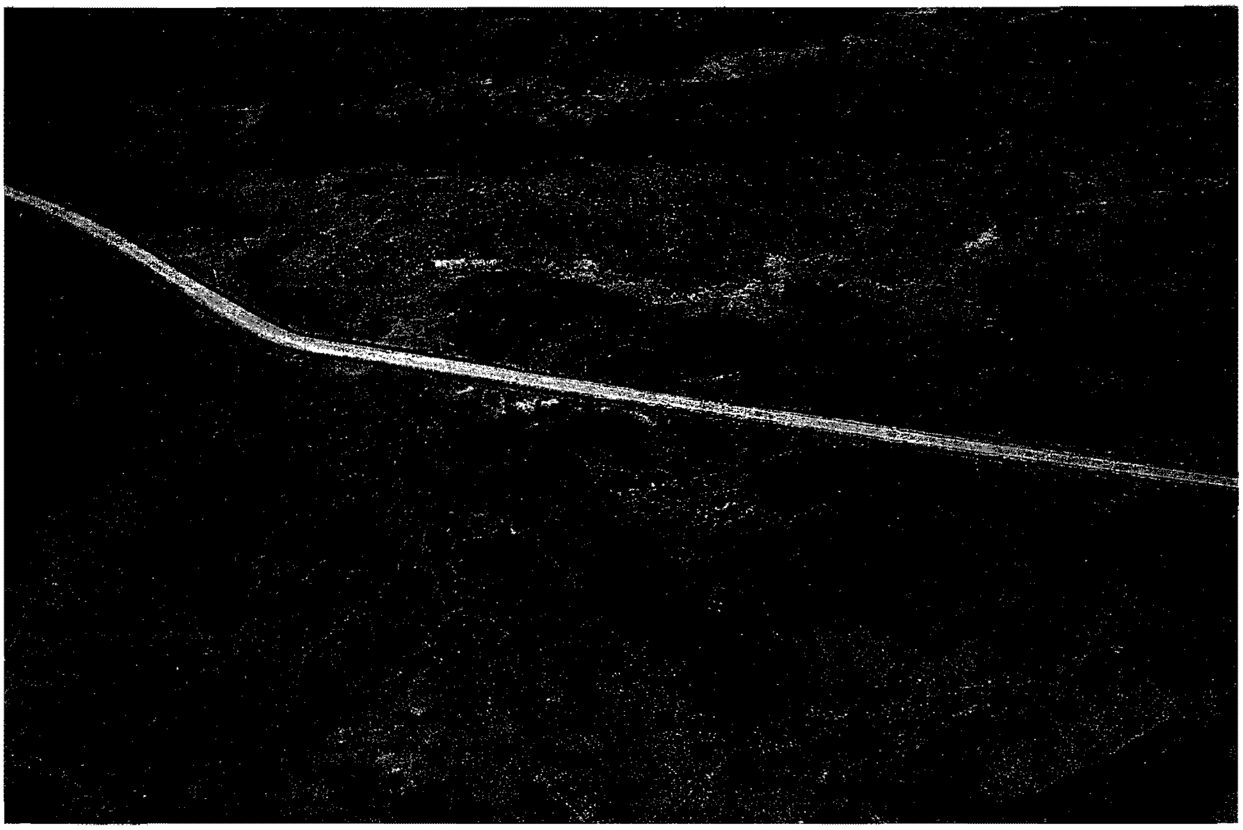

Figure 6-5. Mosaic vegetation pattern of brackish marshes along Chesapeake Bay on the lower Eastern Shore (Somerset County). (Ralph Tiner photo)

(*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 fimbristylis, 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 fimbristylis 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 Chaptico 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. epihydrus, 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

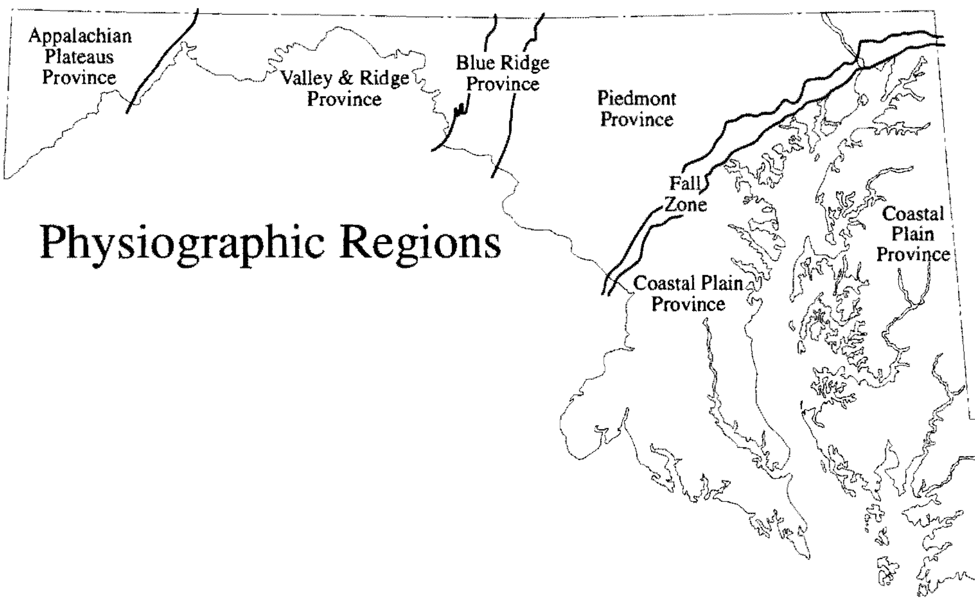

Figure 6-6. Physiographic regions of Maryland.

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 soils[1]. 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

[1]Readers 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 (*Equisetrum 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 hispidus*), 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).

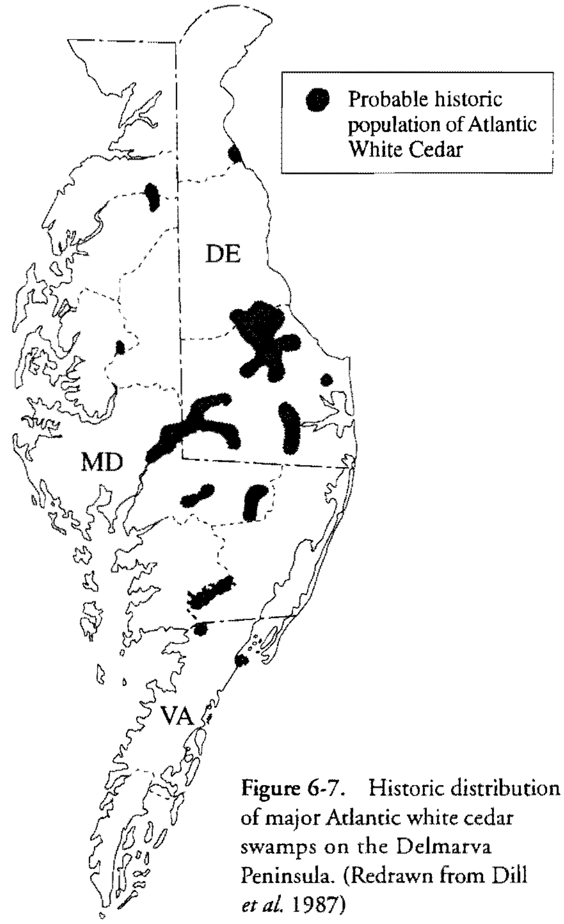

Figure 6-7. Historic distribution of major Atlantic white cedar swamps on the Delmarva Peninsula. (Redrawn from Dill *et al.* 1987)

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 Forests[2]

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

[2]Palustrine 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

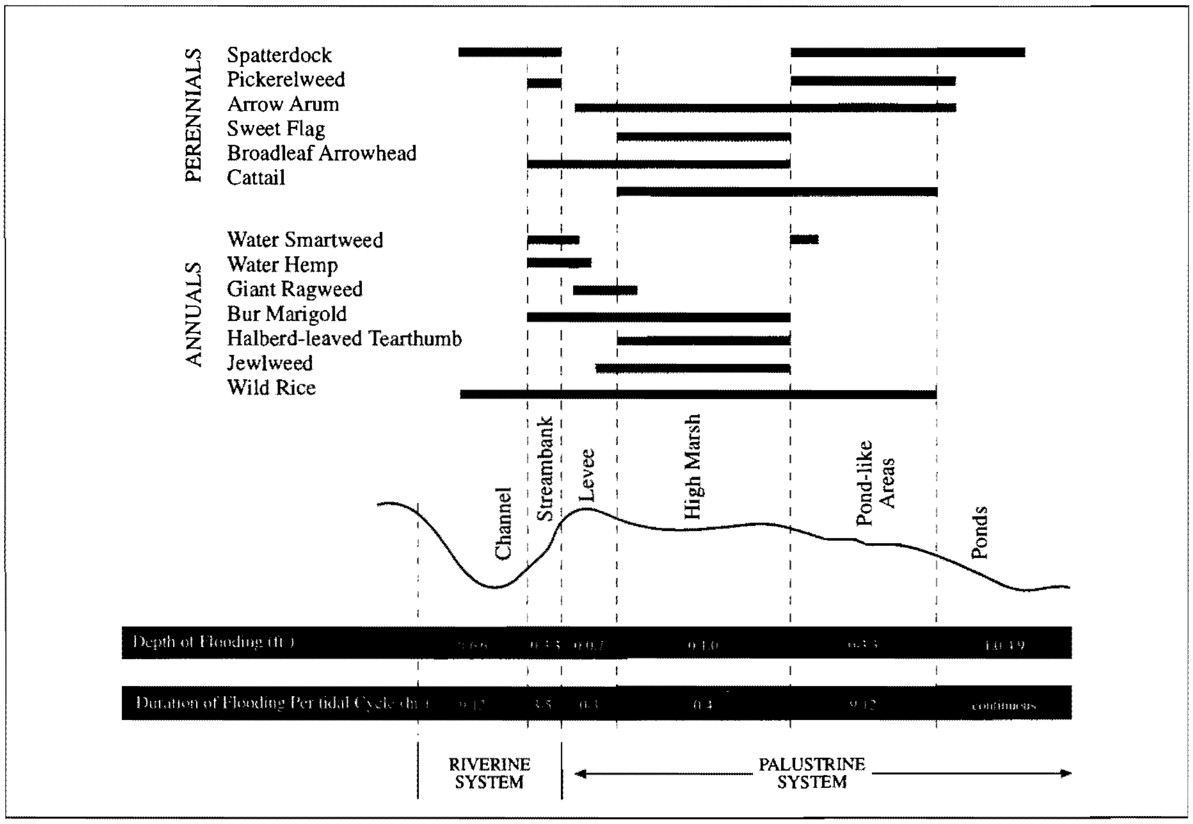

Figure 6-11. Generalized plant zonation in a freshwater tidal marsh in New Jersey, somewhat similar patterns occur in Maryland, although there undoubtedly are differences, e.g. sweet flag may also occur on streambank. (Redrawn from Simpson *et al.* 1983) Note that vegetation occurs in two systems—Riverine 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 panicled 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 elderberry, alder, witch hazel (*Hamamelis virginiana*), winterberry, black haw, nannyberry (*Viburnum lentago*), hawthorn (*Crataegus* spp.), and tartarian honeysuckle (*Lonicera tatarica*). A creeping groundcover of partridgeberry may be locally common.

Herbaceous plants may be abundant in temporarily flooded floodplain forests. They include spring flowering herbs, such as spring beauty (*Claytonia virginica*), trout lily (*Erythronium umbilicatum*, formerly *E. americanum*), and may apple (*Podophyllum peltatum*), plus many other commonly occurring plants including white grass, false nettle, jack-in-the-pulpit, wood nettle (*Laportea canadensis*), field garlic (*Allium vineale*), Indian mock-strawberry (*Duchesnia indica*), riverbank wild-rye, jewelweed, clearweed, stinging nettle, Canada mayflower (*Maianthemum canadense*), white avens (*Geum canadense*), garlic mustard (*Alliaria petiolata*, formerly *A. officinalis*), and Virginia knotweed. Less common herbs, yet characteristic of these wet floodplains, are violets, honewort (*Cryptotaenia canadensis*), lady fern (*Athyrium filix-femina*), enchanter's nightshade (*Circaea lutetiana*), sensitive fern, smartweeds (including *P. persicaria*), ginger (*Asarum* sp.), asters (including *A. simplex*), grape fern (*Botrychium dissectum*), Virginia dayflower (*Commelina virginica*), and false solomon's seal (*Smilacina racemosa*). Wingstem (*Actinomeris alterniflora*) may occur in open areas along streams winding through these wetlands. Christmas fern (*Polystichum acrostichoides*) may occur uncommonly in temporarily flooded floodplain forested wetlands. Japanese honeysuckle and/or poison ivy may cover the ground surface in many of these wetlands, while other vines—Virginia creeper and grapes—are usually less abundant.

Scrub-Shrub Wetlands

A variety of true shrubs and saplings of trees comprise the scrub-shrub wetlands of the Piedmont. Buttonbush usually dominates the semipermanently and the wettest seasonally-flooded shrub swamps. Dominant shrubs or sapling trees in seasonally flooded areas are swamp rose, smooth alder, silky dogwood, chokeberries, southern arrowwood, black willow, red maple, and black gum. Multiflora rose, spicebush, common elderberry, and winterberry are usually less common. Emergent vegetation may be commonly intermixed with the shrubs and even form mixed stands in many valleys. Among the more common emergents are tussock and other sedges, broad-leaved cattail, spatterdock, big arrowhead, rose mallow, swamp aster (*Aster puniceus*), swamp milkweed, climbing hempweed, boneset, jewelweed, tall meadow-rue, hollow-stemmed Joe-Pye-weed (*Eupatoriadelphus fistulosus*), cardinal flower, tearthumbs, smartweeds, and pickerelweed. Virgin's bower (*Clematis virginiana*) may be a common vine in these open mixed wetlands.

Emergent Wetlands

Semipermanently Flooded Marshes

Semipermanently flooded marshes may be colonized by spatterdock, water-willow, bur-reeds, smartweeds, and sometimes by wild rice. Lizard's tail, rose mallow, black willow, and buttonbush also may characterize these wetlands. The former species is a dominant in some marshes along the Potomac River.

Seasonally Flooded Marshes and Meadows

Seasonally flooded emergent marshes and meadows are the most common types of nontidal emergent wetlands in the Piedmont region. Dominant emergent species in seasonally flooded marshes are broad-leaved cattail, soft rush, and rice cutgrass. Arrow arum may be common in these marshes. Halberd-leaved rose mallow (*Hibiscus laevis*, formerly *H. militaris*) may occur in seasonally flooded areas, as observed along the Potomac River. Water parsnip, pinkweed (*Polygonum pensylvanicum*), and beggar-ticks may also occur in these areas.

Seasonally flooded meadows are perhaps the most abundant emergent wetland type in the Piedmont. They are usually found in valleys between the rolling hills. These meadows probably occur in areas of former forested wetlands that were cleared for pastures. In settled areas, meadows predominate the valleys, whereas in undeveloped forested regions, forested wetlands occur in these landscape positions. (Note: These observations are also true for wet meadows in the Appalachian Highlands.) Rice cutgrass, soft rush, wool grass, halberd-leaved tearthumb, arrow-leaved tearthumb, tussock sedge, sweet flag, goldenrods (*Solidago* spp. and *Euthamia* spp.), and reed canary grass are typical dominants, among others. Sweet flag frequently dominates seepage streams and wetlands in many agricultural areas. Wet meadows are often quite diverse in their plant composition, although some are dominated by just one or more of the species listed above (Plate 16). Other common plants in these meadows are sensitive fern, skunk cabbage, marsh fern, green bulrush, smartweeds (including *P. hydropiper*), purple loosestrife, various sedges (including *C. lurida* and *C. vulpinoidea*), bluejoint, St. John's-worts (*Hypericum* spp. and *Triadenum* spp.), Walter millet, three-way sedge, jewelweed, false nettle, willow-herbs (including *E. coloratum*), beggar-ticks, blue vervain (*Verbena hastata*), boneset, and asters (*Aster vimineus*, *A. puniceus*, and others). Small-flowered agrimony (*Agrimonia* *parviflora*), New York ironweed, and hollow-stemmed Joe-Pye-weed, typically occur at higher levels in these meadows. Other characteristic but usually less abundant herbs include square-stemmed monkeyflower (*Mimulus ringens*), meadow-beauty, swamp milkweed, mints (*Mentha* spp.), water-cress (*Nasturtium officinale*), water speedwell (*Veronica anagallis-aquatica*), swamp loosestrife (*Lysimachia terrestris*), yellow fringed loosestrife (*L. ciliata*), seedbox (*Ludwigia alternifolia*), bugleweeds (*Lycopus virginicus* and *L. americanus*), green-headed coneflower, nodding ladies'-tresses (*Spiranthes cernua*), wood-sorrel (*Oxalis* sp.), water purslane (*Ludwigia palustris*), dwarf St. John's-wort (*Hypericum mutilum*), bedstraws (*Galium* spp.), and tall meadow-rue. Dodder (*Cuscuta* sp.), a parasitic vine, may be locally abundant. Climbing hempweed occasionally occurs in these wetlands. Various shrubs and tree saplings may also be intermixed with the herbs, including swamp rose, alder, black willow and other willows, common elderberry, silky and red osier dogwoods, red maple, and American elm.

Temporarily Flooded Wet Meadows

Temporarily flooded wet meadows occur in valleys as do seasonally flooded wet meadows. Many are associated with the latter, occurring at slightly higher elevations. These meadows are often dominated by reed canary grass or soft rush, while deer-tongue, Joe-Pye-weeds, New York ironweed, jewelweed, and goldenrods (including *S. rugosa*) may be common or locally dominant in many areas. Umbrella sedges, pinkweed, purple-headed sneezeweed (*Helenium flexuosum*), fireweed, bugleweeds, asters, and sensitive fern may also occur in these meadows. Clovers (*Trifolium* spp.), daisy fleabane (*Erigeron annus*), Queen Anne's lace (*Daucus carota*), yarrow (*Achillea millefolium*), cocklebur (*Xanthium* sp.), thistle (*Cirsium* sp.), and heal-all (*Prunella vulgaris*) may be found in grazed meadows along with other plants listed above. Multiflora rose is often a common shrub in temporarily flooded wet meadows.

Appalachian Highlands Wetlands

For purposes of this discussion, the Valley and Ridge, Appalachian Plateau, and Blue Ridge physiographic provinces have been combined into the Appalachian Highlands province. This aggregation follows Hammond (1970) and is consistent with Brush and others (1980) who prepared a map of the natural forests of Maryland. Major articles on these wetlands are Mansueti (1958), Fenwick and Brown (1984), Bartgis (1992), and Robinette (1964).

Forested Wetlands

Several tree species may dominate the canopy of forested wetlands in western Maryland. Tables 6-32 and 6-33 present examples of seasonally flooded forested wetlands and temporarily flooded palustrine forests, respectively. Common deciduous trees include red maple, yellow birch (*Betula lutea*), American elm, ashes, sycamore, black cherry, and shagbark hickory. Black cherry may dominate certain streamside temporarily flooded wetlands as observed in Garrett County. Hemlock (*Tsuga canadensis*) is the dominant evergreen species, while red spruce (*Picea rubens*) occasionally occurs. White pine (*Pinus strobus*) may still be present in considerable numbers in seasonally flooded swamps. Spruce and white pine were much more abundant in the past (Shreve 1910c). Red maple and larch (*Larix laricina*) may be present in considerable numbers in hemlock-spruce swamps and may co-dominate. Brush and others (1980) found one swamp—Cranberry Swamp (north of Frostburg)—dominated by larch, with some hemlock present. Common associates in hemlock swamps include rosebay rhododendron (*Rhododendron maximum*), red maple, yellow birch, arrowwood, red chokeberry, highbush blueberry, alders, and serviceberry (*Amelanchier arborea*). Mountain laurel (*Kalmia latifolia*), red spruce, witch hazel, striped maple (*Acer pensylvanicum*), jewelweed, cinnamon fern, wild calla, skunk cabbage, partridgeberry, mountain aster (*Aster acuminatus*), and others may also occur in these wetlands. Black birch (*Betula lenta*) may also be present.

In the deciduous forested wetland communities, ironwood and various herbs—may apple, clearweed, Virginia rye-grass (*Elymus virginicus*), green-headed coneflower, thin-leaved sunflower (*Helianthus decapetalus*), hollow-stemmed Joe-Pye-weed, and wingstem—may commonly occur. Other species present in temporarily flooded floodplain forests include shagbark hickory, swamp white oak, witch hazel, white oak, spicebush, white avens, jewelweed, false nettle, and Christmas fern. Wetter deciduous swamps typically have an understory of skunk cabbage, tussock sedge, royal fern, cinnamon fern, jewelweed, highbush blueberry, and other plants. In many areas, forested wetlands are intermixed with shrub wetlands, with alders, winterberry, common elderberry, and ninebark (*Physocarpus opulifolius*) present. Cardinal flower, great lobelia (*Lobelia siphilitica*), spearmint (*Mentha spicata*), boneset, and other plants occur along streambanks.

Mountain swamps have received only minor attention in comparison to the Eastern Shore swamps and flatwoods. These swamps often occupy headwater positions of various stream systems. Cranesville Pine Swamp is an interesting example of

Figure 6-12. Mixtures of meadowsweet-dominated shrub swamp and bluejoint meadows are common in western Maryland (Garrett County). (Ralph Tiner photo)

one that has received considerable study, perhaps since it represents the southernmost location of larch and many other northern species (Mansueti 1958). This swamp is actually a mosaic of wetland types. Shreve (1910c) reported that at the turn of the century, this type of swamp was dominated by red spruce (incorrectly identified as black spruce, according to Robinette 1964) which composed 60-70 percent of the stands. White pine and hemlock made up about 15-20 percent of the stands. Larch was found in the Cranesville Swamp and another in Thayerville. Deciduous trees, however, are more typical in Garrett County (Fenwick and Boone 1984), with red maple and black gum predominating. Other tree species in these swamps are yellow birch, American mountain-ash (*Sorbus americana*), and black ash (*Fraxinus nigra*). Rosebay rhododendron may form dense thickets along streams in these swamps or where the canopy is more open (Shreve 1910c). Other associated shrubs include black chokeberry, northern wild raisin (*Viburnum cassinoides*), mountain holly (*Nemopanthus mucronata*), winterberry, and spicebush. The herbaceous flora of the spruce swamps may be represented by cinnamon fern, royal fern, spinulose wood fern (*Dryopteris spinulosa*), crested fern (*Dryopteris cristata*), arrow-leaf violet (*Viola sagittata*), purple trillium (*Trillium erectum*), small green woodland orchid (*Platanthera clavellata*), Canada mayflower, jewelweed, turtlehead, false hellebore (*Veratrum viride*), early meadow-rue (*Thalictrum dioicum*), golden saxifrage (*Chrysosplenium americanum*), sweet-scent bedstraw (*Galium triflorum*), purple Joe-Pye-weed (*Eupatoriadelphus purpureus*), square-stemmed monkeyflower, and marsh marigold. Swamp dewberry, a prickly trailing vine, also occurs. In more deciduous swamps, other herbs may be present including greek valerian (*Polemonium reptans*), whorled aster (*Aster acuminatus*), bluebead lily (*Clintonia borealis*), and golden club (Shreve 1910c). The list of species in these mountain swamps bears a strong resemblance to New England swamps.

Streambank communities along high-gradient mountain streams in Garrett County are mostly woody with a few understory herbs. Among the overstory trees are hemlock, ash, red maple, yellow birch, witch hazel, and sugar maple (*Acer saccharum*). Rosebay rhododendron often forms dense, impenetrable thickets along small streams. Other shrubs that may be present are speckled alder (*Alnus rugosa*), ninebark, mountain laurel, and willow. Associated herbs include hollow-stemmed Joe-Pye-weed, rough-stemmed goldenrod (*Solidago rugosa*), jewelweed, sedges, and marsh marigold. In more open areas, marsh fern, turtlehead, and tall meadow-rue may occur (Shreve 1910c).

Scrub-Shrub Wetlands

Two types of shrub swamps occur in western Maryland: wet thickets and shrub bogs (Table 6-25). Several deciduous shrubs predominate the wet thickets: smooth alder, speckled alder, highbush blueberry, northern arrowwood (*Viburnum recognitum*), southern arrowwood, narrow-leaved meadowsweet (*Spiraea alba*), and broad-leaved meadowsweet (*Spiraea latifolia*) (Plates 17 and 18). Of these, alders and meadowsweets are the principal dominants. Common associates of alder thickets include red maple, silky dogwood, black cherry, northern arrowwood, meadowsweets, jewelweed, skunk cabbage, swamp aster (*Aster puniceus*), bluejoint, and rough-stemmed goldenrod (*Solidago rugosa*). Other species present in varying numbers are swamp dewberry (*Rubus hispidus*), turtlehead (*Chelone glabra*), rice cutgrass, arrow-leaved tearthumb, willow-herbs, sensitive fern, cinnamon fern, soft rush, tussock sedge and other sedges, and wool grass. Many shrub wetlands, especially those dominated by narrow-leaved meadowsweet, are interspersed with patches of emergent wetlands dominated largely by bluejoint (Figure 6-12). Other plants present in shrub wetlands include peat mosses, common winterberry, smooth winterberry (*Ilex laevigata*), black chokeberry, red chokeberry (*Aronia arbutifolia*), mountain holly, common elderberry, swamp dewberry, tall meadow-rue, jack-in-the-pulpit, boneset, beggar-ticks, rattlesnake-master (*Glyceria canadensis*), and small white aster (*Aster vimineus*). Big cranberry may also be found here. Black gum, larch, and white pine were common in Finzel Swamp in Garrett County, along with wild calla (*Calla palustris*), cinnamon fern, mountain holly, skunk cabbage, rosebay rhododendron, red chokeberry, winterberry, marsh St. John's-wort, jewelweed, peat mosses, and bugleweeds.

"Shrub Bogs"

Shrub bogs are relatively uncommon. These wetlands are peat-dominated, with an abundance of peat mosses (*Sphagnum* spp.) and haircap moss (*Polystichum juniperinum var. affine*) (Fenwick and Boone 1984). Most of the remaining bogs have mixtures of shrubs and herbs, giving the bogs a more open appearance in contrast to many of the more common wet thickets. Black chokeberry, narrow-leaved meadowsweet, specked alder, mountain holly, swamp azalea, winterberry, and bushy St. John's-wort (*Hypericum densiflorum*) are characteristic shrubs (Shreve 1910c, Fenwick and Boone 1984). Northern arrowwood, red chokeberry, and northern wild raisin may also be present. The herbs include Virginia cotton-grass, round-leaved sundew, small green woodland orchid, marsh St. John's-wort, three-way sedge, marsh fern, royal fern, narrow-leaved gentian (*Gentiana linearis*), wool grass, sedges (*Carex atlantica, C. baileyi*), crested fern, spinulose wood fern, rose pogonia, and marsh marigold (Shreve 1910c). Small cranberry (*Vaccinium oxycoccos*) and swamp dewberry also occur in these wetlands, along with scattered trees, including red spruce, larch, white pine, hemlock, red maple, and black gum (Fenwick and Boone 1984).

Emergent Wetlands

Most of the emergent wetlands in the Appalachian Highlands region of Maryland are seasonally-flooded wet meadows and marshes (Plate 19). Marshes may be represented by broad-leaved cattail, spatterdock, bur-reeds, and rice cutgrass. Soft-stemmed bulrush is less common. Spatterdock may colonize small slow-moving streams through some wet meadows, while cattails may be found in various farm ponds. Wet meadows may be dominated by one or more of the following plant species: rice cutgrass, bluejoint, reed canary grass, tussock and other sedges, wool grass, soft rush, New York ironweed, swamp aster, bentgrass (*Agrostis* sp.), smartweeds, sweet flag, and jewelweed. Meadows are particularly widespread and various shrubs, including meadowsweets and bushy St. John's-wort, may be quite abundant and even co-dominant in these meadows. Other meadows often have a more diverse plant community. Sweet flag may form nearly monospecific stands, especially in grazed areas. Some meadows may be dominated by sedges, which may be co-dominant with bluejoint. Other common emergents in western Maryland include swamp milkweed, blue vervain, small white aster, Joe-Pye-weeds, boneset, tall meadow-rue, arrow-leaved tearthumb, willow-herbs, green bulrush, spike-rushes, fringed sedge (*Carex crinita*), long sedge (*Carex lonchocarpa*), bladder sedge (*Carex intumescens*), other sedges, bugleweeds, rough bedstraw (*Galium tinctorium*), rough-stemmed goldenrod, grass-leaved goldenrod (*Euthamia graminifolia*), beggar-ticks (including *Bidens tripartita* and *B. frondosa*), cinnamon fern, and sensitive fern. Other associated plants include turk's-cap lily (*Lilium canadense var. michiganense*, formerly *L. superbum*), water pepper (*Polygonum hydropiper*), St. John's-worts, goldenrods, wild mint (*Mentha arvensis*), spearmint (*Mentha spicata*), manna grasses, square-stemmed monkeyflower, soft-stemmed bulrush, turtlehead, alders, swamp rose, and common elderberry.

Bartgis (1992) described the vegetation of sinkhole wetlands in the Ridge and Valley Province based on studies in Maryland and West Virginia. He found 56 species in these sinkhole ponds (Table 6-34). Common species included three-way sedge, manna grasses, lurid sedge (*Carex lurida*), false

Figure 6-13. Riverine tidal marsh appears as a regularly flooded tidal flat at low tide in the winter. In spring and summer, these flats support extensive stands of spatterdock. See Plate 20 for summer aspect. (Ralph Tiner photo)

nettle, dotted smartweed, devil's beggar-ticks, bugleweed (*Lycopus americanus*), buttonbush, and winterberry.

"Emergent Bog"

Several "bogs" in western Maryland have an abundance of emergent vegetation. While peat moss and haricap moss (*Polytrichum* sp.) form the dominant groundcover, herbaceous vegetation visually dominates these areas. Common species include soft rush, spike-rushes, goldenrods, Virginia cottongrass, sedges (including *C. canescens, C. interior,* and *C. trisperma*), white beak-rush, and round-leaved sundew. Trailing woody vines—cranberries and swamp dewberry—may be abundant in places. Less common plants include other sedges (*C. intumescens, C. lonchocarpa, C. crinita, C. rostrata*), marsh St. John's-wort, narrow-leaved gentian, bog or Massachusetts fern (*Thelypteris simulata*), hidden-fruit bladderwort (*Utricularia geminiscapa*), Canada rush, and tearthumb (Fenwick and Boone 1984; personal observations). Many rare and uncommon species occur in these wetlands (Table 6-35). Scattered shrubs may also be present in these bogs, including speckled alder, northern arrowwood, bushy St. John's-wort, and highbush blueberry.

Palustrine Aquatic Beds (All Regions)

Small ponds, many of which were artificially-created, are common throughout the state. These permanently or semipermanently flooded waterbodies comprise the wettest of Maryland's palustrine wetlands. Many shallow ponds have aquatic beds covering all or part of their surfaces or bottom. Common dominance types include green algae, floating species such as duckweeds (*Lemna* spp., *Spirodela polyrhiza,* and others) and bladderworts (*Utricularia* spp.), and rooted vascular plants, such as spatterdock, white water lily, water shield, and pondweeds.

Riverine Wetlands

The Riverine System encompasses all of Maryland's fresh water rivers and their tributaries, including the freshwater tidal reaches of coastal rivers such as the Nanticoke and Chester Rivers where salinity is less than 0.5 ppt. This system is composed largely of deepwater habitats and nonvegetated wetlands, with the riverine wetlands occurring between the riverbank and deep water (6.6 feet and deeper). Although many of the state's freshwater vegetated wetlands lie along rivers and streams, only a small fraction of these are considered riverine wetlands according to the Service's classification system (Cowardin *et al.* 1979). Riverine wetlands are, by definition, largely restricted to shallow bottoms and aquatic beds within the channels and to fringing nonpersistent emergent plants growing on river banks or in shallow water. Contiguous wetlands dominated by persistent vegetation (i.e., trees, shrubs, and robust emergents) are classified as palustrine wetlands.

Riverine nontidal wetlands are most visible along slow-flowing, meandering lower perennial rivers and streams. Here nonpersistent emergent plants, such as bur-reeds, spatterdock, pickerelweed, arrowheads (*Sagittaria* spp.), arrow arum, wild rice, rice cutgrass, nodding beggar-ticks (*Bidens cernua*), and smartweeds, colonize very shallow waters and exposed shores. Spatterdock is especially abundant in tidal fresh waters where it forms extensive colonies (Plate 20). Such nonpersistent emergent wetlands are common along the Choptank, Nanticoke, and Patuxent Rivers (Bill Sipple, pers. comm.). In winter, these marshes appear as broad tidal mudflats (Figure 6-13). Water-willow (*Justicia americana*) is dominant in the shallows of the Potomac River (Figure 6-14) and some of its tributaries in the Piedmont and Appalachian Highlands. Aquatic beds may also become established in slightly deeper waters of clear rivers and streams. Important aquatic bed plants include submerged forms of bur-reeds and arrowheads, pondweeds and riverweeds (*Potamogeton* spp.), spatterdock, water starwort (*Callitriche heterophylla*), wild celery, and white water lily.

Lacustrine Wetlands

The Lacustrine System is principally a deepwater habitat system of freshwater lakes, reservoirs and deep ponds. Consequently, wetlands are generally limited to shallow waters and exposed shorelines, as in the Riverine System. While algae are probably more abundant in these waters, vascular macrophytes are often more conspicuous. A variety of life forms can be recognized: (1) free-floating plants, (2) rooted vascular floating-leaved plants, (3) submergent plants, and (4) nonpersistent emergent plants. The first three life forms characterize aquatic beds, whereas the latter dominates lacustrine emergent wetlands.

Lacustrine Aquatic Beds

Floating-leaved and free-floating aquatic beds are common in shallow lacustrine waters. Common floating-leaved plants include white water lily, spatterdock, water shield, and pondweeds. Duckweeds form free-floating aquatic beds, while bladderworts are also free-floating, but are typically submerged except when flowering. Submergent aquatic beds may include pondweeds, bushy pondweeds (*Najas* spp.), water-milfoils (*Myriophyllum* spp.), mermaidweeds (*Proserpinaca* spp.), coontail (*Ceratophyllum demersum*), and fanwort (*Cabomba caroliniana*).

Lacustrine Emergent Wetlands

Emergent wetlands commonly border the margins of lakes, reservoirs, and deep ponds. Common nonpersistent emergent plants may include common three-square, yellow-eyed grass (*Xyris* sp.), pipeworts (*Eriocaulon* spp.), arrow arum, pickerelweed, bur-reeds, arrowheads, water parsnip, three-way sedge, smartweeds, and spike-rushes. Some of these plants are usually persistent, but along lake shores they may be subject to ice-scouring and therefore, may be considered nonpersistent. In many areas, persistent plants like cattails, rose mallows, reed canary grass, bluejoint, water-willow (swamp loosestrife), buttonbush, swamp rose, black willow, and others may form part of the lacustrine boundary. These persistent plants, however, represent palustrine wetlands along the lake shore.

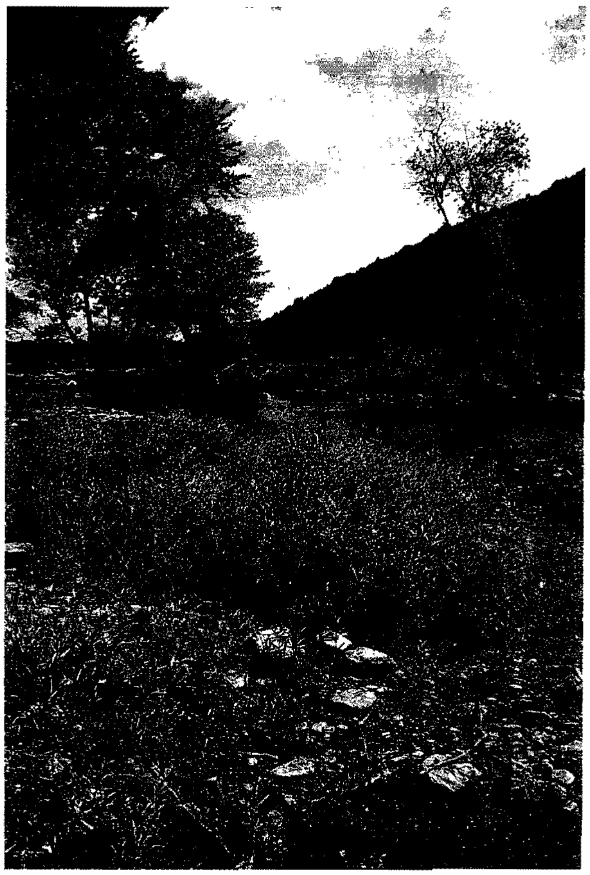

Figure 6-14. Water-willow patches are common along the shores and in shallow water of the Potomac River. (Ralph Tiner photo)

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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

Grass or Grasslike Plants:

Fragrant Galingale (*Cyperus odoratus*)
Creeping Spike-rush (*Eleocharis palustris*)
Dwarf Spike-rush (*Eleocharis parvula*)
Beaked Spike-rush (*Eleocharis rostellata*)
Canada Rush (*Juncus canadensis*)
Switchgrass (*Panicum virgatum*)
Common Reed (*Phragmites australis*)
Foxtail Grass (*Setaria geniculata*)
Giant Foxtail (*S. magna*)
Olney Three-square (*Scirpus americanus*)
Common Three-square (*S. pungens*)
Salt Marsh Bulrush (*Scirpus robustus*)
New England Bulrush (*S. cylindricus*)
Big Cordgrass (*Spartina cynosuroides*)
Salt Hay Grass (*S. patens*)
Smooth Cordgrass (*S. alterniflora*)

Herbs:

Water Hemp (*Amaranthus cannabinus*)
Small-flowered Salt Marsh Aster (*Aster subulatus*)
Grass-leaved Goldenrod (*Euthamia graminifolia*)
Purple Gerardia (*Gerardia purpurea*)
Rose Mallow (*Hibiscus moscheutos*)
Seashore Mallow (*Kosteletzkya virginica*)
Eastern Lilaeopsis (*Lilaeopsis chinensis*)
Salt Marsh Fleabane (*Pluchea purpurascens*)
Curly Dock (*Rumex crispus*)
Large Marsh Pink (*Sabatia dodecandra*)
Salt Marsh Pink (*Sabatia stellaris*)
American Germander (*Teucrium canadense*)
Narrow-leaved Cattail (*Typha angustifolia*)
Water Pimpernel (*Samolus parviflorus*)

Shrubs:

Groundsel-bush (*Baccharis halimifolia*)
High-tide Bush (*Iva frutescens*)
Wax Myrtle (*Myrica cerifera*)
Poison Ivy (*Toxicodendron radicans*)

Vines:

Climbing Hempweed (*Mikania scandens*)

Fresh Water Species

Aquatic Bed Plants:

Spatterdock (*Nuphar luteum*)
White Water Lily (*Nymphaea odorata*)

Grass and Grasslike Plants:

Sedges (*Carex* spp.)
Wood Reed (*Cinna arundinacea*)
Twig-rush (*Cladium mariscoides*)
Umbrella Sedges (*Cyperus* spp.)
Three-way Sedge (*Dulichium arundinaceum*)
Walter Millet (*Echinochloa walteri*)
Soft Rush (*Juncus effusus*)
Fall Panic Grass (*Panicum dichotomiflorum*)
Panic Grasses (*Panicum* spp.)
Reed Canary Grass (*Phalaris arundinacea*)
Brownish Beak-rush (*Rhynchospora capitellata*)
Wool Grass (*Scirpus cyperinus*)
River Bulrush (*S. fluviatilis*)
Soft-stemmed Bulrush (*S. validus*)
Wild Rice (*Zizania aquatica*)

Herbs:

Sweet Flag (*Acorus calamus*)
Swamp Milkweed (*Asclepias incarnata*)
Swamp Aster (*Aster puniceus*)
Bur-marigold (*Bidens laevis*)
Beggar-ticks (*Bidens* spp.)
Partridge Pea (*Cassia fasciculata*)
Water Hemlock (*Cicuta maculata*)
Water-willow (*Decodon verticillatus*)
Rattlesnake Master (*Eryngium aquaticum*)
Maryland Meadow-beauty (*Rhexia mariana*)
Boneset (*Eupatorium perfoliatum*)
Bedstraws (*Galium* spp.)
Hedge-hyssops (*Gratiola* spp.)
Sneezeweed (*Helenium autumnale*)
Swamp Dock (*Rumex verticillatus*)
Water Pennywort (*Hydrocotyle ranunculoides*)
Marsh Pennywort (*H. umbellata*)
St. John's-wort (*Hypericum* spp.)
Jewelweed (*Impatiens capensis*)
Yellow Flag (*Iris pseudacorus*)
Blue Flag (*I. versicolor*)
Seedbox (*Ludwigia alternifolia*)
Water Horehound (*Lycopus americanus*)
Bugleweed (*L. virginicus*)
Purple Loosestrife (*Lythrum salicaria*)
Golden Club (*Orontium aquaticum*)
Royal Fern (*Osmunda regalis*)
Arrow Arum (*Peltandra virginica*)
Clearweed (*Pilea pumila*)
Halberd-leaved Tearthumb (*Polygonum arifolium*)
Cespitose Knotweed (*P. caespitosum*)
Mild Water-pepper (*P. hydropiper*)
Water-pepper (*P. hydropiperoides*)
Pinkweed (*P. pennsylvanicum*)
Lady's Thumb (*P. persicaria*)

Table 6-7. (continued)

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

Table 6-8. Examples of estuarine scrub-shrub and forested wetland communities obsetved 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, Gtoundsel-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 (*Ulva lactuca*)	x	x	x		
Green Algae (*Enteromorpha* sp.)	x	x	x		
Eelgrass (*Zostera marina*)	x	x	x		
Widgeongrass (*Ruppia maritima*)	x	x			
Horned Pondweed (*Zannichellia palustris*)		x	x	x	x
Sago Pondweed (*Potamogeton pectinatus*)		x	x	x	x
Redhead-grass (*P. perfoliatus*)		x	x	x	x
Eurasian Water-milfoil (*Myriophyllum spicatum*)		x	x	x	x
Common Waterweed (*Elodea densa*)			x	x	x
Muskgrasses (*Chara* spp.)			x	x	x
Curly Pondweed (*P. crispus*)			x	x	x
Wild Celery (*Vallisneria americana*)				x	x
Southern Naiad (*Najas guadalupensis*)				x	x
Small Pondweed (*P. pusillus*)				x	x
Coontail (*Ceratophyllus demersum*)				x	x
Slender Naiad (*N. flexilis*)			x		x
Water Chestnut (*Trapa natans*)				x	x
Hydrilla (*Hydrilla verticillata*)				x	x
White Water Lily (*Nymphaea odorata*)				x	x
Nuttall's Waterweed (*Elodea nuttallii*)					x
Other Pondweeds: (*P. amplifolius, P. epihydrus, P. foliosus, P. gramineus, P. nodosus, P. robbinsii*)					x
Cutleaf Water-milfoil (*M. tenellum*)					x
Threadlike Naiad (*N. gracillima*)					x
Water Star-grass (*Zosterella dubia*)					x

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

Wetland Type	Common Associates
Clay Upland Swamps	Trees: Sweet Gum, White Oak, Black Gum, Willow Oak, Red Maple, Swamp White Oak, Loblolly Pine; also less commonly, American Holly, Basket Oak Shrubs: Sweet Pepperbush, Maleberry, Highbush Blueberry, Swamp Azalea, Fetterbush, Southern Arrowwood, Virginia Sweet-spires, Black Haw, Sweet Bay, Common Winterberry, Flowering Dogwood, Smooth Alder Herbs: Sedges (*Carex caroliniana, C. comosa, C. lupulina, C. hirta*), and Pale Manna Grass (*Glyceria pallida*) Others: Peat Moss
Sandy-Loam Upland Swamps	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 Shrubs: Wax Myrtle, Southern Arrowwood, Poison Sumac, Staggerbush, Virginia Sweet-spires, Devil's Walking Stick, Red Chokeberry, American Strawberrybush Herbs: Not specified Others: Peat Moss
Wetter Floodplain Forests	Trees: Red Maple, Black Gum, White Ash, Sweet Bay Shrubs: Common Winterberry, Sweet Pepperbush, Smooth Alder, Southern Arrowwood, Buttonbush, Poison Sumac 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
Sandy Floodplains	Trees: Loblolly Pine, Water Oak, American Holly, Black Gum, Sweet Bay, White Ash, Fringe-tree, Flowering Dogwood, Ironwood Shrubs: Sweet Pepperbush, Southern Arrowwood, Pink Azalea, American Strawberrybush Herbs: Partridgeberry, Bladder Sedge, Long Sedge, Sedge (*Carex laxiculmis*) Vines: Common Greenbrier, Virginia Creeper, Fox Grape, Trumpet Creeper, Wild Yam
Drier Floodplain Forests	Trees: Tulip Poplar, Ironwood, Sweet Gum, White Ash, Sycamore, American Elm, Willow Oak, Red Maple, Black Gum Shrubs: Spicebush, Southern Arrowwood, American Strawberrybush Herbs: Virginia Grape Fern, White Grass, Smooth Solomon's-seal, Jack-in-the-pulpit, Sweet White Violet, Swamp Aster, Wood Sorrel
Upland Swamps of Wicomico Terrace	Trees: Black Gum, Swamp White Oak, Red Maple, Sweet Gum, Willow Oak, White Oak; also American Holly, Beech, Sweet Bay, Swamp Cottonwood Shrubs: Virginia Sweet-spires, Red Chokeberry, Swamp Azalea Herbs: Water Smartweed, Inflated Bladderwort, Mermaid-weed
River Swamps	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) Shrubs: Wax Myrtle, Sweet Pepperbush, Maleberry, Smooth Alder, Buttonbush, Silky Dogwood, Southern Arrowwood, Staggerbush, Water-willow (Swamp Loosestrife), Dangleberry Vines: Trumpet Creeper, Grapes, Common Greenbrier, Virginia Creeper, Poison Ivy, Cross Vine 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
Stream Swamps	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 Shrubs: Common Winterberry, Sweet Pepperbush, Buttonbush, Smooth Alder, Water-willow (Swamp Loosestrife), Silky Dogwood, Virginia Sweet-spires, Poison Sumac, Southern Arrowwood, Swamp Rose 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

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 6-12. Examples of tidal swamp communities on Maryland's Western 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
Bald Cypress (Battle Creek, Calvert County)	Lizard's Tail, Red Maple, Southern Arrowwood	False Nettle, Smooth Alder, Virginia Creeper, Wood Reed, Turtlehead, Green Ash, Sedge, Clearweed, Bugleweed
Bald Cypress-Red Maple-Green Ash-Sycamore (Battle Creek, Calvert County)	Smooth Alder, Winterberry, Poison Ivy, Common Greenbrier, Sensitive Fern, Southern Arrowwood, Jewelweed, Water-willow (in channel)	Lizard's Tail, Fringed Sedge, Pawpaw, Silky Cardinal Flower, Dogwood, Japanese Honeysuckle, Turtlehead, Arrow-leaved Tearthumb, Swamp Rose, Grape, Jack-in-the-pulpit, Blackberry
Red Maple (Buzzard Land Creek, Calvert County)	Black Gum, Common Greenbrier, Winterberry, Wood Reed, Lizard's Tail (creekside)	Bald Cypress (creekside), Silky Dogwood, American Elm, Buttonbush, Fetterbush, Sedges, Sycamore, Southern Wild Raisin, Jack-in-the-pulpit, Jewelweed, Poison Ivy, Bugleweed, False Nettle, Southern Arrowwood, Virginia Creeper, Sweet Gum, Aster, Grape, Rough-stemmed Goldenrod, Manna Grass, Pawpaw (high spots), Japanese Honeysuckle
Red Maple-Green Ash (Patuxent River, Anne Arundel County)	Wood Reed, Winterberry, Highbush Blueberry	Black Gum, Sweet Bay, Ner-veined Chain Fern, Poison Ivy, Jewelweed, Grape, Greenbrier, Goldenrods, Sedge, Tall Meadow-rue, Spicebush, White Grass, Sweet Gum, Southern Arrowwood, and others
*Red Maple-Sycamore (Leonard Creek, Calvert County)	Green Ash, Pawpaw, Virginia Creeper, Poison Ivy, Jewelweed, Spicebush, Sensitive Fern, Common Greenbrier, Marsh Fern, False Nettle, Japanese Honeysuckle, Lurid Sedge, Seedbox, Arrow Arum, Arrow-leaved Tearthumb, Lizard's Tail, Swamp Rose, Dotted Smartweed, Soft Rush	Black Cherry, Dodder, Black Willow, Tulip Poplar, Deer-tongue
*Sweet Gum-Black Gum (St. Marys County)	Spicebush, Smooth Alder, False Nettle, Jewelweed, Poison Ivy, Grape, Common Greenbrier, Virginia Chain Fern, Sensitive Fern, Lizard's Tail, Blackberry, Dodder	Black Willow, Goldenrod, Common Elderberry

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: Sweer 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 6-15. Examples of seasonally flooded palustrine (nontidal) forested wetland communities observed in Calvert, Charles, and St. Marys Counties. These communities are typical of the Upper or Inner Coastal Plain or the Gulf-Atlantic Rolling Plain (Irregular Plains) of Hammond (1970).

Dominance Type (Location)	Associates	
Bald Cypress-Red Maple (Battle Creek, Calvert County)	Trees:	American Elm, Sycamore, Green Ash
	Shrubs:	Winterberry, Southern Arrowwood, Pawpaw, Swamp Rose, Silky Dogwood, Virginia Sweet-spires
	Herbs:	Lizard's Tail, Jewelweed, Sensitive Fern, False Nettle, Jack-in-the-pulpit, Stinging Nettle, Tall Meadow-rue, Water-willow, Fringed Sedge, Arrow-leaved Tearthumb, Turtlehead, Cardinal Flower, Clearweed
	Others:	Japanese Honeysuckle, Grape, Virginia Creeper, Poison Ivy, Blackberry, Common Greenbrier
Basket Oak-Overcup Oak-Red Maple (Zekiah Swamp, Charles County)	Trees:	Ironwood, Black Gum, Sycamore, American Holly, Sweet Gum, Green Ash
	Shrubs:	Southern Arrowwood
	Herbs:	Sedge, Three-way Sedge (wet depressions), False Nettle, Unidentified Grass
	Others:	Poison Ivy, Trumpet Creeper, Common Greenbrier, Japanese Honeysuckle
Basket Oak-Pin Oak-Red Maple (Zekiah Swamp, Charles County)	Trees:	Sweet Gum, Green Ash, Black Gum, Ironwood, American Holly, Pawpaw
	Shrubs:	Southern Arrowwood, Highbush Blueberry
	Herbs:	Arrow Arum, Lizard's Tail, Clearweed, Sedges, Cardinal Flower, Sensitive Fern, Soft Rush, Bladder Sedge, Fringed Sedge, Wool Grass
	Others:	Grape, Virginia Creeper, Poison Ivy, Common Greenbrier, Blackberry
Green Ash (Pinn Point Creek, Calvert County)	Trees:	Red Maple, Black Gum, American Elm
	Shrubs:	Spicebush, Elderberry, Silky Dogwood
	Herbs:	Wood Reed, Jewelweed, Hop Sedge, Lizard's Tail (creek), Goldenrod, Aster, False Nettle, Manna Grass
	Others:	Japanese Honeysuckle, Poison Ivy, Grape, Virginia Creeper, Common Greenbrier
Green Ash-Red Maple (Calvert County)	Trees:	White Oak, Sweet Gum, Pawpaw
	Shrubs:	Spicebush, Smooth Alder, Southern Arrowwood, Silky Dogwood, Buttonbush
	Herbs:	Virginia Knotweed, Dotted Smartweed, Lizard's Tail, Jewelweed, Arrow Arum, Sedge, Cardinal Flower, Big-leaved Arrowhead, Arrow-leaved Tearthumb, Seedbox, Bladder Sedge, Clearweed, Sensitive Fern, Fringed Sedge, Goldenrod, Panic Grass, Bur-reed
	Others:	Common Greenbrier, Grape, Dodder (*Note:* This wetland is beaver-influenced.)
Red Maple-Ironwood-Black Gum (Zekiah Swamp, Charles County)	Trees:	Pin Oak, Basket Oak, American Elm, Sweet Gum, American Holly, River Birch, Pawpaw
	Shrubs:	Spicebush, Southern Arrowwood
	Herbs:	Clearweed, Lizard's Tail, Arrow Arum, False Nettle, Violet, Cardinal Flower, Smartweed
	Others:	Common Greenbrier, Virginia Creeper, Blackberry, Grape, Poison Ivy
Red Maple-River Birch (St. Marys County)	Trees:	Sweet Gum, Green Ash, Sycamore
	Shrubs:	Spicebush, Southern Arrowwood
	Herbs:	Jewelweed, Sedge, Bedstraw
	Others:	Japanese Honeysuckle, Brambles, Poison Ivy, Grape
Red Maple-River Birch (St. Marys County)	Trees:	Ironwood, Sweet Gum (high spots), Tulip Poplar (high spots), Loblolly Pine (high spots), Beech, Sycamore, Swamp White Oak, Sweet Bay
	Shrubs:	Spicebush, Highbush Blueberry
	Herbs:	Sedge, White Grass, Lizard's Tail (creekside), Wood Fern, Net-veined Chain Fern, Wood Reed
	Others:	Common Greenbrier, Japanese Honeysuckle
Red Maple-Sweet Gum-Black Willow (Tobacco Creek, Charles County)	Trees:	Ironwood, American Holly, American Elm, Willow Oak
	Shrubs:	Common Winterberry, Southern Arrowwood
	Herbs:	False Nettle, Crested Fern, Sedge, Goldenrod
	Others:	Poison Ivy, Grape, Virginia Creeper, Peat Moss, Common Greenbrier, Japanese Honeysuckle
River Birch-Swamp Cottonwood-Black Gum-Green Ash (Zekiah Swamp, Charles County)	Trees:	Swamp White Oak, Overcup Oak
	Shrubs:	Smooth Alder, Common Winterberry
	Herbs:	Lizard's Tail, Unidentified Grass, Sedge, Fringed Sedge, Cardinal Flower, Skullcap, Three-way Sedge, Arrow Arum, False Nettle, Blue Flag, Unidentified Grass
Sycamore-American Elm-Red Maple-River Birch (Calvert County)	Shrubs:	Southern Arrowwood, Spicebush
	Herbs:	Jewelweed, Lizard's Tail, Clearweed, Cardinal Flower, Jack-in-the-pulpit, Wood Nettle, Violet
	Others:	Poison Ivy, Grape, Virginia Creeper, Japanese Honeysuckle

Table 6-16. Examples of seasonally flooded palustrine (nontidal) forested wetland communities observed in Prince Georges and Anne Arundel Counties. These communities are typical of the Upper or Inner Coastal Plain or the Gulf-Atlantic Rolling Plain (Irregular Plains) of Hammond (1970).

Dominance Type (Location)	Associates	
Pin Oak-Green Ash-Red Maple (Prince Georges County)	Trees:	River Birch, Black Willow
	Shrubs:	Silky Dogwood
	Herbs:	Lizard's Tail, Manna Grass, Water Hemlock, Jewelweed
	Others:	Common Greenbrier
Red Maple (Anne Arundel County)	Shrubs:	Southern Arrowwood, Swamp Azalea, Sweet Pepperbush, Elderberry
	Herbs:	Tussock Sedge, Jewelweed, False Nettle
	Others:	Common Greenbrier, Poison Ivy
Red Maple (Cypress Creek Natural Area, Anne Arundel County)	Trees:	Pitch Pine, Sweet Bay, Black Gum, American Holly
	Shrubs:	Sweet Pepperbush, Highbush Blueberry, Swamp Azalea
	Herbs:	Royal Fern, Cinnamon Fern, Water-willow
	Others:	Common Greenbrier
Red Maple-Sweet Gum-Green Ash (Patuxent River, Anne Arundel County)	Trees:	Swamp White Oak, Tulip Poplar, Black Gum, River Birch,
	Shrubs:	Elderberry, Southern Arrowwood
	Herbs:	Jewelweed, Tearthumbs, Jack-in-the-pulpit, Pinkweed, Climbing Hempweed
	Others:	Common Greenbrier
Red Maple-Sweet Gum-River Birch-Pin Oak (Mattawoman Creek, Prince Georges County)	Trees:	Willow Oak, Ironwood, American Holly
	Shrubs:	Southern Arrowwood, Common Winterberry, Highbush Blueberry, Sweet Pepperbush, Fetterbush, Smooth Alder
	Herbs:	Sedge, Deer-tongue, Cardinal Flower, Unidentified Grass, Fireweed, Lizard's Tail (in channels)
	Others:	Common Greenbrier
Sweet Gum (Anne Arundel County)	Trees:	Box Elder
	Shrubs:	Common Elderberry
	Herbs:	Clearweed, Wood Nettle, White Avens, Bugleweed, Jack-in-the-pulpit, Sedge, Marsh Marigold
	Others:	Japanese Honeysuckle

Table 6-17. Examples of seasonally flooded palustrine (nontidal) forested wetland communities observed in Baltimore, Cecil, and Harford Counties. These communities are typical of the Upper or Inner Coastal Plain or the Gulf-Atlantic Rolling Plain (Irregular Plains) of Hammond (1970).

Dominance Type (Location)	Associates
Green Ash (Baltimore County)	Trees: Red Maple, Pin Oak, Box Elder Shrubs: Southern Arrowwood, Spicebush Herbs: White Grass, Clearweed, Skunk Cabbage Others: Poison Ivy
Green Ash-Red Maple (Gunpowder Falls, Baltimore County)	Trees: Box Elder Shrubs: Spicebush, Silky Dogwood Herbs: Skunk Cabbage, Wood Reed
Green Ash-Red Maple (White Marsh Run, Baltimore County)	Trees: Black Gum Shrubs: Southern Arrowwood, Smooth Alder Herbs: Skunk Cabbage, Jewelweed, Manna Grass, Umbrella Sedge, Fox Sedge, Unidentified Grass Others: Japanese Honeysuckle, Grape
Red Maple (Harford County)	Trees: Pin Oak Shrubs: Sweet Pepperbush, Highbush Blueberry Herbs: Lizard's Tail, False Nettle, Eulalia, Wood Reed, Manna Grass Others: Poison Ivy, Virginia Creeper
Red Maple (Harford County)	Trees: Sweet Gum, American Holly Shrubs: Highbush Blueberry, Common Winterberry, Japanese Barberry Herbs: Eulalia, False Nettle, Deer-tongue, Manna Grass, Wood Reed, Sensitive Fern, Virginia Chain Fern, Blue Flag Others: Common Greenbrier, Grape, Virginia Creeper, Smooth Carrion-flower
Red Maple (tributary to Northeast River, Cecil County)	Trees: Sweet Gum, Tulip Poplar, Black Cherry (banks) Shrubs: Spicebush, Southern Arrowwood, Silky Dogwood Herbs: Sensitive Fern, Manna Grass, Jewelweed, Marsh Fern, Tall Meadow-rue, Soft Rush (low spots), Deer-tongue, Jack-in-the-pulpit Others: Poison Ivy, Common Greenbrier, Virginia Creeper
Red Maple-Sweet Gum (Ford Run, Cecil County)	Trees: Tulip Poplar, Pine, Big-toothed Aspen Shrubs: Sweet Pepperbush, Highbush Blueberry, Silky Dogwood, Southern Arrowwood Herbs: Jewelweed, Cinnamon Fern, Sensitive Fern Others: Grape, Poison Ivy, Japanese Honeysuckle
Sweet Bay (Romney Creek, Harford County)	Trees: Pine, Sweet Gum, White Oak, Willow Oak, Water Oak, Red Oak Shrubs: Sweet Pepperbush, Highbush Blueberry, Swamp Azalea, Winterberry, Fetterbush, Shadbush Herbs: Cinnamon Fern, Net-veined Chain Fern, Royal Fern Others: Common Greenbrier

Table 6-18. Vascular plants of the Pocomoke River Swamp on the Eastern Shore. (Adapted from Beaven and Oosting 1939)

Trees
Bald Cypress (*Taxodium distichum*)
Red Maple (*Acer rubrum*)
Swamp Black Gum (*Nyssa sylvatica biflora*)
Black Gum (*N. sylvatica*)
Sweet Gum (*Liquidambar styraciflua*)
Green Ash (*Fraxinus pennsylvanica*)
Swamp Cottonwood (*Populus heterophylla*)
Loblolly Pine (*Pinus taeda*)
Pond Pine (*P. serotina*)
Atlantic White Cedar (*Chamaecyparis thyoides*)
Sweet Bay (*Magnolia virginiana*)
American Holly (*Ilex opaca*)
Eastern Red Cedar (*Juniperus virginicus*)
Fringe-tree (*Chionanthus virginicus*)
Ironwood (*Carpinus caroliniana*)

Shrubs
Smooth Alder (*Alnus serrulata*)
Southern Arrowwood (*Viburnum dentatum*)
Northern Wild Raisin (*Viburnum cassinoides*)
Southern Wild Raisin (*V. nudum*)
Black Haw (*V. prunifolium*)
Pink Azalea (*Rhododendron nudiflorum*)
Swamp Azalea (*R. viscosum*)
Fetterbush (*Leucothoe racemosa*)
Highbush Blueberry (*Vaccinium corymbosum*)
Evergreen Fetterbush (*Lyonia lucida*)
Sweet Pepperbush (*Clethra alnifolia*)
Silky Dogwood (*Cornus amomum*)
Virginia Sweet-spires (*Itea virginica*)
Buttonbush (*Cephalanthus occidentalis*)
Common Winterberry (*Ilex verticillata*)
Red Chokeberry (*Aronia arbutifolia*)
Spicebush (*Lindera benzoin*)

Herbs
Cinnamon Fern (*Osmunda cinnamomea*)
Royal Fern (*Osmunda regalis*)
Net-veined Chain Fern (*Woodwardia areolata*)
Manna Grass (*Glyceria* sp.)
Bladder Sedge (*Carex intumescens*)
Hop Sedge (*C. lupulina*)
Long's Sedge (*C. lonchocarpa*)
Fringed Sedge (*C. crinita*)
White-edge Sedge (*C. debilis*)
Weak Stellate Sedge (*C. seorsa*)
Wood Reed (*Cinna arundinacea*)
White Grass (*Leersia virginica*)
Short-bristle Beak-rush (*Rhynchospora corniculata*)
Lizard's Tail (*Saururus cernuus*)
False Nettle (*Boehmeria cylindrica*)
Seedbox (*Ludwigia alternifolia*)
Taper-leaf Bugleweed (*Lycopus rubellus*)
Yerba-de-tajo (*Eclipta alba*)
Gentian (*Gentiana latifolia*)
Turtlehead (*Chelone glabra*)
Swamp Milkweed (*Asclepias incarnata*)
Stiff-leaf Cowbane (*Oxypolis rigidior*)

Vines
Grapes (*Vitis* spp.)
Cross Vine (*Bignonia capreolata*)
Laurel-leaved Greenbrier (*Smilax laurifolia*)
Red-berried Greenbrier (*S. walteri*)
Trumpet Creeper (*Campsis radicans*)
Poison Ivy (*Toxicodendron radicans*)
Virginia Creeper (*Parthenocissus quinquefolia*)
Japanese Honeysuckle (*Lonicera japonica*)
Wild Yam (*Dioscorea villosa*)
Ground-nut (*Apios americana*)
Climbing Hempweed (*Mikania scandens*)
Dodder (*Cuscuta compacta*)

Table 6-19. Plants of Atlantic white cedar swamps on the Delmarva Peninsula (Dill *et al.* 1987). These plants were observed within a one trunk-length radius from a cedar tree; based largely on observations in Delaware.

Trees:
Red Maple (*Acer rubrum*)
Flowering Dogwood (*Cornus florida*)
Persimmon (*Diospyros virginiana*)
American Holly (*Ilex opaca*)
Red Cedar (*Juniperus virginiana*)
Tulip Poplar (*Liriodendron tulipifera*)
Sweet Bay (*Magnolia virginiana*)
Black Gum (*Nyssa sylvatica*)
Loblolly Pine (*Pinus taeda*)
Virginia Pine (*Pinus virginiana*)
Willow (*Salix* sp.)

Shrubs:
Seaside Alder (*Alnus maritima*)
Smooth Alder (*Alnus serrulata*)
Red Chokeberry (*Aronia arbutifolia*)
Buttonbush (*Cephalanthus occidentalis*)
Sweet Pepperbush (*Clethra alnifolia*)
Wintergreen (*Gaultheria procumbens*)
Inkberry (*Ilex glabra*)
Smooth Winterberry (*Ilex laevigata*)
Common Winterberry (*Ilex verticillata*)
Virginia Sweet-spires (*Itea virginica*)
Fetterbush (*Leucothoe racemosa*)
Maleberry (*Lyonia ligustrina*)
Northern Bayberry (*Myrica pensylvanica*)
Azalea (*Rhododendron* sp., probably *viscosum*)
Swamp Rose (*Rosa palustris*)
Brambles (*Rubus* sp.)
Common Elderberry (*Sambucus canadensis*)
Cat Greenbrier (*Smilax glauca*)
Laurel-leaved Greenbrier (*Smilax laurifolia*)
Common Greenbrier (*Smilax rotundifolia*)
Red-berried Greenbrier (*Smilax walteri*)
Poison Ivy (*Toxicodendron radicans*)
Poison Sumac (*Toxicodendron vernix*)
Highbush Blueberry (*Vaccinium corymbosum*)
Southern Arrowwood (*Viburnum dentatum*)
Southern Wild Raisin (*Viburnum nudum*)
Grape (*Vitis* sp.)

Herbs:
Ground-nut (*Apios americana*)
Swamp Milkweed (*Asclepias incarnata*)
Aster (*Aster* sp.)
Beggars-tick (*Bidens* sp.)
False Nettle (*Boehmeria cylindrica*)
Water Shield (B*rasenia schreberi*)
Collins' Sedge (*Carex collinsii*)
Bearded Sedge (*Carex comosa*)
Long's Sedge (*Carex lonchocarpa = C. folliculata*)
Turtlehead (*Chelone glabra*)
Striped Wintergreen (*Chimaphila maculata*)
Water Hemlock (*Cicuta* sp.)
Dodder (*Cuscuta pentagona*)
Water-willow (*Decodon verticillatus*)
Spatulate-leaved Sundew (*Drosera intermedia*)
Round-leaved Sundew (Drosera rotundifolia)
Three-way Sedge (*Dulichium arundinaceum*)
Bright-green Spike-rush (*Eleocharis olivacea*)
Square-stemmed Spike-rush (*Eleocharis quadrangulata*)
Flattened Pipewort (*Eriocaulon compressum*)
Parker's Pipewort (*Eriocaulon parkeri*)
Thoroughwort (*Eupatorium* sp.)
Hairy Umbrella-sedge (*Fuirena squarrosa*)
Umbrella-sedge (*Fuirena* sp.)
Bedstraw (*Galium* sp.)
Manna Grass (*Glyceria obtusa*)
Swamp Pink (*Helonias bullata*)
St. John's-worts (*Hypericum* spp.)
Jewelweed (*Impatiens capensis*)
Slender Blue Flag (*Iris prismatica*)
Blue Flag (*Iris versicolor*)
Rush (*Juncus* sp.)
Grass (*Leersia* sp.)
Duckweed (*Lemna* sp.)
Lobelia (*Lobelia* sp.)
Bugleweed (*Lycopus* sp.)
Climbing Hempweed (*Mikania scandens*)
Partridgeberry (*Mitchella repens*)
Water-cress (*Nasturtium officinale*)
Spatterdock (*Nuphar luteum*)
White Water Lily (*Nymphaea odorata*)
Golden Club (*Orontium aquaticum*)
Cinnamon Fern (*Osmunda cinnamomea*)
Royal Fern (*Osmunda regalis*)
Stiff Cowbane (*Oxypolis rigidior var. ambigua*)
Panic Grass (*Panicum* sp.)
Arrow Arum (*Peltandra virginica*)
Common Reed (*Phragmites australis*)
Green Wood Orchid (*Platanthera clavellata*)
Smartweed (*Polygonum* sp.)
Pickerelweed (*Pontederia cordata*)
Pondweed (*Potamogeton* sp.)
White Beak-rush (*Rhynchospora alba*)
Tall Beak-rush (*Rhynchospora macrostachya*)
Northern Pitcher Plant (*Sarracenia purpurea ssp. purpurea*)
Southern Pitcher Plant (*Sarracenia purpurea ssp. venosa*)
Lizard's Tail (*Saururus cernuus*)
Wool Grass (*Scirpus cyperinus*)
Mad-dog Skullcap (*Scutellaria lateriflora*)
Meadow Spike-moss (*Selaginella apoda*)
Goldenrods (*Solidago* spp.)
Great Bur-reed (*Sparganium eurycarpum*)
Bur-reed (*Sparganium* sp.)
Nodding Ladies'-tresses (*Spiranthes cernua*)
Meadow-rue (*Thalictrum* sp.)
Marsh Fern (*Thelypteris thelypteroides = T. palustris*)
Bog Fern (*Thelypteris simulata*)
Marsh St. John's-wort (*Triadenum virginicum*)
Narrow-leaved Cattail (*Typha angustifolia*)
Broad-leaved Cattail (*Typha latifolia*)
Humped Bladderwort (*Utricularia gibba*)
Rush Bladderwort (*Utricularia juncea*)
Common Bladderwort (*Utricularia macrorhiza*)
Violet (*Viola* sp.)
Net-weined Chain Fern (*Woodwardia areolata*)
Virginia Chain Fern (*Woodwardia virginica*)

Mosses:
Peat Mosses (*Sphagnum* spp.)

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 6-21. Examples of temporarily 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 (*) were observed by William Sipple.

Dominance Type (Location)	Associates
Black Gum-Basket Oak (Caroline County)	Trees: Red Maple, Loblolly Pine, Water Oak, Sweet Gum, White Oak, Willow Oak, Southern Red Oak, American Holly Shrubs: Fetterbush, Highbush Blueberry, Swamp Azalea, Maleberry Others: Peat Moss (depressions), Common Greenbrier
Loblolly Pine-Red Maple-Sweet Gum (Caroline County)	Trees: American Holly, Sweet Bay, Red Maple, Sweet Gum, Black Cherry, Black Gum, Beech, Tulip Poplar Shrubs: Fetterbush, Southern Arrowwood, Highbush Blueberry Herbs: Sedges, Royal Fern (low spots) Others: Common Greenbrier, Partridgeberry
Loblolly Pine-Red Maple-White Oak-Willow Oak (Talbot County)	Trees: Sweet Gum, Black Gum, Southern Red Oak Shrubs: Dangleberry, Sweet Pepperbush, Highbush Blueberry, Swamp Azalea, Serviceberry Herbs: Slender Spike-grass, Wool Grass, Bladder Sedge, White Grass Others: Common Greenbrier, Partridgeberry
Red Maple-Green Ash-Black Willow (Sassafras River, Kent County)	Trees: Black Cherry, Flowering Dogwood (high levee), Box Elder Shrubs: Silky Dogwood Herbs: Field Garlic Others: Common Greenbrier, Japanese Honeysuckle
Red Maple-Sweet Gum (Caroline County)	Trees: River Birch (streamside), Sweet Bay Shrubs: Sweet Pepperbush, Southern Arrowwood, Fetterbush, Highbush Blueberry Others: Japanese Honeysuckle, Swamp Dewberry
Red Maple-Sweet Gum-White Oak (Talbot County)	Trees: Black Gum, Red Oak, American Holly, Beech Shrubs: Sweet Pepperbush, Highbush Blueberry, Fetterbush, Swamp Azalea Herbs: Sedge Others: Common Greenbrier
Red Maple-Tulip Poplar-Basket Oak-Sweet Gum (Hog Creek, Caroline County)	Trees: Ironwood, Sweet Bay, American Holly, Beech, Green Ash Shrubs: Spicebush, Fetterbush Herbs: Skunk Cabbage (low spots), Sedge, Net-veined Chain Fern Others: Japanese Honeysuckle, Poison Ivy, Common Greenbrier, Grape, Partridgeberry
Red Maple-White Oak-Loblolly Pine (Talbot County)	Trees: Southern Red Oak, Black Gum, Sweet Gum, Beech, Willow Oak Shrubs: Sweet Pepperbush, Highbush Blueberry Herbs: Slender Spike-grass Others: Virginia Creeper, Poison Ivy, Japanese Honeysuckle, Brambles, Common Greenbrier, Partridgeberry
Red Maple-Willow Oak (Kent County)	Trees: Black Gum, Beech, White Oak, Red Oak, Sweet Gum Shrubs: Sweet Pepperbush, Fetterbush, Highbush Blueberry, Swamp Azalea, Winterberry Others: Common Greenbrier
Southern Red Oak-Red Maple-Loblolly Pine-White Oak-Basket Oak (Talbot County)	Trees: Sweet Gum, Black Gum, American Holly Shrubs: Highbush Blueberry, Sweet Pepperbush, Fetterbush, Swamp Azalea Others: Common Greenbrier, Peat Moss (low spots)
Sweet Gum (Queen Annes County)	Trees: Loblolly Pine, Red Maple, Black Gum, Red Mulberry, Southern Red Oak, Black Cherry Shrubs: Black Haw, Highbush Blueberry, Elderberry Herbs: Sensitive Fern, Wood Nettle, Jewelweed, Jack-in-the-pulpit, Net-veined Chain Fern Others: Japanese Honeysuckle, Poison Ivy, Common Greenbrier, Swamp Dewberry, Trumpet Creeper, Virginia Creeper

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 6-22. Examples of temporarily flooded palustrine (nontidal) forested wetland communities observed in Charles, St. Marys, and Calvert Counties. These communities are typical of the Upper or Inner Coastal Plain or the Gulf-Atlantic Rolling Plain (Irregular Plains) of Hammond (1970).

Dominance Type (Location)	Associates
American Holly-Black Gum (Cedarville State Forest, Charles County)	Trees: Tulip Poplar, Red Maple, Pawpaw Shrubs: Sweet Pepperbush, Spicebush Herbs: Tapering Fern, Skunk Cabbage (low spots), Ground-pine, Royal Fern Others: Common Greenbrier, Partridgeberry
American Holly-Sweet Gum-Tulip Poplar (Wolf Den Branch, Charles County)	Trees: Red Maple, Ironwood, Black Gum, Sycamore, Atlantic White Cedar Shrubs: Fetterbush, Southern Arrowwood, Sweet Pepperbush, Pawpaw, Spicebush, American Strawberry-bush, Highbush Blueberry Herbs: Tapering Fern, Lady's Fern, Deer-tongue, Jack-in-the-pulpit, Starflower, Sedge, Royal Fern Others: Partridgeberry, Common Greenbrier, Grape, Swamp Dewberry, Virginia Creeper, Poison Ivy
Green Ash (Sewell Branch, Calvert Counry)	Trees: American Elm, Sycamore Shrubs: Pawpaw, Spicebush, Southern Arrowwood Herbs: Wood Nettle, Jewelweed, False Nettle, Wood Reed, Deer-tongue Others: Grape, Japanese Honeysuckle, Poison Ivy
Red Maple (Swans Creek, Charles County)	Trees: Tulip Poplar, Pawpaw, American Elm, Black Willow, Green Ash, Ironwood, River Birch, American Holly Shrubs: Southern Arrowwood, Spicebush Herbs: False Nettle, Lizard's Tail (low spots), Reed Canary Grass, Jewelweed, Arrow Arum (in channels), Jack-in-the-pulpit, Wood Nettle, Violet, Virginia Chain Fern, Christmas Fern Others: Poison Ivy, Virginia Creeper, Grape, Common Greenbrier, Japanese Honeysuckle
Red Maple-Tulip Poplar-Sweet Gum-Pin Oak-Sycamore (Clark Run, Charles County)	Trees: American Elm, Hickory, Black Gum, Black Willow Shrubs: Spicebush, Southern Arrowwood, Silky Dogwood Herbs: False Nettle, Jack-in-the-pulpit, Bugleweed, Jewelweed, Cardinal Flower Others: Japanese Honeysuckle, Grape, Virginia Creeper, Common Greenbrier
Red Maple-White Oak (Charles County)	Trees: American Holly, Willow Oak Shrubs: Highbush Blueberry, Sweet Pepperbush Others: Common Greenbrier, Partridgeberry, Peat Moss (low spots)
River Birch (Budds Creek, Charles County)	Trees: Black Willow, American Elm, American Holly, Tulip Poplar Shrubs: Smooth Alder, Spicebush Herbs: Jewelweed, Sensitive Fern, Lady's Fern, Smartweeds, False Nettle, Sedge, Unidentified Grass, Christmas Fern Others: Poison Ivy, Japanese Honeysuckle, Brambles, Common Greenbrier
Swamp White Oak-Tulip Poplar-Sweet Gum-American Holly (Zekiah Swamp, Charles County)	Trees: Ironwood, Red Maple, Beech, Southern Red Oak, Black Gum, River Birch (creekside) Shrubs: Sweet Pepperbush, Pawpaw, Southern Arrowwood, Spicebush, American Strawberry-bush Herbs: Tapering Fern, Lady's Fern Others: Swamp Dewberry, Partridgeberry, Ground Cedar, Poison Ivy, Common Greenbrier, Virginia Creeper
Sweet Gum-Black Gum-Red Maple (St. Marys County)	Trees: American Holly, Willow Oak Herbs: Sensitive Fern, Lizard's Tail (low spots), Lurid Sedge Others: Common Greenbrier, Virginia Creeper
Sweet Gum-Red Maple (Zekiah Swamp, Charles County)	Trees: Pin Oak, Pawpaw, Green Ash, American Elm, River Birch, Ironwood, American Holly Shrubs: Southern Arrowwood Herbs: White Grass, Sedge, Rough-stemmed Goldenrod, False Nettle, Virginia Knotweed Others: Poison Ivy, Virginia Creeper, Common Greenbrier

Table 6-22. (continued)

Dominance Type (Location)	Associates
Sycamore-River Birch (Calvert County)	Trees: Red Maple, Sweet Gum, Ironwood, Pawpaw Shrubs: Southern Arrowwood, Spicebush, Choke Cherry, Elderberry Herbs: White Avens, Wood Reed, Wood Nettle Others: Japanese Honeysuckle, Poison Ivy, Grape
Sycamore-Sweet Gum-Red Maple (St. Marys County)	Trees: Ironwood, American Holly, Sweet Bay, Tulip Poplar Shrubs: Choke Cherry, Privet, Sweet Pepperbush Herbs: Jewelweed, Bugleweed, Panic Grass, False Nettle, Net-veined Chain Fern, Wood Reed, Wood Fern Others: Poison Ivy, Japanese Honeysuckle, Grape, Trumpet Creeper, Brambles
Tulip Poplar-River Birch-Sweet Gum (County Line Creek, Charles County)	Trees: Red Maple, Ironwood Herbs: Lady's Fern, White Avens, Smartweed, Christmas Fern, Jewelweed, Sensitive Fern, Jack-in-the-pulpit, Hollow-stemmed Joe-Pye-weed, Bugleweed, Boneset, Violet, Tall Meadow-rue, Panic Grass, Sedge, Deer-tongue
White Oak-Basket Oak-Sweet Gum-Black Gum-Loblolly Pine (St. Marys County)	Trees: American Holly, Willow Oak, Sweet Bay Shrubs: Highbush Blueberry Herbs: Sensitive Fern Others: Common Greenbrier, Virginia Creeper

Table 6-23. Examples of temporarily flooded palustrine (nontidal) forested wetland communities observed in Prince Georges and Anne Arundel Counties. These communities are typical of the Upper or Inner Coastal Plain or the Gulf-Atlantic Rolling Plain (Irregular Plains) of Hammond (1970).

Dominance Type (Location)	Associates
Beech-Sweet Gum-Red Maple (Mattawoman Creek, Prince Georges County)	Trees: Ironwood, American Holly, Tulip Poplar, River Birch, Basket Oak Shrubs: Southern Arrowwood Herbs: Tapering Fern, Virginia Chain Fern, Violet, Unid. Grass Others: Poison Ivy, Common Greenbrier, Partridgeberry, Japanese Honeysuckle
Box Elder (tributary of Patuxent River, Anne Arundel County)	Trees: Sweet Gum, Pawpaw (higher levees), Green Ash, Sycamore, Basket Oak, Black Willow, River Birch, American Elm, Red Maple, Flowering Dogwood Shrubs: Spicebush, Elderberry Herbs: Asters, Indian Strawberry (high spots), White Avens, Jack-in-the-pulpit, Violet, False Nettle, Clearweed, Field Garlic, Jewelweed, Wood Nettle, Smartweed, Garlic Mustard Others: Japanese Honeysuckle, Grape, Poison Ivy, Trumpet Creeper, Blackberry
Box Elder (Piscataway Creek, Prince Georges County)	Trees: Black Willow, River Birch, American Elm, Green Ash, Sycamore Shrubs: Spicebush, Multiflora Rose Herbs: Jewelweed, Bottlebrush Grass, White Avens, Ground Ivy, Honewort, Wood Nettle, Sensitive Fern, Jack-in-the-pulpit Others: Grape, Trumpet Creeper, Poison Ivy
Green Ash-Box Elder-Swamp White Oak-Sweet Gum (Patuxent River, Anne Arundel County)	Trees: Ironwood, Sassafras Shrubs: Pawpaw, Nannyberry Herbs: Wood Nettle, Jewelweed, False Nettle, Clearweed, Smartweed, Wood Sorrel, Wild Rye Grass, White Avens Others: Poison Ivy, Japanese Honeysuckle, Trumpet Creeper
Green Ash-Red Maple-Sweet Gum (Patuxent Wildlife Research Center, Prince Georges County)	Trees: Beech, Flowering Dogwood, American Holly Shrubs: Spicebush, Japanese Barberry Herbs: False Nettle, Sedge, Jack-in-the-pulpit, Virginia Knotweed Others: Virginia Creeper, Japanese Honeysuckle, Grape
Pin Oak-River Birch-Black Gum (Henson Creek, Prince Georges County)	Trees: Sycamore, Green Ash, American Elm Shrubs: Spicebush Herbs: Jewelweed, Water Hemlock, Honewort, Clearweed, Manna Grass Others: Poison Ivy, Grape
Red Maple (Piscataway Creek, Prince Georges County)	Trees: Black Gum, Sweet Gum, Pin Oak, River Birch Shrubs: Spicebush, Swamp Rose, Silky Dogwood, Common Elderberry, Southern Arrowwood Herbs: Wood Reed or Wild Rye Grass, Jewelweed, False Nettle, Aster, Sedge, Goldenrod, Water Hemlock Others: Poison Ivy, Japanese Honeysuckle, Common Greenbrier, Swamp Dewberry, Grape
Red Maple-American Elm-Green Ash-Sweet Gum (Little Patuxent River, Anne Arundel County)	Shrubs: Black Haw Herbs: White Grass, White Avens, Moneywort, Wood Reed, False Nettle, Clearweed, Wood Nettle
Red Maple-River Birch-Sycamore (Charles Branch, Prince Georges County)	Trees: Green Ash, Box Elder, Beech Shrubs: Spicebush Herbs: Wood Nettle, Jack-in-the-pulpit Others: Poison Ivy, Japanese Honeysuckle
Red Maple-Sweet Gum (Deale, Anne Arundel County)	Trees: Southern Red Oak, Swamp White Oak, Basket Oak, Black Gum Shrubs: Multiflora Rose, Southern Arrowwood Herbs: Jack-in-the-pulpit, Panic Grass, Sedge Others: Common Greenbrier, Poison Ivy, Virginia Creeper, Trumpet Creeper

Table 6-23. (continued)

Dominance Type (Location)	Associates
Red Maple-Willow Oak-Sweet Gum (Anne Arundel County)	Trees: Black Gum, Sweet Bay, White Oak, Pin Oak, Basket Oak Shrubs: Highbush Blackberry Herbs: Sedge, Royal Fern, Cinnamon Fern Others: Common Greenbrier, Peat Moss (low spots)
River Birch (Mataponi Creek, Prince Georges County)	Trees: Tulip Poplar, Ironwood, Green Ash, Sassafras, Red Maple, Sycamore, Sweet Gum Shrubs: Spicebush, Southern Arrowwood, Pawpaw, Choke Cherry Herbs: Jack-in-the-pulpit, Jewelweed, May Apple, False Nettle, Enchanter's Nightshade, Clearweed, Wood Nettle, Deer-tongue Others: Poison Ivy, Japanese Honeysuckle, Common Greenbrier, Swamp Dewberry
River Birch-Red Maple-Green Ash (Piscataway Creek, Prince Georges County)	Trees: Black Cherry, Sycamore, Pawpaw, Box Elder, Ironwood Shrubs: Spicebush, Elderberry Others: Japanese Honeysuckle, Poison Ivy, Common Greenbrier, Virginia Creeper
Sycamore-Red Maple-Green Ash (Flat Creek, Anne Arundel County)	Trees: River Birch, Black Gum, Ironwood, American Elm Shrubs: Spicebush, Southern Arrowwood, Elderberry Herbs: Enchanter's Nightshade, Wood Reed, Jack-in-the-pulpit, Yerba-de-tajo, Sensitive Fern, Pokeweed Others: Japanese Honeysuckle, Poison Ivy, Grape

Table 6-24. Examples of temporarily flooded palustrine (nontidal) forested wetland communities observed in Baltimore, Cecil, and Harford Counties. These communities are typical of the Upper or Inner Coastal Plain or the Gulf-Atlantic Rolling Plain (Irregular Plains) of Hammond (1970).

Dominance Type (Location)	Associates
American Beech (Harford County)	Trees: Black Gum, Shellbark Hickory, Sweet Gum, Red Maple Shrubs: Highbush Blueberry, Black Haw Herbs: Eulalia Others: Virginia Creeper, Common Greenbrier
Pin Oak-Sweet Gum (Baltimore County)	Trees: Red Maple, Willow Oak, Beech Shrubs: Winterberry, Southern Arrowwood Herbs: Sedges Others: Poison Ivy, Virginia Creeper
Red Maple (Susquehanna River, Cecil County)	Trees: Sycamore, River Birch, American Elm, Box Elder Shrubs: Elderberry Herbs: Violet, Field Garlic, Sensitive Fern, Pokeweed Others: Japanese Honeysuckle, Poison Ivy
Red Maple (Harford County)	Trees: Sweet Gum, American Holly Shrubs: Smooth Winterberry, Highbush Blueberry Herbs: Eulalia, False Nettle, Wood Reed, Jewelweed Others: Poison Ivy, Common Greenbrier, Grape
Sweet Gum (Spesutie Island, Harford County)	Trees: Pawpaw, Black Gum, Black Locust, Green Ash Shrubs: Blackberry Herbs: Sensitive Fern, Sedge, Bedstraw, False Nettle, Turk's Cap Lily, Wild Yam, Blue Flag Others: Grape, Trumpet Creeper, Japanese Honeysuckle
Sweet Gum-Red Maple (Dundee Creek, Baltimore County)	Trees: Black Cherry, American Holly, Hickory Shrub: Southern Arrowwood Herbs: False Nettle Others: Common Greenbrier, Poison Ivy, Virginia Creeper

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 (*Mixed Shrub Swamp-Wet Meadow*) (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
Alders (Appalachian Highlands)	Shrubs: Arrowwood, Elderberry Herbs: Bluejoint
Arrowwood-Bluejoint (*Mixed Shrub Swamp-Wet Meadow*) (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 (*Panicum verrucosum*), 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 6-28. Plants of Maryland's tidal fresh marshes. (List prepared from personal observations, McCormick and Somes 1982, and Shreve 1910)

Ferns
Marsh Fern (*Theypteris thelypteroides*)
Sensitive Fern (*Onoclea sensibilis*)
Royal Fern (*Osmunda regalis*)

Grasses
Big Cordgrass (*Spartina cynosuroides*)
Common Reed (*Phragmites australis*)
Switchgrass (*Panicum virgatum*)
Fall Panic-grass (*P. dichotomiflorum*)
Wild Rice (*Zizania aquatica*)
Rice Cutgrass (*Leersia oryzoides*)
Walter Millet (*Echinochloa walteri*)
Wood Reed (*Cinna arundinacea*)
Virginia Rye Grass (*Elymus virginicus*)
Swamp Wedgescale (*Sphenopholis pensylvanicum*)
Reed Canary Grass (*Phalaris arundinaceum*)

Grasslike Plants
Narrow-leaved Cattail (*Typha angustifolia*)
Broad-leaved Cattail (*T. latifolia*)
Southern Cattail (*T. domingensis*)
River Bulrush (*Scirpus fluviatilis*)
Sedges (*Carex alata, C. lurida, C. crinita, C. albolutescens, C. squarrosa, C. stipata*)
Soft Rush (*Juncus effusus*)
Salt Marsh Bulrush (*Scirpus robustus*)
Three-way Sedge (*Dulichium arundinaceum*)
Soft-stemmed Bulrush (*Scirpus validus*)
Spike-rushes (*Eleocharis* spp.)
Wool Grass (*Scirpus cyperinus*)
Common Three-square (*Scirpus pungens*)
Autumn Sedge (*Fimbristylis autumnalis*)
Tall Beak-rush (*Rhynchospora macrostachya*)
Yellow Flatsedge (*Cyperus flavescens*)
Canada Rush (*Juncus canadensis*)
Tapertip Rush (*J. acuminatus*)
Umbrella Sedge (*Cyperus nuttallii*)
Sweet Flag (*Acorus calamus*)
Greater Bur-reed (*Sparganium eurycarpum*)

Flowering Herbs
Rose Mallow (*Hibiscus moscheutos*)
Seashore Mallow (*Kosteletzkya virginica*)
Spatterdock (*Nuphar luteum*)
Arrow Arum (*Peltandra virginica*)
Pickerelweed (*Pontederia cordata*)
Big-leaved Arrowhead (*Sagittaria latifolia*)
Bull-tongue (*S. lancifolia*)
Water-willow (*Decodon verticillatus*)
Water Parsnip (*Sium suave*)
Water Hemp (*Amaranthus cannabinus*)
Golden Club (*Orontinum aquaticum*)
Bur-marigold (*Bidens laevis*)
Beggar-ticks (*Bidens cernua, B. coronata, B. frondosa*)
Blue Flag (*Iris versicolor*)
Yellow Flag (*I. pseudacorus*)
Clearweed (*Pilea pumila*)
Sneezeweed (*Helenium autumnale*)
Jewelweed (*Impatiens capensis*)
Tearthumbs (*Polygonum arifolium, P. sagittatum*)
Smartweeds (*Polygonum hydropiper, P. hydropiperoides*)
New York Ironweed (*Vernonia noveboracensis*)
Swamp Milkweed (*Asclepias incarnata*)
Boneset (*Eupatorium perfoliatum*)
Marsh Eryngo (*Eryngium aquaticum*)
Elongate Lobelia (*Lobelia elongata*)
Seaside Goldenrod (*Solidago sempervirens*)
Mock Bishop-weed (*Ptilimnium capillaceum*)
Dwarf St. John's-wort (*Hypericum mutilum*)
Marsh Pennywort (*Hydrocotyle umbellata*)
Lance-leaved Frog-fruit (*Lippia lanceolata*)
Purple-leaved Willowherb (*Epilobium coloratum*)
Small Salt Marsh Pink (*Sabatia stellaris*)
Large Salt Marsh Pink (*S. dodecandra*)
Stiff Cowbane (*Oxypolis rigidior*)
Canada St. John's-wort (*Hypericum canadense*)
Sweet-scent Bedstraw (*Galium triflorum*)
Marsh St. John's-wort (*Triadenum virginicum*)
Marsh Mermaid-weed (*Proserpinaca palustris*)
Sensitive Joint Vetch (*Aeschynomene virginica*)
Broad-tooth Hedge-nettle (*Stachys latidens*)
Water Pimpernel (*Samolus parviflorus*)
Swamp Candles (*Lysimachia terrestris*)
Water Hemlock (*Cicuta maculata*)
Dye Bedstraw (*Galium tinctorium*)
White Water Lily (*Nymphaea odorata*)
Dotted Smartweed (*Polygonum punctatum*)
Water Dock (*Rumex verticillatus*)
Pinkweed (*Polygonum pennsylvanicum*)
White Panicled Aster (*Aster lanceolatus*)
Asters (*Aster* spp.)

Shrubs
Groundsel-bush (*Baccharis halimifolia*)
Swamp Rose (*Rosa palustris*)
Multiflora Rosa (*R. multiflora*)
Smooth Alder (*Alnus serrulata*)
Seaside Alder (*Alnus maritima*)
Willow (*Salix* sp.)

Vines
Climbing Hempweed (*Mikania scandens*)
Virginia Creeper (*Parthenocissus quinquefolia*)
Hedge Bindweed (*Calystegia sepium*)
Dodder (*Cuscuta* spp.)
Bittersweet Nightshade (*Solanum dulcamara*)

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 Bluet (*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*)

Table 6-30. Examples of seasonally flooded palustrine forested wetland communities in the Piedmont.

Dominance Type (Location)	Associates
Black Walnut-Sycamore-Black Willow-Pin Oak (somewhat open canopy) (Middle Run, Carroll County)	Shrubs: Multiflora Rose, Elderberry Herbs: Jewelweed, Goldenrod, Arrow-leaved Tearthumb, White Avens, Small-flowered Agrimony, False Nettle, Rice Cutgrass, Milkweed, Clearweed, Swamp Aster, Deer-tongue, Hollow-stemmed Joe-Pye-weed, Green-headed Coneflower, Rough Bedstraw, Asiatic Tearthumb Others: Japanese Honeysuckle, Virgin's Bower, Dodder, Poison Ivy
Black Willow (Lock Raven Reservoir, Baltimore County)	Trees: Ash, Crack Willow, Box Elder, Red Maple Shrubs: Silky Dogwood Herbs: Rough Bedstraw, Sensitive Fern Others: Japanese Honeysuckle (banks)
Black Willow-Red Maple (Carroll County)	Trees: Swamp White Oak Shrub: Spicebush, Multiflora Rose, Southern Arrowwood Herbs: Skunk Cabbage, False Nettle, Field Garlic
Box Elder (Middle Patuxent River, Howard County)	Trees: Eastern Cottonwood, Sycamore, Black Willow (streamside) Shrubs: Multiflora Rose, Spicebush Herbs: Jewelweed, Goldenrod, Boneset, Wild Rye Grass, Reed Canary Grass, Giant Ragweed, False Nettle, Jack-in-the-pulpit, White Avens, Wood Sorrel, Lady's Thumb, Pokeweed
Red Maple (Baltimore County)	Trees: Ironwood, Tulip Poplar, Ash Shrubs: Spicebush, Southern Arrowwood Herbs: Skunk Cabbage, Jewelweed, Cinnamon Fern Others: Common Greenbrier
Red Maple (Mill Creek, Cecil County)	Trees: Black Cherry, Black Gum, Tulip Poplar Shrubs: Southern Arrowwood, Swamp Azalea, Spicebush, Sweet Pepperbush Herbs: Skunk Cabbage, Jewelweed, Cinnamon Fern, Jack-in-the-pulpit, Clubmoss
Red Maple (Patuxent River State Park, Montgomery County)	Trees: Tulip Poplar, Green Ash, White Oak, American Hazelnut, Pin Oak Shrubs: Spicebush, Southern Arrowwood, Winterberry, Silky Dogwood, Highbush Blueberry, Black Haw Herbs: Skunk Cabbage, Jewelweed, False Nettle, Enchanter's Nightshade, White Avens, Water Hemlock Others: Virginia Creeper, Common Greenbrier (edges), Poison Ivy, Grape
Red Maple-Ash (Northeast Creek, Cecil County)	Trees: American Elm, Ironwood Shrubs: Southern Arrowwood, Spicebush Herbs: Jewelweed, Manna Grass, Stinging Nettle, Sensitive Fern Others: Poison Ivy, Wintergreen
Red Maple-Pin Oak (Carroll County)	Trees: Green Ash Shrub: Southern Arrowwood, Smooth Alder Herbs: Pinkweed, Jewelweed, Arrow-leaved Tearthumb Others: Grape
Red Maple-Tulip Poplar (Baltimore County)	Trees: White Ash, Silver Maple, Black Cherry Shrubs: Spicebush, Elderberry Herbs: Jewelweed, Tall Meadow-rue, Skunk Cabbage Others: Common Greenbrier, Japanese Honeysuckle (*Note:* Tulip Poplar occurred on upper edges)
Silver Maple-Black Willow (Frederick County)	Trees: Red Maple Shrubs: Alder, Silky Dogwood Herbs: Jewelweed, Joe-Pye-weed, Blue Vervain, Lurid Sedge, Big Arrowhead
Silver Maple-Green Ash-Pin Oak (Potomac River, Montgomery County)	Trees: American Elm Shrubs: Buttonbush (low spot) Herbs: False Nettle, Clearweed, Pinkweed, Small-flowered White Aster, Hop Sedge (low spot), Halberd-leaved Rose Mallow (low spot)
Swamp White Oak-Red Maple (Councilmans Run, Baltimore County)	Trees: Green Ash, Black Walnut (high spots), Silver Maple, Sycamore Shrubs: Spicebush, Silky Dogwood, Winterberry, Multiflora Rose, White Mulberry Herbs: Stinging Nettle, Reed Canary Grass, Tall Meadow-rue, Three-way Sedge, Jack-in-the-pulpit Others: Poison Ivy, Japanese Honeysuckle, Virginia Creeper

Table 6-31. Examples of temporarily flooded palustrine forested wetland communities in the Piedmont.

Dominance Type (Location)	Associates	
Black Locust-Box Elder (Potomac River, Montgomery County)	Trees:	Black Walnut
	Shrubs:	Multiflora Rose
	Herbs:	Wild Rye Grass, Indian Strawberry, Wood Nettle, Moneywort, Clearweed, Honewort, Violet
	Others:	Grape
Black Walnut-Red Maple-Box Elder (Oregon Run, Baltimore County)	Trees:	Black Willow, Silver Maple, Sycamore
	Shrubs:	Multiflora Rose, Silky Dogwood
	Others:	Japanese Honeysuckle, Grape, Virginia Creeper, Poison Ivy
Box Elder (Middle Patuxent River, Howard County)	Trees:	Black Walnut, Bitternut Hickory, Green Ash, Pin Oak
	Shrubs:	Spicebush
	Herbs:	Indian Strawberry, White Avens, Garlic Mustard, Wood Nettle, Field Garlic, Virginia Knotweed, Jack-in-the-pulpit, Sedge
	Others:	Japanese Honeysuckle, Poison Ivy, Virginia Creeper
Green Ash-Red Maple-Black Locust (Carroll County)	Trees:	Black Cherry, Ironwood, Black Gum
	Shrubs:	Spicebush, Arrowwood, Smooth Alder, Elderberry, Silky Dogwood, Black Haw, Winterberry
	Herbs:	Clearweed, Lady's Thumb, False Nettle, Sensitive Fern, White Grass, Meadow-rue, Jewelweed (wetter spots), Manna Grass (wetter spots)
Green Ash-Sycamore-Box Elder (Bennett Branch of Monocacy River, Frederick County)	Trees:	Pawpaw, Ironwood, Beech, Hackberry, Tulip Poplar
	Shrubs:	Spicebush, Elderberry
	Herbs:	Wood Nettle, Garlic Mustard, Wood Sorrel, Lady's Thumb, False Nettle (low spots), Clearweed
	Others:	Virginia Creeper, Poison Ivy
Green Ash-Sycamore-Shagbark Hickory (Big Silver Run, Carroll County)	Trees:	Black Cherry, Black Walnut, Hackberry
	Shrubs:	Multiflora Rose, Tartarian Honeysuckle, Spicebush
	Herbs:	Sedge, Wild Ginger, Wood Nettle, White Avens, Goldenrod, Virginia Knotweed
	Others:	Poison Ivy, Grape, Virginia Creeper
Pin Oak-Red Maple (Montgomery County)	Shrubs:	Southern Arrowwood, Silky Dogwood, Multiflora Rose, Elderberry
	Herbs:	Sensitive Fern, Skunk Cabbage (low spots), Water Hemlock (low spots), False Nettle, Jewelweed
	Others:	Common Greenbrier, Japanese Honeysuckle, Virginia Creeper
Red Maple (Carroll County)	Trees:	Persimmon
	Shrubs:	Spicebush, Arrowwood, Multiflora Rose, Elderberry, Winterberry
	Herbs:	False Nettle, Lady's Fern, Meadow-rue, Field Garlic, Virginia Dayflower, Jack-in-the-pulpit, Wood Reed, Blue Flag
	Others:	Virginia Creeper, Poison Ivy
Red Maple (Frederick County)	Trees:	Sycamore, Box Elder, Silver Maple
	Shrubs:	Multiflora Rose
	Herbs:	Jewelweed, Goldenrod
	Others:	Japanese Honeysuckle, Blackberry
Red Maple (Hooker's Branch, Montgomery County)	Trees:	Tulip Poplar, Witch Hazel, Shagbark Hickory, Green Ash
	Shrubs:	Spicebush, Winterberry, Southern Arrowwood, Multiflora Rose
	Herbs:	Jewelweed, False Nettle, White Avens, May Apple, Enchanter's Nightshade
	Others:	Poison Ivy, Virginia Creeper, Common Greenbrier
Silver Maple (Carroll County)	Trees:	Black Cherry, Black Willow, Red Maple
	Shrubs:	Arrowwood, Multiflora Rose
	Herbs:	Jewelweed
Tulip Poplar (Montgomery County)	Trees:	Black Willow, Box Elder, Red Maple
	Shrubs:	Alder, Elderberry
	Others:	Poison Ivy

Table 6-32. Examples of seasonally flooded palustrine forested wetlands observed in the Appalachian Highlands. (*Note:* Information on Rock Lodge Bog comes from Fenwick and Boone 1984.)

Dominance Type (Location)	Associates	
Hemlock (Garrett County)	Trees:	Red Maple, Yellow Birch
	Shrubs:	Rosebay Rhododendron, Speckled Alder, Highbush Blueberry, Red Chokeberry, Swamp Azalea
	Herbs:	Wild Calla, Cinnamon Fern, Skunk Cabbage, Jewelweed, Nerved Manna Grass, Pale Touch-me-not, Purple Joe-Pye-weed, Canada Mayflower
Hemlock (Rock Lodge Bog)	Trees:	Red Spruce, White Pine, Yellow Birch, Red Maple, Shadbush, Striped Maple
	Shrubs:	Rosebay Rhododendron
Hemlock (Savage River State Forest, Garrett County)	Trees:	Rosebay Rhododendron, Red Maple, Yellow Birch, Witch Hazel
Hemlock-Red Maple (Garrett County)	Trees:	Yellow Birch
	Shrubs:	Rosebay Rhododendron, Shadbush
	Herbs:	Unidentified Grass, Skunk Cabbage
	Others:	Partridgeberry
Hemlock-Yellow Birch-Red Maple-Speckled Alder (Garrett County)	Trees:	Red Spruce, Witch Hazel
	Shrubs:	Rosebay Rhododendron, Winterberry, Mountain Laurel, Spicebush
	Herbs:	Jewelweed, Skunk Cabbage, Aster, Cinnamon Fern
	Others:	Partridgeberry
Red Maple-Hemlock (Garrett County)	Shrubs:	Speckled Alder, Highbush Blueberry, Rosebay Rhododendron, Red Chokeberry, Arrowwood
	Herbs:	Wild Calla, Cinnamon Fern, Skunk Cabbage
Yellow Birch-Hemlock (Garrett County)	Trees:	Red Maple
	Shrubs:	Swamp Azalea
	Herbs:	Jewelweed, Manna Grass, Marsh Fern, Bee Balm, Wood Reed, Dock, Violet, Wood Sorrel, Pale Touch-me-not, Sedges, Buttercup, Canada Mayflower (hummocks), Tall Meadow-rue, Skunk Cabbage, Purple Joe-Pye-weed

Table 6-33. Examples of temporarily flooded palustrine forested wetlands observed in the Appalachian Highlands.

Dominance Type (Location)	Associates	
Ash (Washington County)	Trees:	Black Willow, Silver Maple, Box Elder, Red Maple
	Herbs:	Cocklebur, Wingstem, Goldenrod
Ash (Washington County)	Trees:	American Elm, Black Walnut
	Shrubs:	Redbud, Mulberry
Black Cherry (Garrett County)	Trees:	Red Maple, Swamp White Oak
	Shrubs:	Southern Arrowwood, Winterberry (wetter edges), Hawthorn
	Herbs:	Bluejoint, Cinnamon Fern, Jewelweed, Long Sedge (wetter edge)
	Others:	Swamp Dewberry
Black Cherry (Little Youghiogheny River, Garrett County)	Trees:	Ash
	Shrubs:	Hawthorn, Shadbush
	Herbs:	Jewelweed, Tall Meadow-rue, White Avens, Wild Rye Grass, Goldenrod
Common Hackberry (Sharman's Branch, Washington County)	Trees:	Bitternut Hickory, Shagbark Hickory, Sycamore, Flowering Dogwood, Witch Hazel, White Ash, Swamp White Oak
	Shrubs:	Spicebush, Black Haw, Redbud
	Herbs:	Virginia Knotweed, Moonseed, Jack-in-the-pulpit
	Others:	Japanese Honeysuckle, Common Greenbrier, Virginia Creeper
Red Maple (Garrett County)	Trees:	Tulip Poplar, Green Ash
	Shrubs:	Spicebush, Winterberry, Northern Arrowwood, Multiflora Rosa
	Herbs:	Jewelweed, False Nettle, White Avens, White Grass, Virginia Knotweed, Clearweed, May Apple, Enchanter's Nightshade
	Others:	Poison Ivy, Virginia Creeper, Common Greenbrier
Red Maple (Garrett County)	Trees:	Ash
	Herbs:	White Grass, Jewelweed, Virginia Knotweed, Clearweed, Jack-in-the-pulpit
Red Maple (Mt. Briar Wetland Preserve, Washington County)	Trees:	American Elm, Green Ash, White Ash, Black Cherry, Tulip Poplar, Red Oak
	Shrubs:	Multiflora Rose, Spicebush, Arrowwood
	Herbs:	White Grass, White Avens, Yellow Wood Sorrel, Sedge, Jack-in-the-pulpit, Heal-all, Lobelia
Silver Maple-Box Elder-Sycamore (Potomac River, Washington County)	Trees:	Cottonwood
	Shrubs:	Pawpaw, Spicebush
	Herbs:	Wood Nettle, White Grass, Garlic Mustard, Smartweed, Avens, Pale Touch-me-not, Goldenrod

Table 6-34. Vascular plants associated with sinkhole ponds in western Maryland and West Virginia according to Bartgis (1992). (*Note:* These ponds are formed on sandstone and are not in direct contact with the underlying limestone.)

Herbs:
Grass-leaved Arrowhead (*Sagittaria graminea*)
Big-leaved Arrowhead (*S. latifolia*)
Water Parsnip (*Sium suave*)
Sensitive Fern (*Onoclea sensibilis*)
Devil's Beggar-ticks (*Bidens frondosa*)
Dwarf St. John's-wort (*Hypericum mutilum*)
Spotted St. John's-wort (*H. punctatum*)
Spreading Dogbane (*Apocynum androsaemifolium*)
Manna Grasses (*Glyceria acutiflora, G. septentrionalis, G. striata*)
Rice Cutgrass (*Leersia oryzoides*)
Sedges (*Carex comosa, C. gynandra, C. intumescens, C. lupulina, C. lurida, C. tribuloides, C. vesicaria*)
Three-way Sedge (*Dulichium arundinaceum*)
Spike-rushes (*Eleocharis obtusa, E. tenuis*)
Wool Grass (*Scirpus cyperinus*)
Barbed-bristle Bulrush (*Scirpus ancistrochaetus*)
Mermaid-weed (*Proserpinaca palustris*)
Soft Rush (*Juncus effusus*)
Bugleweeds (*Lycopus americanus, L. uniflorus*)
Mad-dog Skullcap (*Scutellaria lateriflora*)
Water Purslane (*Ludwigia palustris*)
Arrow-leaved Tearthumb (*Polygonum sagittatum*)
Water Smartweed (*Polygonum amphibium var. emersum*)
Dotted Smartweed (*Polygonum punctatum*)
Clayton's Bedstraw (*Galium tinctorium*)
Golden Saxifrage (*Chrysosplenium americanum*)
Overlooked Hedge-hyssop (*Gratiola neglecta*)
Meadow Spike-moss (*Selaginella apoda*)
Broad-leaved Cattail (*Typha latifolia*)
False Nettle (*Boehmeria cylindrica*)
Clearweed (*Pilea pumila*)
Violet (*Viola obliqua*)

Shrubs:
Common Winterberry (*Ilex verticillata*)
Swamp Rose (*Rosa palustris*)
Buttonbush (*Cephalanthus occidentalis*)

Vines:
Common Greenbrier (*Smilax rotundifolia*)

Trees:
Red Maple (*Acer rubrum*)
Black Birch (*Betula lenta*)
Persimmon (*Diospyros virginiana*)
Pin Oak (*Quercus palustris*)
Black Gum (*Nyssa sylvatica*)
Green Ash (*Fraxinus pennsylvanica*)
Black Willow (*Salix nigra*)

Aquatics:
Water Starwort (*Callitriche heterophylla*)
Duckweed (*Lemna minor*)
Spatterdock (*Nuphar luteum*)
Pondweed (*Potamogeton pulcher*)

Table 6-35. List of rare and uncommon plants associated with peat-dominated wetlands in western Maryland according to Fenwick and Boone (1984). Rare species may be threatened to extinction in the state. Species marked by an asterisk (*) are known only from these wetland types.

Rare Species	Uncommon Species
Pearly Everlasting (*Anaphalis margaritacea*)	Brown Sedge (*Carex brunnescens*)
Rough-leaved Aster (*Aster radula*)	Silvery Sedge (*Carex canescens*)
*Wild Calla (*Calla palustris*)	Inland Sedge (*Carex interior*)
Brome-like Sedge (*Carex bromoides*)	Bristle-stalked Sedge (*Carex leptalea*)
Necklace Sedge (*Carex projecta*)	Three-seeded Sedge (*Carex trisperma*)
Beaked Sedge (*Carex rostrata*)	Round-leaved Sundew (*Drosera rotundifolia*)
Yellow Clintonia (*Clintonia borealis*)	Virginia Cottongrass (*Eriophorum virginicum*)
Goldthread (*Coptis trifolia*)	Narrow-leaved Gentian (*Gentiana linearis*)
*Early Coralroot (*Corallorhiza trifida*)	Ground Cedar (*Lycopodium tristachyum*)
*Bunchberry (*Cornus canadensis*)	Mountain Holly (*Nemopanthus mucronatus*)
Showy Lady's-slipper (*Cypripedium reginae*)	Red Spruce (*Picea rubens*)
Woodland Horsetail (*Equisetum sylvaticum*)	Rose Pogonia (*Pogonia ophioglossoides*)
*Creeping Snowberry (*Gaultheria hispidula*)	White Beak-rush (*Rhynchospora alba*)
Narrow-panicled Rush (*Juncus brevicaudatus*)	Canada Burnet (*Sanguisorba canadensis*)
*Larch (*Larix laricina*)	Bog Goldenrod (*Solidago uliginosa*)
*Appalachian Twayblade (*Listera smallii*)	American Mountain-ash (*Sorbus americana*)
Canada Honeysuckle (*Lonicera canadensis*)	Green-fruited Bur-reed (*Sparganium chlorocarpum*)
Bog Clubmoss (*Lycopodium inundatum*)	American Yew (*Taxus canadensis*)
*Buckbean (*Menyanthes trifoliata*)	Bog Fern (*Thelypteris simulata*)
Large Purple-fringed Orchid (*Platanthera grandiflora*)	Large Cranberry (*Vaccinium macrocarpon*)
*Jacobs-Ladder (*Polemonium van-bruntiae*)	Velvet-leaf Blueberry (*Vaccinium myrtilloides*)
*Skunk Currant (*Ribes glandulosum*)	
*Pussy Willow (*Salix discolor*)	
*Small Cranberry (*Vaccinium oxycoccos*)	

Wetland Values

Introduction

Wetlands provide many functions that are now highly valued by people (Table 7-1). These values are essentially produced free-of-charge. Maryland's wetlands have been traditionally used for hunting, trapping, fishing, berry and timber harvest, bird watching, and livestock grazing. Chesapeake Bay wetlands are recognized as some of the most important wetland areas in the United States and have received worldwide recognition as "Wetlands of International Importance Especially as Waterfowl Habitat" under the 45-nation Ramsar Convention treaty. Traditional uses of wetlands tend to preserve their integrity, although the qualitative nature of wetlands may be modified, especially by livestock grazing and timber harvest. Human uses are not limited to these activities, but also include destructive and often irreversible actions such as drainage for agriculture and filling for industrial or residential development. In the past, most people considered wetlands to be wastelands whose best use could only be attained through "reclamation projects" which led to the destruction of many wetlands. Unfortunately, some people still hold this belief, despite many recognized functions that clearly benefit society. These benefits can be divided into three basic categories: (1) fish and wildlife values, (2) environmental quality values, and (3) socio-economic values. The following discussion emphasizes the more important values of Maryland's wetlands, with significant national examples also presented. This chapter is intended to be an overview of wetland values, and is not an exhaustive treatment for Maryland. It should give readers a better understanding of why wetlands are important natural resources. For a closer examination of wetland values, the reader is referred to *Wetland Functions and Values: The State of Our Understanding* (Greeson *et al.* 1979) and *Wetlands* (Mitsch and Gosselink 1986). In addition, the U.S. Fish and Wildlife Service has created and maintains a wetland values database which records abstracts for over 5,000 articles. *(Note: All tables, except Table 7-1, are placed at the end of this chapter.)*

Table 7-1. List of major wetlands values.

Fish and Wildlife Values

- Fish and Shellfish Habitat
- Waterfowl and Other Bird Habitat
- Mammal and Other Wildlife Habitat

Environmental Quality Values

- Water Quality Maintenance
  - Pollution Filter
  - Sediment Removal
  - Oxygen Production
  - Nutrient Recycling
  - Chemical and Nutrient Absorption
- Aquatic Productivity
- Microclimate Regulator
- World Climate (Ozone layer)

Socio-economic Values

- Flood Control
- Wave Damage Protection
- Shoreline Erosion Control
- Groundwater Recharge
- Water Supply
- Timber and Other Natural Products
- Energy Source (Peat)
- Livestock Grazing
- Fish and Shellfishing
- Hunting and Trapping
- Recreation
- Aesthetics
- Education and Scientific Research

Fish and Wildlife Values

Many species of birds, mammals, reptiles and amphibians use or depend on wetlands for breeding, wintering, and stopover during migration. Wetlands supply food, breeding sites, and escape and cover areas for these animals. Because many wetlands support abundant vegetation and are often associated with surface waters, wildlife have needed access to water supplies and food sources such as aquatic and terrestrial wildlife, insects, living plants, and decayed vegetation. Riverine wetlands support diverse plant and animal species because of varying water velocities, temperatures and depths. These features create numerous micro-environments for wildlife. Wetlands and nearby waters serve as important spawning or nursery sites for many finfish and shellfish species such as spot, croaker, striped bass, menhaden, herring, and shad, as well as clams, oysters, and blue crabs. As clearing of upland forests continues at a rapid rate in many urbanizing areas of Maryland, wetlands along protected floodplains often become the only remaining habitat for wildlife. Wetlands are also essential habitat for many rare and endangered animals and plants.

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.

[1]Waterfowl 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 Paridiso (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)

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

nitrate concentration were observed along two different transects. The calculated phosphorus retention by this forested wetland was 80 percent. Forested wetlands on the Western Shore have been shown to be effective water quality buffers between Coastal Plain bogs and the upstream watershed (Whigham 1987).

Wetlands along rivers and streams are important for sediment retention, nitrogen processing, and phosphorus removal. Whigham and others (1988) suggested that the water quality functions of wetlands might best be understood in relation to their position on the landscape. They suggest that riparian wetlands are perhaps most important for nutrient processing of groundwater and retention of larger sediment particles, while farther downstream, additional phosphorus can be removed from surface waters, most notably in areas where water flows through the vegetation/litter zone. Forested wetlands were most effective in nutrient retention and sedimentation during floods. The upper portion of floodplain forests that are rarely flooded was not as effective as the frequently inundated areas. Studies in Coastal Plain floodplains of North Carolina have shown that increased inundation of the floodplain (e.g., greater than 50%) led to a significant increase in phosphorus retention, so forested wetlands along rivers are very efficient at retaining phosphorus during floods (Yarbro *et al.* 1984). Freshwater tidal wetlands have proven effective in reducing nutrient and heavy metal loading from surface water runoff from urban areas in the upper Delaware River estuary (Simpson *et al.* 1983c). It is, however, possible to overload a wetland and thereby reduce its ability to perform this function. Every wetland has a limited capacity to absorb nutrients and individual wetlands differ in their ability to do so.

Wetlands have been shown to be excellent removers of waste products from water. Sloey and others (1978) summarize the value of freshwater wetlands at removing nitrogen and phosphorus from the water and address management issues. They note that some wetland plants are so efficient at this task that some artificial waste treatment systems are using these plants. A $57 million dollar sewage treatment facility for the Mayo peninsula in Anne Arundel County uses wetlands to treat wastewater. The facility will eventually serve most residents of the area and will process up to one million gallons of wastewater per day. After raw wastewater is processed through sand filters, it then passes through a manmade marsh of cattail and bulrush for suspended solids and nitrogen removal. Ultraviolet disinfection is then used

Figure 7-7. The location of wetlands along rivers and in areas of sediment deposition make them good sites for filtering and storing nutrients, pollutants, and other water-borne materials thereby improving water quality. (Ralph Tiner photo)

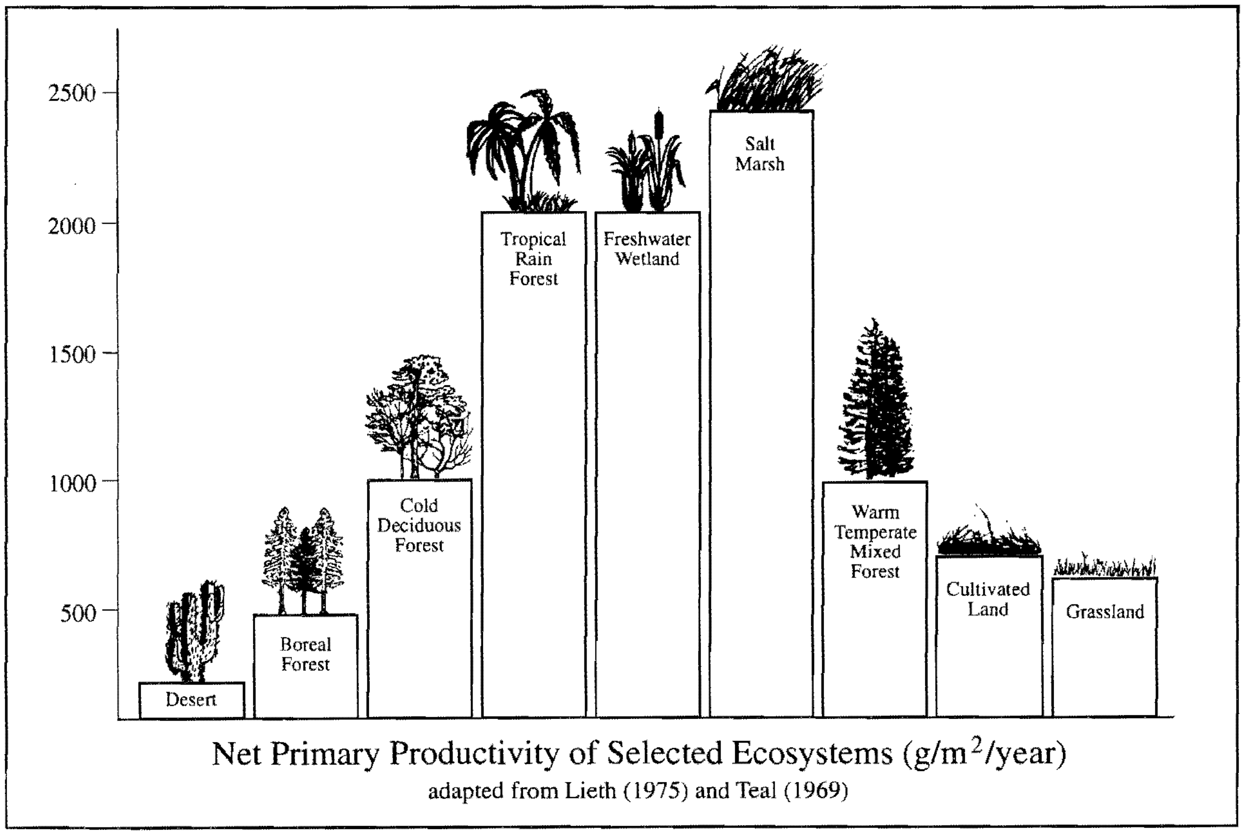

Figure 7-8. Certain wetlands are among the world's most productive ecosystems. (Redrawn from Newton 1981)

to kill germs before the wastewater flows through peat wetlands, where the molecular composition of the wastewater is changed and phosphates are trapped in the wetland. After a final ultraviolet disinfection process is completed, the effluent is released. Preliminary water tests show the complete system produces an effluent containing a fifth of the suspended solids, phosphates and nitrogen of effluent contained in the new Patuxent Water Reclamation Facility in Crofton (Williams 1989).

The Department of Natural Resources has successfully used existing peat wetlands and artificially created cattail marshes to treat coal mine acid drainage at several sites in western Maryland. Acid mine drainage occurs when air and water in the presence of naturally occurring bacteria comes in contact with soil or rock particles containing sulfur and iron compounds left after coal is removed. Test data collected by the Department's Bureau of Mines have shown that wetlands are able to decrease water acidity, manganese, sulfate and, especially, iron. At one site, water samples showed a drop in iron content from 21.0 ppm to 1.14 ppm after treatment by the wetlands (Kepple 1987). Numerous scientists have proposed that certain types of wetlands be used to process domestic wastes and some wetlands are already used for this purpose (Sloey *et al.* 1978; Carter *et al.* 1979; Kadlec 1979). It must, however, be recognized that individual wetlands have a finite capacity for natural assimilation of excess nutrients and research is needed to determine this threshold (Good 1982). Also, caution should be exercised in using natural wetlands to treat various wastewaters. At the present time, created wetlands seem to be the better option.

Wetlands play a valuable role in reducing turbidity of flooding waters. This is especially important for aquatic life and for reducing siltation of ports, harbors, rivers and reservoirs. Removal of sediment load is also valuable because sediments often transport absorbed nutrients, pesticides, heavy metals and other toxins which pollute our Nation's waters (Boto and Patrick 1979). Depressional wetlands should retain all of the sediment entering them (Novitzki 1978). In Wisconsin, watersheds with 40 percent coverage by lakes and wetlands had 90 percent less sediments in water than watersheds with no lakes or wetlands (Hindall 1975). Creekbanks of salt marshes typically support more productive vegetation than the marsh interior. Deposition of silt is accentuated at the water-marsh interface, where vegetation slows the velocity of water, causing sediment to drop out of solution. In addition to improving water quality, this process

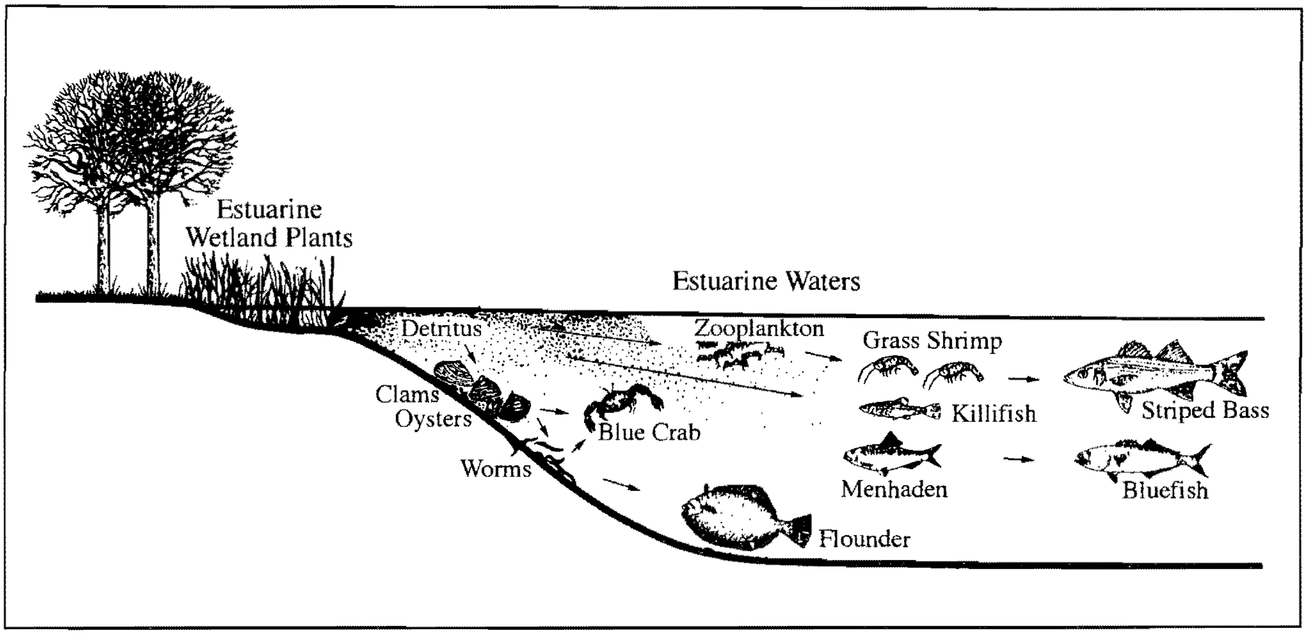

Figure 7-9. Tidal marshes are the estuarine farmlands that produce tons of food each year that support Chesapeake Bay's living aquatic resources and ultimately, provide food for human consumption. Simplified food pathways from tidal marsh plants to commercial and sport fishes of value to humans are shown.

adds nutrients to the creekside marsh which leads to higher plant density and plant productivity (DeLaune *et al.* 1978).

The U.S. Army Corps of Engineers has investigated the use of marsh vegetation to lower turbidity of dredged disposal runoff and to remove contaminants. In a 50-acre dredged material disposal impoundment near Georgetown, South Carolina, after passing through about 2,000 feet of marsh vegetation, the effluent turbidity was similar to that of the adjacent river (Lee *et al.* 1976). Wetlands have also been proven to be good filters of nutrients and heavy metal loads in dredged disposal effluents (Windom 1977).

The ability of wetlands to retain heavy metals has been reported (Banus *et al.* 1974; Mudroch and Capobianca 1978; Simpson *et al.* 1983c). Wetland soils have been regarded as primary sinks for heavy metals, while wetland plants may play a more limited role. Waters flowing through urban areas often have heavy metals (e.g., cadmium, chromium, copper, nickel, lead, and zinc). The ability of freshwater tidal wetlands, along the Delaware River in New Jersey, to sequester and hold heavy metals has been documented (Good *et al.* 1975; Whigham and Simpson 1976; Simpson *et al.* 1983a, 1983b, 1983c). Simpson and Good (1985) concluded that all tidal wetlands including those fringing the Chesapeake Bay and its associated estuaries, play an important role in mitigating the impacts of heavy metals from upland and upstream ecosystems.

Aquatic Productivity

Wetlands are among the most productive ecosystems in the world and they may be the highest, exceeding our best cornfields (Figure 7-8). Wetland plants are particularly efficient converters of solar energy. Through photosynthesis, plants convert sunlight into plant material or biomass and produce oxygen as a by-product. Other materials, such as organic matter, nutrients, heavy metals, and sediment, also are captured by wetlands and either stored in the sediment or converted to biomass (Simpson *et al.* 1983a). This biomass serves as food for a multitude of animals, both aquatic and terrestrial. For example, many waterfowl depend heavily on seeds of marsh plants, while muskrats eat cattail tubers and young shoots. Surprisingly, one of the favorite winter foods of the eastern cottontail is the tender new growth of red maples (Cronan and Brooks 1968). American strawberry-bush (*Euonymus americanus*) seems to be a preferred food for some mammals, perhaps deer and/or cottontails, as the senior author has seen evidence of heavy browsing in many forested wetlands. Browsing is so intense that the plant is most commonly observed as a twiglike "seedling" less than one foot tall.

Although direct grazing of wetland plants may be considerable in freshwater marshes, their major food value to most aquatic organisms is reached upon death when plants break down to form "detritus." This detritus forms the base

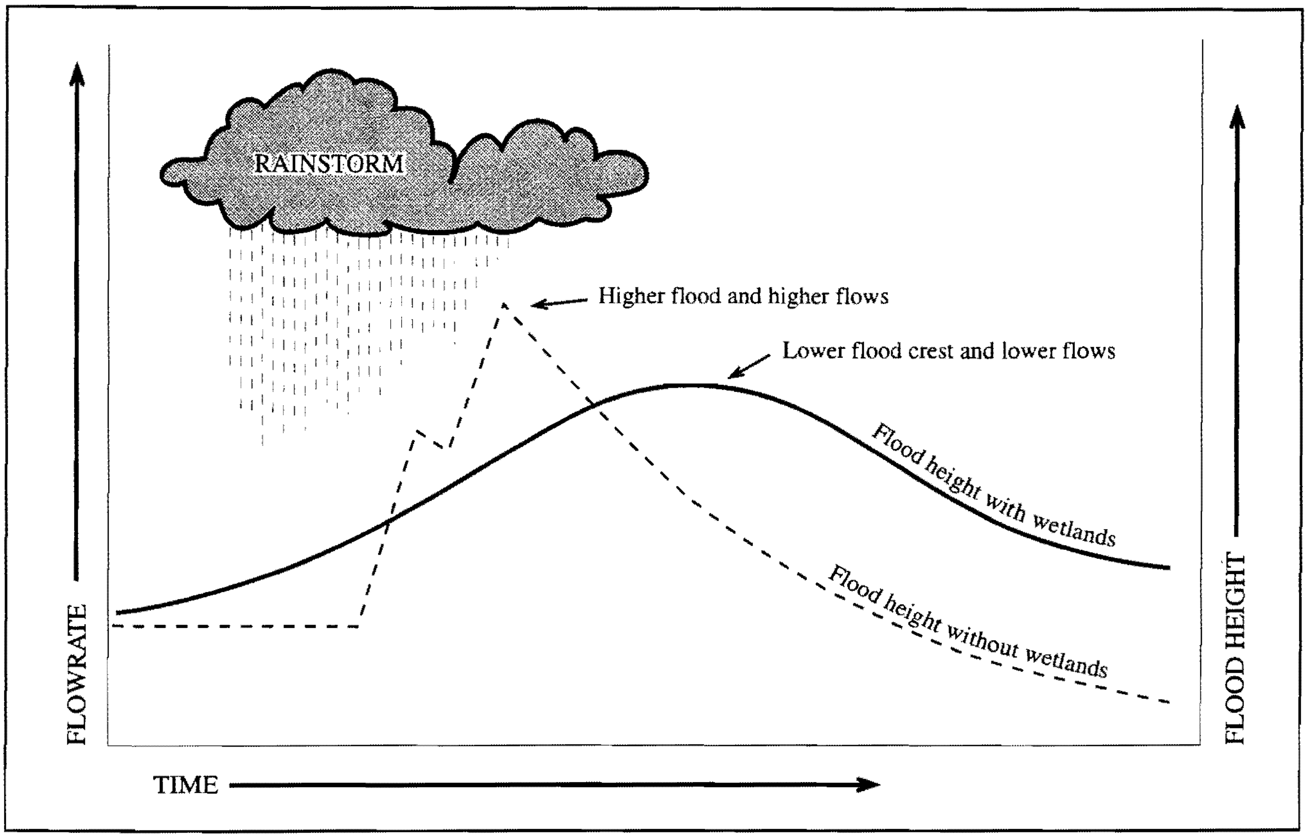

Figure 7-10. Wetlands provide important flood control functions in watersheds; they help reduce flood heights and flow rates, while delaying flood crests after rainstorms. (Redrawn from Kusler 1983)

of an aquatic food web that supports higher consumers, e.g., commercial fishes. This relationship is especially well-documented for coastal areas. Animals like zooplankton, shrimp, clams, worms, killifish and mullet eat detritus or graze upon the bacteria, fungi, diatoms and protozoa growing on its surfaces (Crow and MacDonald 1979; de la Cruz 1979). Forage fishes (e.g., anchovies, sticklebacks, killifishes, and silversides) and grass shrimp are the primary food for commercial and sport fishes, including bluefish, flounder, weakfish, and white perch (Sugihara *et al.* 1979). A simplified food web for the Chesapeake Bay is presented as Figure 7-9. Thus, wetlands can be regarded as the farmlands of the aquatic environment where great volumes of food are produced annually. The majority of non-marine aquatic animals also depend, either directly or indirectly, on this food source.

Socio-economic Values

The more tangible benefits of wetlands to society may be considered socio-economic values and they include flood and storm damage protection, erosion control, water supply and groundwater recharge, harvest of natural products, livestock grazing and recreation. Since these values provide either dollar savings or financial profit, they are more easily understood by most people.

Flood and Storm Damage Protection

About 6 percent of the land area of the conterminous United States is prone to flooding by streams. Flood damages in 1986 were more than $6 billion dollars, causing 208 fatalities, 80 percent of which were attributed to flash floods (Council of Environmental Quality 1989). Many approaches, such as dam construction and restriction of development in floodplains, have been used to reduce damages due to flood losses, yet wetlands may play an important role in solving this national problem.

Wetland scientists have become increasingly interested in the capacity of wetlands to store surface water runoff and reduce flood peaks and the effect of wetland drainage on streamflow characteristics. In many instances, the combination of dense vegetation, fallen logs, hummocks, topographical depressions and braided, constricted or circuitous stream channel segments often characteristic of many wetland systems, can provide a significant amount of water storage and frictional resistance to surface waters passing through wetlands during flood events. This interaction with the wetland can slow the flow of water, store it temporarily and slowly release it downstream, thereby protecting downstream property owners from flood damage. This process may also lower water velocity and wave heights, thus reducing the water's erosive potential (Figure 7-10). Second, waters passing through these areas may be released over a longer period of time which may help to maintain streamflow within the defined channel and thereby reducing the amount of area flooded. Third, and most important, wetlands may reduce the peak flood heights as well as delay the flood crest. This becomes increasingly important in urban areas, where development has increased the rate and volume of surface water runoff and the potential for flood damage (Figure 7-11). The degree to which these functions are performed by a wetland may vary greatly.

Adamus and Stockwell (1983) identify several factors affecting wetlands function relative to flood storage and attenuation of peak flows: (1) the magnitude and duration of storms, (2) the ability of upslope areas to retain and dissipate runoff, (3) the above and below ground storage capacity of the wetland, (4) the frictional resistance of the wetland, and (5) the position of the wetland in the watershed. They point out that wetlands are more likely to store peak flows if these flows enter gradually and if the drainage area of the watershed is small relative to the size of the wetland. This is particularly true for nontidal palustrine, lacustrine, and upper (high in the watershed) riverine wetlands. Clark and Clark (1979) observed that the effectiveness of wetlands is generally greatest during high-intensity, short-duration storm events, which generate the largest floods, and less effective for smaller floods generated from longer-duration rainfall or snowmelt. In Maryland, it has been suggested that much of the flooding-related damages to property are due to these more frequent high-intensity, short duration events that are often unreported or ineligible for Federal flood insurance claims (Rebbecca Quinn, pers. comm.).

Winter (1988) concluded that most studies indicate that drainage basins containing wetlands have different runoff characteristics than drainage basins that do not contain wetlands. For example, Novitzki (1979), using Conger's (1971) regression analyses of 13 watershed characteristics from Wisconsin watersheds, concluded that in basins with 40 percent lakes and wetlands compared to basins lacking or with few lakes and wetlands, flood flows may be lowered as much as 80 percent. Pothole wetlands in the Devils Lake basin of North Dakota store nearly 75 percent of the total runoff (Ludden *et al.* 1983). Winter (1988) has pointed out that although such statistically based studies are useful, the results are difficult to apply on a general basis.

In specific situations, wetlands have been determined to be particularly valuable in mitigating flooding problems. The U.S. Army Corps of Engineers has recognized the value of wetlands for flood storage in Massachusetts. In the early 1970s, they considered various alternatives to providing flood protection in the lower Charles River watershed near Boston, including: (1) 55,000 acre-foot reservoir, (2) extensive walls and dikes, and (3) perpetual protection of 8,500 acres of wetland (U.S. Army Corps of Engineers 1976). If 40 percent of the Charles River wetlands were destroyed, flood damages would have increased by at least $3 million annually. Loss of all basin wetlands would cause an average annual flood damage cost of $17 million (Thibodeau and Ostro 1981). The Corps concluded that wetlands protection—"Natural Valley Storage"—was the least-cost solution to future flooding problems. In 1983, they completed acquisition of approximately 8,500 acres of Charles River wetlands for flood protection. This protective value of wetlands has also been reported for other areas. Undeveloped floodplain wetlands in New Jersey protect against flood damages (Robichaud and Buell 1973). In the Passaic River watershed, annual property losses to flooding approached $50 million in 1978 and the

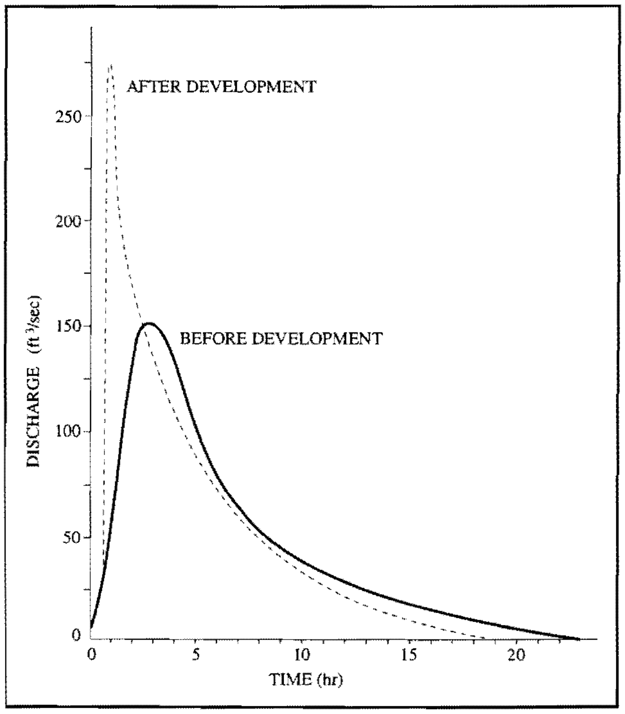

Figure 7-11. Impervious surfaces of urban development increase peak discharge in rivers. (Redrawn from Fusillo 1981)

Figure 7-12. Homes built on former wetlands may be threatened by periodic flooding, despite minor filling to raise the land surface. (Drew Koslow photo)

Corps of Engineers in considering wetland acquisition as an option to prevent flood damages from escalating in the future (U.S. Army Corps of Engineers 1979).

In Maryland, the major flood-prone population resides in the tidal/coastal floodplain, however, with the exception of the state's oceanfront community and a few Chesapeake Bay locations subject to wave attack, the most hazardous types of flooding are generally beyond the areas flooded by tides (Marguerite Whilden, pers. comm.; Figure 7-12). Given what is known about the flood control functions of nontidal wetlands and flooding events in Maryland, there may be watershed-specific situations in nontidal areas where wetlands regulatory protection or acquisition programs are important considerations in mitigating the effects of flooding. In tidal areas, wetlands have been proven effective in lessening damages resulting from wave attack and currents which cause flooding (see discussion below) and may sometimes reduce or increase flooding depending upon tidal conditions (Clark and Clark 1979).

Shoreline Erosion Control

Located between watercourses and uplands, wetlands help protect uplands from erosion. Wetland vegetation can reduce shoreline erosion in several ways, including: (1) increasing durability of the sediment through binding with its roots, (2) dampening waves through friction, and (3) reducing current velocity through friction (Dean 1979). This process also helps reduce turbidity and thereby helps improve water quality.

Shoreline erosion is a major problem in the Chesapeake Bay. Slaughter (1967) determined nearly 25,000 acres of land were lost to erosion between the mid-1800s and 1947. Spoeri and others (1985) summarized the findings of other authors, citing that besides the complete disappearance of certain Bay islands and extensive shoreline loss damages, eroded shoreline sediments form a measurable contribution to the sediment budget for the upper Chesapeake Bay. The authors indicated that sediments from erosion in the northernmost portion of the Bay (above 39°13'N, 76°14'W) equaled about 12 percent of the annual sediment discharge of the Susquehanna River (the principal source of fluvial sediment in the Maryland portion of the Bay). From the Potomac River to this northern most portion of the Bay, shoreline sediments were equivalent to 30 percent of the annual sediment discharge of the Susquehanna River (Biggs 1970).

The Department of Natural Resources has made extensive use of wetland vegetative stabilization techniques to reduce shoreline erosion in low wave energy areas (Figure 7-13). As an important part of the state's Chesapeake Bay Restoration Program, a number of 50 percent matching grants to property owners have been made to plant, principally, smooth cordgrass (*Spartina alterniflora*) in the intertidal zone, and salt hay grass (*Spartina patens*) above mean high tide. Other wetland plant species including big cordgrass (*Spartina cynosuroides*) and salt grass (*Distichlis spicata*), and American beach grass (*Ammophila breviligulata*) have been successfully used to control shoreline erosion in the supratidal zones in Chesapeake Bay (Clark and Clark 1979). Using these wetland creation techniques, the Department of Natural Resources has protected 63,290 linear feet of shoreline, created nearly 30 acres of wetlands, and conserved an estimated 22,929 cubic yards per year of sediments from entering the waterways of Maryland (Leonard Larese-Casanova, pers. comm.).

In freshwater areas, willows (*Salix* spp.), alders (*Alnus* spp.), ashes (*Fraxinus* spp.), cottonwoods and poplars (*Populus* spp.), maples (*Acer* spp.), and elms (*Ulmus* spp.) are particularly good stabilizers (Allen 1979). Their roots bind the soil, making it more resistant to erosion, while their trunks and branches slow the flow of flooding waters and dampen wave heights. In fact, trees are such good stabilizers that the banks of some rivers have not been eroded for 100 to 200 years due to the presence of trees (Leopold and Wolman 1957; Wolman and Leopold 1957; Sigafoos 1964). Successful emergent plants in freshwater areas include reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.) (Hoffman 1977).

Groundwater Discharge and Recharge

The science of wetland hydrology is relatively recent and still evolving. Winter (1988) provided an extensive discussion of the nature of wetland hydrology in a conceptual framework

Figure 7-13. The State of Maryland is encouraging the construction of wetlands to control shoreline erosion. Project site at Wye Island (Queen Annes County): immediately after planting (top) and six months later (bottom). (Maryland Department of Natural Resources photo)

he described for assessing cumulative impacts on the hydrology of nontidal wetlands. Winter observed that it may be appropriate to assume that regional groundwater flow systems are recharged in uplands and discharged in lowlands (wetlands). At the same time, he noted that similar assumptions commonly do not apply on a local scale because of the spatial and temporal dynamics of groundwater recharge. Wetlands often have regional discharge and recharge relationships, whereby the water recharging an aquifer below a wetland positioned in uplands may partially discharge to a downgradient wetland. Discharge-recharge relationships between wetlands and groundwater may vary according to the position of the wetland in the landscape, size and porosity of underlying sediments, climatic conditions, seasonality, the groundwater piezometric surface, and other factors which influence surface and groundwater flow rates.

Some of these discharge-recharge relationships have been observed in Maryland and nearby wetlands. At Blackbird State Forest in Delaware, the U.S. Geological Survey is conducting a study of the hydrology and hydrochemistry of an undisturbed forested area containing many small seasonal ponds (less than 3 acres in size) with rare plant and animal species. Observations at the study area show that water levels are higher in the ponds and the sediments underlying them than they are in the surrounding uplands during mid-May through February. From February through mid-May this relationship changes with water-table gradients sloping from the uplands to the ponds. It is believed that much of the water in the ponds is derived from discharge from adjacent shallow groundwater sources developed in response to summer rainfall events (Phillips 1990).

Surface and groundwater relationships in the Zekiah Swamp Run Basin were studied by Hopkins and others (1986). They found that the swamp is underlaid by a thin water-table alluvium aquifer generally less than 20 feet thick and that most of the year this water table is above Zekiah Swamp Run, and therefore contributes to and helps maintain streamflow. At times of high evapotranspiration during the summer, the surrounding water table dropped below stream level, causing water from the stream to move into the alluvium below the swamp. Pumping of groundwater from the Aquia and Magothy aquifers has resulted in sharp water table declines (40–60 feet, respectively) and has increased the downward gradient between the water-table aquifer in the swamp and these underlying confined aquifers. The significance for potential loss of water from the swamp as a result of these declines cannot be determined without further technical studies.

In summary, as noted by Winter (1988), the hydrologic system is a continuum. A modification of one component will have an effect on contiguous components and lack of understanding of such hydrologic factors (as noted in these and similar studies) can lead to misunderstanding of the hydrologic function of wetlands within various positions of the landscape and mismanagement of wetland ecosystems. Wetland protection and groundwater pollution control could be instrumental in helping to solve current and future water supply problems.

Harvest of Natural Products

A variety of natural products are produced by wetlands including timber, fish and shellfish, wildlife, peat moss, cranberries, blueberries, and wild rice. Wetland grasses are hayed in many places for winter livestock feed. During other seasons, livestock graze directly in numerous Maryland wetlands.

Nearly 42 percent of the state, or approximately 2.7 million acres are forest lands. Approximately 95 percent of Maryland's forest land is classified as commercial forest. The forest industry is the fifth largest industry in the state, contributing an estimated $440 million annually to the state's economy (Maryland Department of Natural Resources 1988). Although forested wetlands comprise a portion of Maryland's total forest industry, specific data on the relative commercial importance of forested wetlands species are unknown. Preliminary surveys conducted by DNR's Forest, Parks and Wildlife Service personnel suggest that many hardwood species of local commercial importance found in wetlands along floodplains and bottomlands do not grow as well as the same species found in upland areas. This is particularly true of facultative tree species which are found frequently in upland areas such as red maple, yellow-poplar, sweet gum, hickory, and various oak species (Terrance Clark, pers. comm.). While not commonly thought of as a "wetland" tree species, loblolly pine is found in both nontidal and tidal (to a far lesser extent) wetlands. The loblolly pine wetlands of the lower Eastern Shore are potentially the most commercially important forested wetland type in Maryland. Many of these areas are sufficiently drained to be commercially productive, yet are still wet enough to be classified as wetlands. Of the logs harvested in any single year, loblolly pine represents 31 percent of the total harvest, or second only to oak species. The forestry industry is the second largest employer on the Eastern Shore. Loblolly pine/short leaf forest type represents 12.1 percent of the forest types in Maryland (Maryland Department of Natural Resources 1988).

Figure 7-14. Wetland and associated waterbodies are great places to observe unique and interesting plants and animals. (Ralph Tiner photo)

Many wetland-dependent fishes and wildlife are also used by society. Commercial fishermen and trappers make a living from these resources. In 1987, Maryland ranked 15th in the United States for commercial fish landings, registering over 81 million pounds harvested with a direct value of over $53 million dollars (Department of Commerce 1989) (Table 7-10). Associated commercial fisheries industry expenditures such as picking, packing, transporting, equipment purchases, and other goods and services used by commercial fishermen contribute substantial sums to the Maryland economy.

Many furs come from wetland associated animals. Nationally, and in Maryland, furs from beaver, mink, nutria, otter and raccoon are harvested in commercially important quantities. The harvest value of these furbearers in Maryland has averaged well over $1 million per year from 1979 to 1987 (Table 7-11). By far, muskrat values exceed those of all other species, with raccoons ranking a distant second.

Recreation and Aesthetics

Many recreational activities take place in and around wetlands. Hunting and fishing are popular sports. Waterfowl hunting is a major activity in wetlands, but big game hunting is also important locally. In 1985, 186,600 Maryland residents spent an average of 20 days hunting and approximately $103 million in related expenses. In 1985, 980,000 residents and nonresidents fished an average of two weeks in Maryland. About two-thirds of these fishermen were Marylanders (Department of the Interior 1989). A recent report from the Sport Fishing Institute (1988) indicated that sport fishing in Maryland accounted for $314 million in direct expenditures.

Other recreation in wetlands is largely non-consumptive and involves activities like hiking, nature observation and photography, and canoeing and other boating. Many people simply enjoy the beauty and sounds of nature and spend their leisure time walking or boating in or near wetlands and observing plant and animal life (Figure 7-14). This aesthetic value is extremely difficult to place a dollar value upon, although people spend a great deal of money traveling to places to enjoy the scenery and to take pictures of these scenes and plant and animal life. In 1985, there were almost 2.2 million Maryland residents who took an active interest in wildlife around their homes by participating in activities including observing, photographing or feeding wildlife; visiting public parks; maintaining natural areas; or maintaining food or cover plants to benefit wildlife (Department of the Interior 1989).

Summary

Marshes, swamps and other wetlands are assets to society in their natural state. They provide numerous products for human use and consumption, protect private property and provide recreational and aesthetic appreciation opportunities. Wetlands may also have other values yet unknown to society. For example, a microorganism from Pine Barrens swamps of southern New Jersey has been discovered to have great value to the drug industry. In searching for a new source of antibiotics, the Squibb Institute examined soils from around the world and found that only one contained microbes suitable for producing a new family of antibiotics. From a Pine Barrens swamp microorganism, scientists at the Squibb Institute have developed a new line of antibiotics which will be used to cure diseases not affected by present antibiotics (Moore 1981). This represents a significant medical discovery. If these wetlands were destroyed or grossly polluted, this discovery might not have been possible.

Destruction or alteration of wetlands eliminates or minimizes their values. Drainage of wetlands, for example, eliminates all the beneficial effects of the wetlands on water quality and directly contributes to flooding problems (Lee *et al.* 1975). While the wetland landowner can derive financial profit from some of the values mentioned, the general public receives the vast majority of wetland benefits through flood and storm damage control, erosion control, water quality improvement and fish and wildlife resources. It is, therefore, in the public's best interest to protect wetlands to preserve these values for themselves and future generations. Since over half of the Nation's original wetlands have already been destroyed, the remaining wetlands are even more valuable as public resources.

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

	Wetland Type		
Species	Forested	Scrub-shrub	Emergent
Grebes			
Pied-billed Grebe—H			WMN+
Wading Birds			
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
Waterfowl			
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+
Birds of Prey			
Northern Harrier—H			WMN
Red-shouldered Hawk	WMN		
Gallinaceous Game Birds			
Ring-necked Pheasant*		W	W
Ruffed Grouse*	W	W	
Rails			
Virginia Rail		WMN	WMN+
Sora—H			MN+
Black Rail—I		MN+	MN+
Common Moorhen—I			MN+
Shorebirds			
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
Owls			
Eastern Screech-owl*	WN		
Great Horned Owl*	WN		
Barred Owl*	WN		
Northern Saw-whet Owl—H	WM	WM	
Hummingbirds			
Ruby-throated Hummingbird	M	MN	
Kingfishers			
Belted Kingfisher	WMN		
Woodpeckers			
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		
Perching Birds			
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	Forested	Wetland Type Scrub-shrub	Emergent
Perching Birds (continued)			
Black-capped Chickadee*	WN	WN	
Carolina Chickadee*	WN	WN	
Tufted Titmouse*	WN	WN	
Red-breasted Nuthatch—H	WMN		
White-breasted Nuthatch	WM	WM	
Brown Creeper	WMN	WM	
Carolina Wren*	WN	WN	
Winter Wren—H	WMN	WM	
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-cheeked 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		

Species	Forested	Wetland Type Scrub-shrub	Emergent
Perching Birds (continued)			
Northern Cardinal*	W	WN	
Song Sparrow		WMN	
Swamp Sparrow	WM	WMN+	WMN+
White-throated Sparrow	WM	WM	
Red-winged Blackbird	W	WMN	WMN
Rusty Blackbird	WM	WM	WM
Total Species	80	67	57
Total Dependent Species	10	13	28

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).

	Wetland Type		
Species	Forested	Scrub-shrub	Emergent
Marsupials			
Virginia Opossum	X	X	X
Shrews and Moles			
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+
Rabbits			
Eastern Cottontail	X	X	X
Rodents			
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+
Carnivores			
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	
Deer			
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			
Salamanders			
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+		
Frogs and Toads			
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			
Lizards			
Ground Skink	X		
Northern Coal Skink—E	X	X	X
Five-lined Skink	X		
Broad-headed Skink	X	X	
Snakes			
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
Turtles			
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

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

ENDANGERED PLANT SPECIES

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

Table 7-7. (continued)

THREATENED PLANT SPECIES

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

Table 7-10. Maryland fish and shellfish landings and value, inshore and offshore (less than 3 miles from the coast). (Source data from National Marine Fisheries Service; table from Lipton 1987).

Species	Inshore Pounds (000)	Inshore Dollars (000)	Offshore Pounds (000)	Offshore Dollars (000)	Total Pounds (000)	Total Dollars (000)
Fish						
Alewives	755	76			755	76
Bluefish	356	57	7	1	363	58
Butterfish	14	7	3	1	17	8
Croaker	75	24	45	17	120	41
Fl-Blackback	17	12			17	12
Fl-Fluke	122	143	199	202	321	345
Hake-Red			17	2	17	2
Mackerel-Atl.	1				1	
Menhaden	5753	357			5753	357
Mullet	1				1	
Sea Bass-Bk.	1	1	492	344	493	345
Sea Trout-Gray	346	208	17	3	363	211
Shark-Dogfish	14	5	61	8	75	13
Sharks-Unc.			20	24	20	24
Mackerel-Span.	3			1	3	1
Swordfish			322	1108	322	1108
Tilefish			1	2	1	2
Tuna-Albacore			1	1	1	1
Tuna-Bluefin			5	11	5	11
Tuna-Yellowfin			150	205	150	205
Tuna-Unc.	3	5	9	22	12	27
Tuna-Bigeye			118	466	118	466
Whiting	1				1	1
Fish-Other	2202	792	39	35	2241	827
Total Fish	9673	1699	1530	2486	11203	4185
Shellfish						
Crab-Blue-Hd	41988	20482			41988	20482
Crab-Soft-Pl	1880	4760			1880	4760
Crab-Other	23	37	51	75	74	112
Lobster-Amer.			50	192	50	192
Clam (meat) O.Q.			12368	3656	12368	3656
Clam (meat) Soft	3155	5645			3155	5645
Clam (meat) Surf			7669	3659	7669	3659
Oyster (meats)	3649	11794			3649	11794
Scallop (meats)		1	62	246	62	247
Squid	1		1		2	
Shellfish-Other	1817	4369	48	8	11865	4377
Total Shellfish	50206	41437	20249	7836	70455	49273
Grand Total	59879	43136	21779	10322	81658	53458

Table 7-11. Furbearer harvest values of wetlands related species from reported take in Maryland, 1979-87 (P. Jayne, pers. comm.).

	HARVEST VALUE BY SEASON (DOLLARS)							
Species	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Beaver	18,913	10,760	5,880	1,830	3,540	3,648	6,105	13,860
Mink	7,583	5,805	3,684	4,634	2,758	3,450	4,860	5,025
Muskrat	1,162,522	962,432	544,980	540,045	636,660	468,440	443,008	578,133
Nutria	580	624	305	108	36	54	108	822
Otter	15,939	8,195	6,008	3,870	4,260	3,075	3,150	4,360
Raccoon	626,800	564,432	464,202	372,000	229,980	198,648	211,392	265,824
Total	1,832,337	1,552,248	1,025,059	922,487	877,234	677,315	668,623	868,024
Expanded Total*	3,303,006	2,806,760	1,854,017	1,672,585	1,588,589	1,225,981	1,208,106	1,563,318

* "Expanded" totals are the estimated total dollar values of the harvest. Expanded totals more accurately reflect total harvest values since the "reported" take historically under-represents the actual take. Conversion factors for each species are developed by comparing pelt tag totals with reported takes.

Maryland Wetland Trends

Introduction

Conservation-minded government agencies, private groups, and individuals have long recognized the importance of wetlands to fish and wildlife. Wetlands have historically been viewed by most of the general public as wastelands—lands best suited for conversion to other uses such as agriculture, landfills, industrial sites, and residential housing and some people still hold this view. The general public's attitude towards wetlands has been changing since the 1970s and a majority of the public now considers wetlands to be valuable natural resources due to their multitude of values (see Chapter 7). Many consumptive uses (e.g., agriculture or housing) result in the physical destruction of wetlands and the losses of the environmental benefits and public values that wetlands naturally provide. Other uses alter the character or quality of a wetland but do not destroy all of its natural values. For example, the diking and other restrictions of tidal flow of water into coastal marshes along Chesapeake Bay have disrupted their ecology and estuarine productivity, yet these wetlands still provide wildlife habitat and other functions. In addition, certain development activities may indirectly impact the functional capacity of wetland areas by changing drainage or nutrient input from adjacent sites. The following discussion addresses factors causing wetland change and presents an estimate of wetland alteration in Maryland. For information on national wetland trends, the reader is referred to Tiner (1984) for trends prior to the 1980s and to Dahl and Johnson (1991) and Frayer (1991) for trends between the mid-1970s and mid-1980s.

This chapter is based largely on recent studies of wetland trends conducted by the U.S. Fish and Wildlife Service (Service). These studies used a technical definition of wetland (see Chapter 2) and consequently reflect changes in the overall wetland resources. These studies did not separate regulated wetlands from those that are not regulated, and the results, therefore, cannot be used to fully evaluate the effectiveness of various regulatory programs on protecting the subset of wetlands that fall within government jurisdiction. Moreover, the dates of these trends studies do not coincide with major changes in regulatory policies by state or Federal agencies. This further limits their utility for assessing current wetland regulatory programs. The effective dates of the studies were determined based on the availability of aerial photography, since these studies rely on wetland photointerpretation techniques to identify wetland trends. The studies do, however, provide the only available assessment of how wetlands have fared during periods of strengthening wetland regulations.

Table 8-1. Major causes of wetland loss and degradation in Maryland (adapted from Zinn and Copeland 1982; Gosselink and Baumann 1980; Tiner *et al.* 1994).

Human Threats

Direct:

1. Discharges of materials (e.g., pesticides, herbicides, other pollutants, nutrient loading from domestic sewage, urban runoff, agricultural runoff, and sediments from dredging and filling projects, agricultural lands, and other land development) into waters and wetlands.
2. Filling for dredged spoil and other solid disposal, roads and highways, and commercial, residential, and industrial development.
3. Dredging and stream channelization for navigation channels, marinas, flood protection, coastal housing developments, and reservoir maintenance.
4. Construction of dikes, dams, levees, and seawalls for flood control, shoreline protection, water supply, irrigation, wildlife management, and regulated shooting areas.
5. Drainage for crop production, timber production, and mosquito control.
6. Alteration of wetland hydrology and disruption of natural river flows through diversion of fresh water for human uses (e.g., water supply, industry, and agriculture).
7. Flooding wetlands for creating ponds, waterfowl impoundments, reservoirs, and lakes.
8. Clearing of native vegetation and cultivation of agricultural crops.
9. Conversion of "natural" forested wetlands to pine silviculture plantations.

Indirect:

1. Sediment diversion by dams, deep channels, and other structures.
2. Hydrologic alterations by canals, spoil banks, roads, and other structures.

Natural Threats

1. Subsidence (including natural rise of sea level).
2. Droughts.
3. Hurricanes and other storms.
4. Erosion.
5. Biotic effects, e.g., muskrat and snow goose "eat-outs" and beaver impoundments.

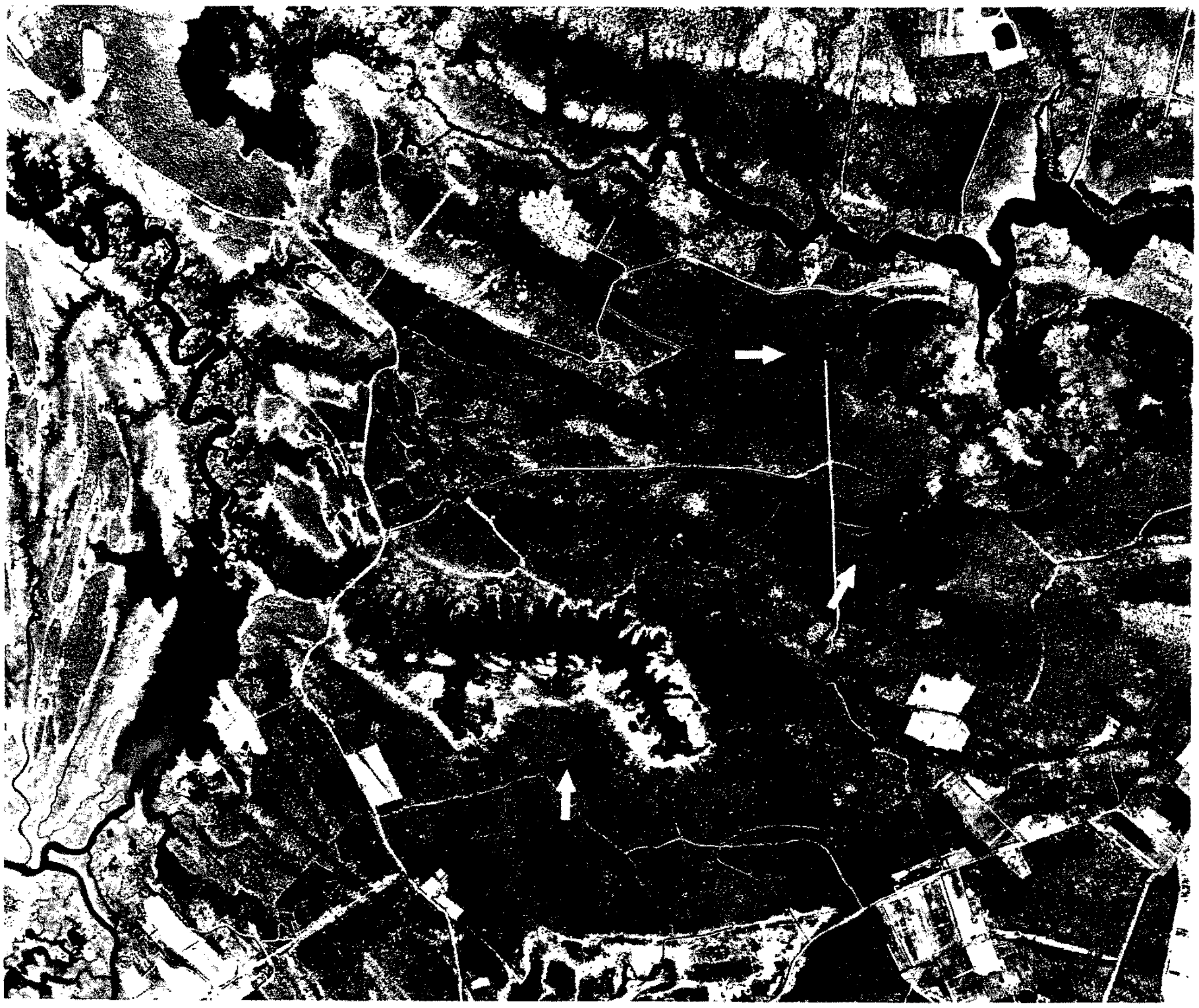

Figure 8-1. On the bayside of the lower Eastern Shore, the effects of rising sea level and coastal subsidence can be seen as salt marshes migrate landward, gradually replacing former nontidal forested wetlands. Arrows indicate forested wetlands that are now estuarine and salt-stressed.(Ralph Tiner photo)

Forces Changing Wetlands

Wetlands are dynamic ecosystems subject to change by both natural processes and human action. These forces interact to cause both gains and losses in wetland acreage, as well as changes in the functional values of the wetland areas. In general, the overall effect in Maryland has been a loss and degradation of wetlands. Table 8-1 outlines major causes of wetland loss and degradation in the state.

Natural Processes

Natural events influencing wetlands include rising sea level, coastal subsidence, natural changes in vegetation, natural sedimentation and erosion, beaver dam construction, and fire. The rise in sea level (roughly one foot per century) has the potential to both increase wetland acreage by periodically flooding low-lying uplands and to destroy vegetated wetlands through permanent inundation. This situation is particularly evident on the lower Eastern Shore, e.g., Dorchester and Somerset Counties (Figure 8-1). Significant marsh loss can be observed at Blackwater River National Wildlife Refuge (Pendleton and Stevenson 1983; Stevenson *et al.* 1986). Natural succession and fire typically change the vegetation of a wetland, usually with no net loss or gain in wetland acreage. Deposition of water-borne sediments along rivers and streams often leads to formation of new wetlands, while erosion removes wetland acreage. The activities of beaver create or alter wetlands by damming stream channels to build beaver ponds. Thus, natural forces act in a variety of ways to create, modify, or destroy wetlands.

Human Actions

Human actions have a significant impact on wetlands. Unfortunately, most human activities have been destructive to natural wetlands, either by direct conversion to agricultural land, urban/suburban development, or other uses, or indirectly by degrading their quality. Key human impacts in Maryland have been caused by such factors as channelization for flood control (Figure 8-2); filling for housing, highways, industrial, and commercial development; deposition of material into sanitary landfills; dredging for navigation channels, harbors, and marinas; agricultural conversion (Figure 8-3); reservoir construction; timber harvest; and various forms of water pollution and waste disposal. A few human actions do, however, create and preserve wetlands. Construction of farm ponds, and in some cases, reservoirs may increase wetland acreage, although valuable natural wetlands and their associated functional values may be destroyed in the process. Traditionally, Federal and state fish and wildlife agencies have managed wetlands in Maryland to improve their value to waterfowl. Marsh creation and restoration of previously altered wetlands can also be beneficial. Federal and state agencies have increased their efforts to restore Maryland wetlands. Wetland protection efforts, such as Federal and state wetland regulatory programs and wetland acquisition programs, serve to help maintain and enhance wetland resources, despite mounting pressures to convert them to other uses.

Wetland Trends

Changes in Maryland's wetlands can be generally divided into two categories: (1) quantitative changes and (2) qualitative changes. The former represent actual increases or decreases in the amount of wetland, while the latter relate to quality changes. It is important to distinguish between these types of changes, especially when considering the Federal and state goals of no-net-loss of wetlands for their regulatory programs.

Quantitative Changes in Wetlands

While some wetlands are created by reservoir and pond construction, impoundments, other water control projects, and more recently by wetland restoration projects, the net effect of these gains to date is minimal in Maryland. Extensive conversion of wetlands to other uses has occurred since Maryland's settlement in the 1600s. Wetlands have been drained and leveled for crop production, and filled for residential housing, commercial and industrial development, and highways. These and other activities have converted thousands of wetlands to nonwetlands, thereby eliminating all or most of the functions that wetlands provide.

Pre-settlement Wetland Acreage and Cumulative Losses

How many acres of wetlands existed in Maryland at the time of this country's settlement by Europeans? This is a significant question, principally because it seeks to determine the "original" wetland acreage from which cumulative losses can be estimated. As one might expect, however, this question does not have a simple answer. Most wetland acreage statistics are based on wetland inventories performed by interpreting aerial photographs. Aerial photos have only been available for large geographic areas since the late 1930s. Estimating wetland acreage in the 1700s, therefore, must be done by reviewing existing information, mainly soil mapping data which can give a rough approximation of the pre-settlement acreage. The main limitations of these statistics are: (1) many acres of nonhydric soils are included in hydric soil map units, (2) poorly drained soil map units contain substantial acreage of somewhat poorly drained soils, since they were viewed similarly from the agricultural use standpoint—drainage must be provided to improve the site for crop production, and (3) soil mappers often provided more detailed mapping on farmland and more generalized mapping in the woods.

A recent U.S. Fish and Wildlife Service report to Congress on historical wetland losses in the U.S. estimated Maryland's pre-settlement wetland base at 1.65 million acres (Dahl 1990). This figure was derived from available soil drainage statistics. Given that soils have been mapped throughout the state, data are available on potential hydric soils (see Chapter 5). From these data, the pre-settlement wetland acreage may be projected at 1.4 million acres. Due to inclusions of somewhat poorly drained soils within the hydric soil map units, it is most likely that this figure is a slight overestimate. For practical purposes, we might say that the pre-settlement wetland acreage is between 1.4 and 1.0 million acres and can use 1.2 million acres as the average. Again, one must recognize that this is a soft number.

Comparing 1.2 million acres to the results of the Maryland's wetlands inventory (about 600,000 acres), we project a loss of roughly 600,000 acres or 50 percent of the pre-settlement acreage. Yet, we must recognize that the current wetland acreage statistic is an underestimate, since many acres of seasonally saturated forested wetlands were not inventoried. Our educated guess would say that overall, Maryland has lost about 45 percent of its wetlands since the 1700s.

There are no better projections of wetland losses than the above estimates. So, depending on the analysis protocols,

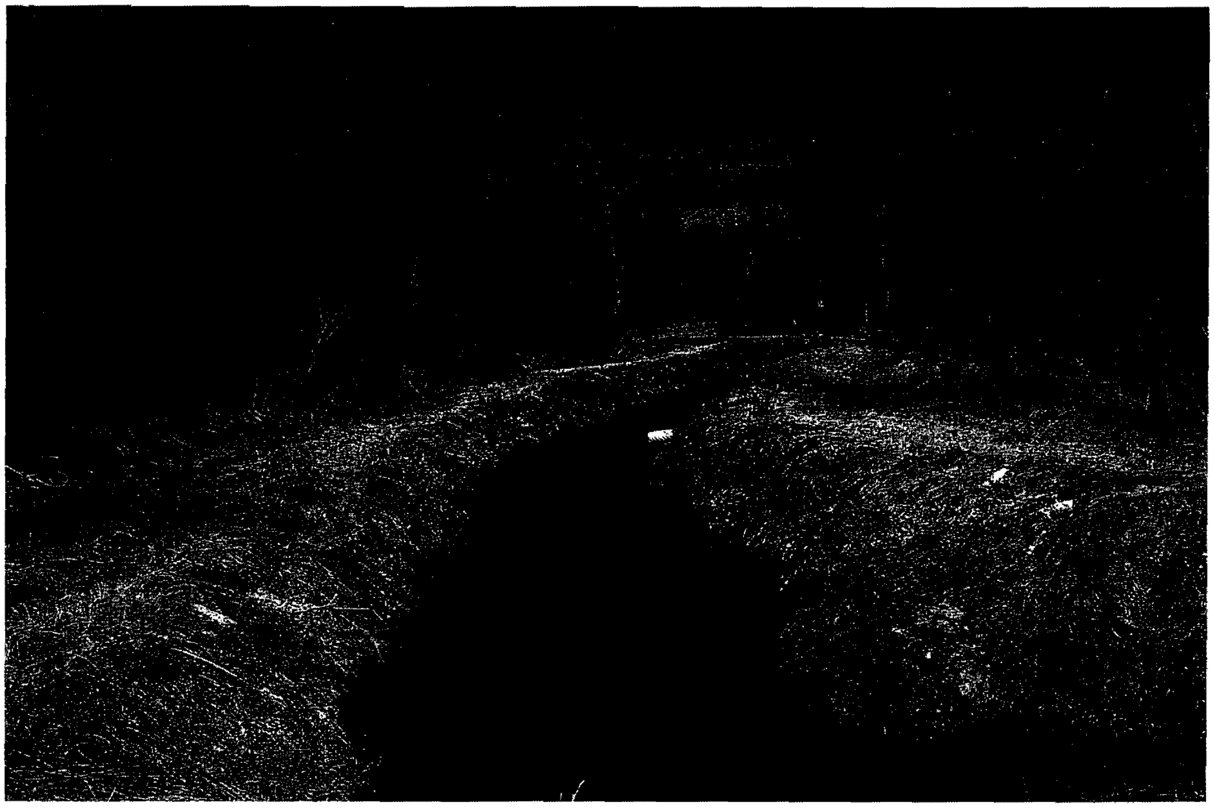

Figure 8-2. Channelized wetland in Caroline County. (Ralph Tiner photo)

Figure 8-3. Many forested wetlands have been converted to cropland on the Eastern Shore. (Ralph Tiner photo)

Maryland has lost between 45-65 percent of its wetlands. By any account, this represents a significant loss of an important natural resource and the valuable functions it provides. Much former wetland is now agricultural land, especially on the Eastern Shore. Many acres of estuarine wetlands have been filled for resorts, residential housing, port development, or disposal of dredged material. Other tidal marshlands have been excavated for marinas and navigation canals. Many wetlands have been used for livestock grazing throughout the state. Construction of Deep Creek Lake in Garrett County permanently inundated hundreds of acres of river valley wetlands. Thayerville bog was flooded by Deep Creek Lake and smaller wetlands were inundated by Lake Meadows (Fenwick and Boone 1984). Mining has also destroyed many wetlands in western Maryland. Strip mining for coal may have eliminated about half of the peatlands in Garrett County (Fenwick and Boone 1984). Peat mining for horticultural peat moss has had major impacts on wetlands in western Maryland.

Recent Statewide Trends

A simple comparison of existing inventories or wetland surveys does not usually provide meaningful statistics about wetland trends, since differences in acreages may result from varied methods and definitions. For example, one look at the results of past surveys of coastal marshes as reported in McCormick and Somes (1982) provides an illustration of the difficulty of drawing meaningful conclusions from such comparison. The following estimates of coastal wetland acreage in Maryland were reported between 1954 and 1978: 228,958 (1954), 268,373 (1956), 297,398 (1962), 257,811 (1973), and 261,309 (1978). The numbers for 1962 even included some unspecified acreage in Delaware and Virginia. So rather than analyze these findings, we will focus on the results of two U.S. Fish and Wildlife Service studies that employed similar methods to evaluate wetland trends from the mid-1950s to the late 1970s/early 1980s (Tiner and Finn 1986) and from 1982 to 1989 (Tiner *et al.* 1994). (*Note:* Both of these studies are based on statistical sampling techniques so the acreages produced are estimates and have associated standard deviations; refer to the original reports for statistical parameters.)

1955-1978 Trends

The Tiner and Finn study (1986) examined wetland trends in five Mid-Atlantic states: Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. For Maryland, they reported that Maryland's vegetated wetlands declined substantially between 1955 and 1978, whereas vast acreages of freshwater ponds were created. About 8 percent of the estuarine vegetated wetlands (largely emergent wetlands) and almost 6 percent of the palustrine vegetated wetlands (mostly emergent types) were lost. Annual net losses of these two types averaged about 450 acres and 650 acres, respectively. About two-thirds of the estuarine vegetated wetland losses were due to conversion of tidal marshes to coastal deepwater habitats. This resulted from a combination of both natural and human-induced factors such as coastal submergence due to rising sea level, coastal erosion, dredging projects, and creation of saltwater impoundments. Of the other factors causing losses of estuarine wetlands, urbanization and freshwater impoundment construction were important, combining for about 76 percent of the losses directly attributed to human impacts (Figure 8-4).

Roughly 15,000 acres of palustrine vegetated wetlands were lost. Most of this loss impacted freshwater emergent wetlands. Agriculture and other factors (mostly channelization related to agriculture) were equally responsible for about two-thirds of the palustrine vegetated wetland losses. Pond construction in these wetlands was also a significant factor, accounting for nearly 30 percent of the losses. By contrast, urban development caused only 8 percent of the losses. The Lower Coastal Plain region (e.g., Eastern Shore) was by far the most heavily impacted area of the state: about 91 percent of the state's palustrine vegetated wetland losses occurred here.

From 1955-1978, pond acreage in Maryland greatly increased—by 366 percent or over 14,000 acres. About 45 percent of the new ponds were created from vegetated wetlands, with palustrine forested wetlands and emergent wetlands being most affected. Another 45 percent of the ponds came from farmland, with most of the remainder coming from upland forests.

1982-1989 Trends

The Tiner and others study (1994) was designed to assess wetland status and trends in the Chesapeake Bay Watershed, so only the portion of Maryland that drains into the Bay was examined. This area, however, amounts to about 90 percent of the state.

From 1982 to 1989, Maryland experienced a net loss of 4,324 acres of palustrine vegetated wetlands and 562 acres of estuarine vegetated wetlands, and net gains of 1,074 acres of estuarine nonvegetated wetlands (tidal flats) and 3,236 acres of palustrine nonvegetated wetlands (ponds). In addition, a net total of 2,062 acres of farmed wetlands were effectively drained and converted to upland agriculture. This represents about half of the farmed wetlands that existed in 1982. For vegetated wetlands, the figures represent a 1.4 percent loss of

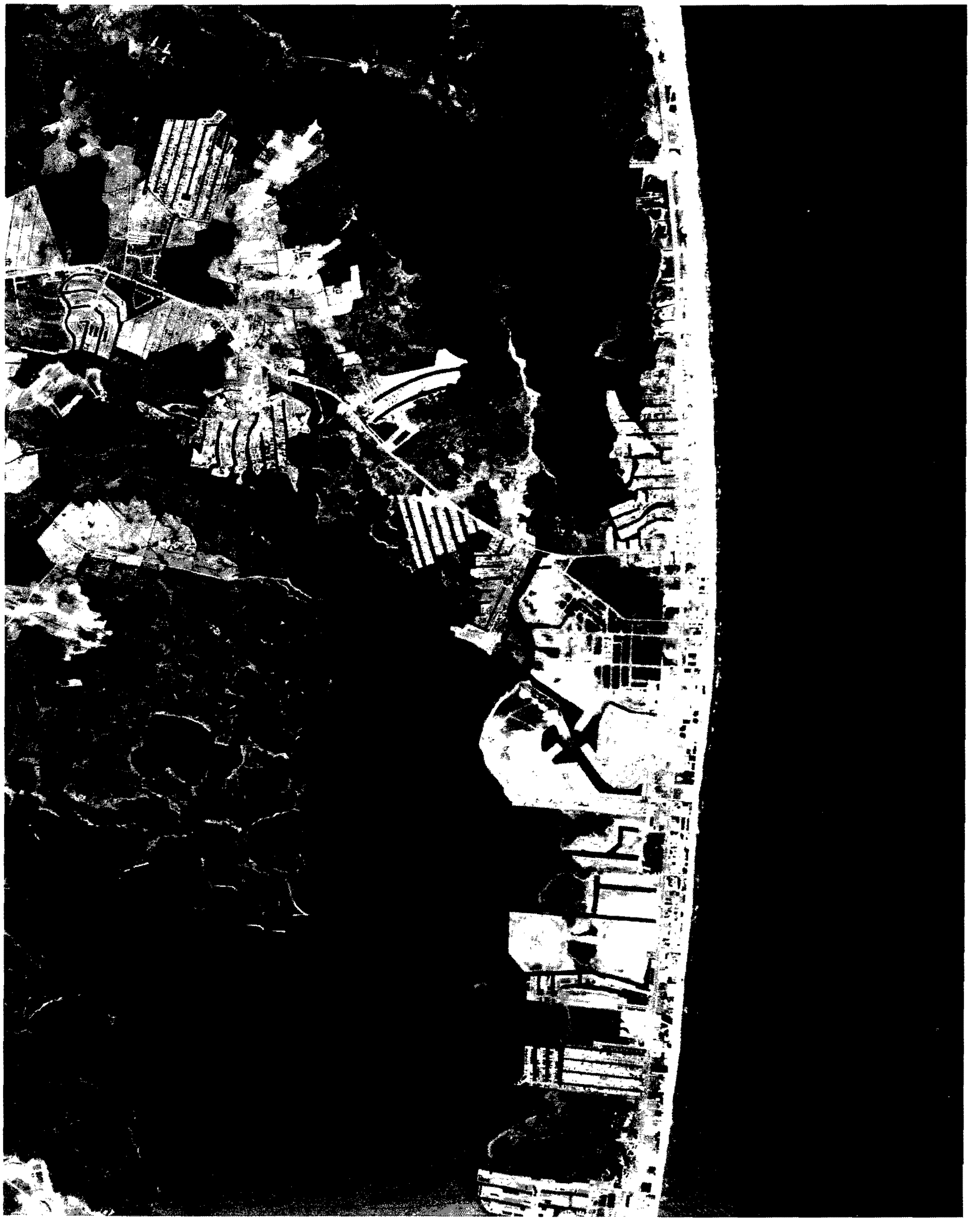

Figure 8-4. Aerial view of Ocean City area. It is easy to see the magnitude of dredging and filling development that took place prior to Federal and state wetland regulations.

palustrine types and a 0.5 percent loss of estuarine types. Not all vegetated types, however, had net losses; scrub-shrub wetlands showed net substantial gains largely due to succession in recently cutover forested wetlands.

More acres of palustrine forests were destroyed than any other wetland type, with an estimated 2,534 acres converted to uplands or waterbodies between 1982 and 1989 (Table 8-2). *(Note: Tables 8-2 through 8-7 are located at the end of this chapter).* Over 80 percent of these losses took place in the Lower Coastal Plain, mainly in the Pothole region (849 acres) and the rest of the Coastal Flats region (1,127 acres). An additional 437 acres of palustrine forests were destroyed on the Western Shore. The main causes for palustrine forest destruction were agriculture (31%), pond construction (28%), and urban/rural development (22%).

Approximately 7,500 acres of palustrine forests were harvested for timber between 1982 and 1989. Logging impacts were greatest on the Eastern Shore. Harvest of forested wetlands specifically managed for timber production represents only a short-term change in wetland type, with perhaps no long-term change since forested wetlands eventually become re-established in the affected areas.

An estimated 2,370 acres of palustrine emergent wetlands were converted to uplands or waterbodies between 1982 and 1989. Nearly 72 percent of these losses occurred in the Lower Coastal Plain. Most of these losses took place in the Pothole region where 911 acres were destroyed. An estimated 344 acres of marshes and wet meadows were destroyed in the Piedmont region. Agricultural conversion of palustrine emergent wetlands was responsible for 63 percent of the losses of this type.

Despite a net gain overall, an estimated 454 acres of palustrine scrub-shrub wetlands were filled or permanently flooded. As with the emergent wetlands, most of the losses were in the Lower Coastal Plain.

An estimated 671 acres of estuarine emergent wetlands were destroyed. Major factors responsible for these losses were agricultural practices, coastal erosion and dredging, and urban and other development. Agriculture accounted for 38 percent of the losses, with conversion to cropland associated with regulated shooting areas being especially significant. Erosion and increased tidal flooding were also important, accounting for 27 percent of the recent losses of tidal marshes.

Changes in Recent Wetland Trends

A comparison between the wetland trends reported in the two studies provides some interesting observations relative to the role of wetland regulations in reducing wetland destruction. Table 8-3 summarizes this correlation. Of particular note is the tremendous reduction in the annual loss rate of estuarine emergent wetlands from 428 acres to 10 acres. This can largely be attributed to strong regulation of coastal wetland alteration through Maryland's Tidal Wetlands Act and Federal regulations pursuant to the Federal Clean Water Act (see Chapter 9 for details on these programs). The picture for inland wetlands also showed some encouraging results. The Federal government has gradually increased regulation of these wetlands since 1975. The wetland trends data shows that annual losses of inland marshes (palustrine emergent wetlands) have been cut in half, but at first glance, yearly losses of palustrine forested wetlands appear to have increased by a factor of 13. The forested statistic is quite misleading since the *net change figures* include changes in wetland type, such as induced by timber harvest. A closer examination of the study results show that between 1955 and 1978, 9,125 acres of palustrine forests were destroyed by conversion to agriculture, unknown development activities, and lakes and ponds. This loss translates to a 397 acres per year loss rate. By comparison, the 1982 to 1989 results show that 2,534 acres were destroyed for an annual loss rate of 362 acres. There appears to be some reduction in the annual loss rate of these wetlands. Timber harvest activities appeared to have increased during the later period causing a tremendous rise in the *net loss* rate of forested wetlands. An estimated 7,500 acres were harvested between 1982 and 1989.

The Eastern Shore continued to be the major wetland loss hotspot in the state. The area's geology and topography have created conditions favoring the establishment of vast expanses of wetlands. Traditional land uses in the region—farming and forestry—have often converted and/or utilized wetlands for the production of food and fiber. These predominant land-use activities coupled with the region's abundance of wetlands increase the likelihood for wetland conversion. From 1982 to 1989, the Eastern Shore lost over 4,000 acres of palustrine vegetated wetlands to dryland (e.g., through drainage) and to waterbodies (e.g., through pond construction). This loss represents more than 75 percent of the statewide losses of these wetland types. Half of the losses impacted forested wetlands and 40 percent affected emergent wetlands. The latter is particularly significant in that it amounts to a 17 percent loss of the marshes and wet meadows present in 1982. In addition to the above losses, over 7,000 acres of forested wetlands were harvested between 1982 and 1989.

Figure 8-5. Wet meadows in western Maryland are often used for livestock grazing. (Ralph Tiner photo)

The above numbers reflect the trends in wetlands prior to 1989. In 1989, the Maryland legislature passed the Nontidal Wetlands Act (see Chapter 9) giving the state regulatory powers over hundreds of thousands of inland wetland acres beginning in 1991. Since 1989, the U.S. Army Corps of Engineers has substantially strengthened its jurisdiction in these wetlands. Thus, current wetland losses should be significantly reduced over those reported in the studies cited above. There are, however, some wetlands that do not appear to be receiving adequate protection. Many, if not most, seasonally saturated forested wetlands are not regulated because they usually fail to meet the hydrologic requirement of the Corps 3-parameter test (Tiner *et al.* 1994). These wetlands occupy extensive tracts on the Eastern Shore.

County and Other Local Wetland Trends Summaries

During the past few years, the Service has conducted several wetland trends studies in specific geographic areas in Maryland. County wetland trends studies were conducted for the following counties: Anne Arundel, Charles, Calvert, Dorchester, Prince Georges, and St. Marys Counties. Similar studies were performed for selected quads on the Lower Eastern Shore, Kent Island, in the Piedmont, and for the following quads: North East, Relay, and White Marsh. Results from these studies are summarized in Tables 8-4 through 8-7.

Trends in Submerged Aquatic Vegetation

In the 1950s and 1960s, some of Chesapeake Bay's most extensive submerged aquatic beds occurred in the upper Bay—Susquehanna Flats and the Elk, Sassafras, and Northeast Rivers. Today, only 20 percent of the area supports such beds (Dennison *et al.* 1993). Baywide declines in submerged aquatic vegetation (SAV) began in the late 1960s (Orth 1994). The Choptank River once supported about 37,000 acres of SAV composed of several species, yet in 1990, only 470 acres were observed and only one species was present. These changes represent examples of the drastic changes in SAV that have taken place recently. Such declines in SAV have been used to exemplify the degradation of Chesapeake Bay's water quality.

The results of the 1992 and 1993 SAV studies, however, show significant increases in SAV beds in the Bay (Orth *et al.* 1993, 1994). Large increases have been found in the Choptank and Chester Rivers and in Eastern Bay. Some areas experienced decreases, including the Western Shore and the Upper Eastern Shore. Government efforts to improve the status of SAV seem to be paying off (Frank Dawson, pers. comm.).

Figure 8-6. Former palustrine forest south of Salisbury (Wicomico County) just after timber harvest. (Ralph Tiner photo)

The Potomac River also had experienced significant declines in SAV. Due largely to better water quality resulting from sewage treatment improvements and favorable weather conditions, SAV returned to the Potomac in 1983 (Haramis and Carter 1983; Dennison *et al.* 1993). Today, about 6,200 acres are present, covering about 19 percent of the river's shallow water bottoms (Carter and Rybicki 1990; Orth *et al.* 1991; Dennison *et al.* 1993).

More detailed information on SAV trends can be found in the following references: Davis (1985), Bayley and others (1978), Kemp and others (1983), Orth and Moore (1983), Orth and others (1991, 1993, 1994), and Stevenson and Confer (1978).

Qualitative Wetland Changes

Qualitative changes may be more subtle and more difficult to detect than the gross effects of filling, drainage, and impoundment. They typically involve changes in the vegetation and/or the hydrology of wetlands, both of which may profoundly alter wetland functions, such as wildlife habitat, water quality renovation, and flood storage. These effects are brought about from activities including livestock grazing (Figure 8-5), logging operations, direct (point source) discharges of industrial wastes and municipal sewage, freshwater diversions, and indirect (non-point source) discharges such as urban and agricultural runoff.

Logging operations in forested wetlands in Maryland may alter the character or plant composition of wetlands (Figure 8-6). Historically, Atlantic white cedar swamps were more widespread than they are today. Past forestry practices have reduced many of the cedar swamps to sparse stands. In other areas where cedar has been selectively cut, these evergreen swamps have changed to hardwood stands, mainly red maple swamps. More intensively managed pine plantations are replacing more diverse forested wetland stands. This must have an impact on wildlife species, giving preference to species favoring pine forests.

Diversion of fresh water and alteration of natural river and stream flow patterns have significant adverse effects on the hydrology of downstream wetlands and watercourse channels. Altered flows may lead to changes in vegetation affecting wildlife use and impacting the ability of downstream wetlands to temporarily store flood waters and improve water quality.

Figure 8-7. Federal and state agencies are now engaged in proactive wetland restoration—simply restoring wetlands because these areas can provide important functions. Site in Talbot County where the U.S. Fish and Wildlife Service's Partners for Wildlife Program has worked: site in February before restoration (top; Carol Wienhold photo) and site 1.5 years later in September (bottom; Laura Mitchell photo).

Figure 8-8. Palustrine wetlands are still under pressure for development. Some types are still not receiving adequate protection. This forested wetland is planned for conversion to a housing-golf course complex. (Drew Koslow photo)

Water pollution and disposal of hazardous and other wastes have degraded wetlands and watercourses. Urbanization has increased sedimentation and nutrient levels in streams, thereby affecting wetlands and aquatic plants and animals as well as water quality. In numerous instances, less desirable plants, like common reed and purple loosestrife, have invaded urban wetlands replacing native species. Urbanization has also increased surface water runoff, which has led to downcutting of stream channels and increasing erosive forces of affected watercourses. Natural patterns of stream flow have been altered with a likely impact to the ecology of watershed wetlands. Agricultural runoff (e.g., nutrients, fertilizers, herbicides, and pesticides) also negatively affects wetlands and water quality.

Future Outlook

While Maryland may have lost 45-65 percent of its original wetlands, wetlands remain quite abundant. About 10 percent of the state is wetland, with wetlands most widespread on the Coastal Plain (e.g., Eastern Shore) where 16 percent of the land area is occupied by wetlands. Many of the lost wetlands are on farmland that may be suitable for restoration (Figure 8-7). Increased Federal and state efforts in wetland restoration may eventually help achieve a net gain in wetlands, provided wetland regulatory programs maintain effective control of existing wetland resources.

Government regulatory programs have improved wetland conservation and should continue to do so in the future, despite rising concern over private property rights. Existing wetlands are now receiving better protection than at anytime before. As our population expands, there will be increased demand for real estate for commercial, resort, and residential development that will undoubtedly place additional pressure on those responsible for protecting wetlands (Figure 8-8). To date, the public has continued to support wetland protection efforts and it is likely that they will continue to do so, recognizing the important water quality, flood storage, wildlife habitat, and other functions that wetlands perform.

Water quality problems will likely continue to affect the state's wetlands. Although control of point sources of water pollution, such as industrial effluents and municipal wastewater treatment plants, is improving the quality of many of Maryland's watercourses, urban and agricultural runoff continues to degrade water quality. Improved techniques for stormwater discharge treatment and riparian habitat management (e.g. streamside fencing) and employing best management practices on farmland and managed forests may further enhance water and wetland quality.

Overall, the status of Maryland's wetlands is much improved over what it was in the 1950s and 1960s due largely to government regulatory programs that minimize wetland destruction, water pollution abatement programs, and the public's support of environmental protection policies. Their condition can be further improved with the attainment of water quality objectives, continued refinement of wetland and other land-use regulations that benefit aquatic resources, pro-active wetland restoration, and other non-regulatory wetland protection strategies. This combination of approaches can help achieve a high quality natural environment, while meeting the evolving socio-economic needs of our society.

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Table 8-2. Changes in specific types of vegetated wetlands in the Maryland portion of the Chesapeake Watershed (1982-1989). (Source: Tiner *et al.* 1994) Symbols used for wetland types are as follows: palustrine wetlands—forested (PFO), scrub-shrub (PSS), and emergent (PEM), and estuarine wetlands—emergent (E2EM), scrub-shrub (E2SS), and forested (E2FO). (*Note*: Estuarine figures represent a substantial underestimate of these wetlands; this is probably due to the random selection of study plots and suggests that the coastal zone should be further stratified for sampling in the future, despite acceptable standard errors).

Vegetated Wetland Type	1982 Acres	1989 Acres	Acres Changed to Other Veg. Wetlands	Acres Gained From Veg. Wetlands	Acres Destroyed	Acres Gained From Other Areas	Net Change
PFO	269,991**	262,128**	8,748*	3,315*	2,534**	104	-7,863*
PSS	15,674**	20,852**	3,568*	9,102*	454*	98*	+5,178*
PEM	21,881**	20,243**	3,145*	2,964*	2,370**	913*	-1,638
E2EM	96,525**	96,453**	173*	708	671*	64	-72
E2SS	2,117*	2,396*	150	429*	0	0	+279
E2FO	18,993*	18,227*	1,155	423	62	28	-766

** Standard error is 20 percent or less than the estimate.
* Standard error is less than 50 percent of the estimate, but greater than 20 percent of the estimate.
Note: Estimates without an asterisk have higher standard errors.

Table 8-3. Comparison of estimated wetland trends for certain types in Maryland (1955 to 1978 versus 1982 to 1989) from Tiner and Finn (1986) and Tiner *et al.* (1994). Under the average annual net change rate category, gains are indicated by a "+" and losses by a "-". The data are based on the *net changes* which tend to understate the conversion of existing wetlands to dryland and deepwater habitats.

Wetland Type	Net Acreage Change 1955 to 1978 Trends	Average Annual Net Change	Net Acreage Change 1982 to 1989 Trends	Average Annual Net Change
Estuarine Emergent	-9,845	-428	-72	-10
Estuarine Scrub-Shrub	-183	-8	+279	+40
Estuarine Forested	No Data	NA	-766	-109
Estuarine Nonvegetated	+1,049	+46	+1,074	+153
Palustrine Emergent	-11,496	-500	-1,638	-234
Palustrine Scrub-Shrub	-5,557	-242	+5,178	+740
Palustrine Forested	-2,004	-87	-7,863	-1,123
Palustrine Nonvegetated (Ponds)	+14,435	+628	+3,236	+462

Table 8-4. Recent wetland trends in several Maryland counties based on U.S. Fish and Wildlife Service reports. Data reported for wetland types experiencing more than 10 acres of change.

County (Trend Period)	Wetland Type	Acres Converted to Upland	Acres Changed to Other Veg. Wetlands*	Acres Changed to Nonveg. Wetlands	Acres Changed to Deepwater Habitats
Anne Arundel	PEM	20.2	12.0	18.9	0.0
(1981/82 to	PFO	111.5	54.8	7.8	0.0
1988/90)	E2EM	5.4	1.5	7.2	1.1
Calvert	PEM	10.2	23.8	9.8	0.0
(1981/82 to	PSS	0.4	22.6	3.8	0.0
1988/89)	PFO	9.6	68.7	28.2	0.0
	E2EM	8.4	7.4	0.9	2.6
Charles	PEM	8.7	35.8	4.1	0.0
(1981 to 1988/89)	PSS	5.8	16.4	0.3	0.0
	PFO	106.1	86.9	25.4	0.0
	E2EM	1.8	1.4	10.0	0.0
Dorchester	PEM	140.8	179.7	54.0	—
(1981/82 to	PSS	122.8	39.3	1.7	—
1988/89)	PFO	1,029.1	3,689.9**	68.3	—
	E2FO	99.1	345.1	12.3	—
	E2EM	43.6	32.3	29.9	—
Prince Georges	PEM	20.6	49.4	9.6	11.0
(1981 to 1988/90)	PSS	19.6	18.2	24.4	25.0
	PFO	81.2	79.2	35.5	0.0
St. Marys	PEM	8.0	16.7	3.8	33.9
(1981/82 to	PSS	0.0	6.5	3.4	12.9
1988/89)	PFO	38.0	88.3	24.9	2.2
	E2EM	3.2	38.2	6.1	3.3

* Represents changes in wetland class (e.g., emergent to scrub-shrub) but not changes in water regime within a given wetland class.
** Ninety-six percent of this figure changed due to timber harvest.

Table 8-5. Major causes of vegetated wetland conversion to upland in selected Maryland counties based on recent U.S. Fish and Wildlife Service studies. Data are from the early 1980s to the late 1980s/1990.

County	Major Causes of Conversion	Main Wetland Types Affected
Anne Arundel	Roads/Highways (38.2 acres), Housing (37.3 acres), Commercial/Industrial Development (25.6 acres), and Public Facilities (22.2 acres)	PFO (111.5 acres), PEM (20.2 acres)
Calvert	Agriculture (8.7 acres), Roads/Highways (8.6 acres), and Recreational Facilities (8.4 acres)	PEM (10.2 acres), PFO (9.6 acres), E2EM (8.4 acres)
Charles	Housing (44.9 acres), Unknown (30.9 acres), Commercial Development (17.4 acres), and Roads (12.3 acres)	PFO (106.1 acres)
Dorchester	Agriculture (1,031.1 acres), Timber Harvest (173.6 acres), Roads/Highways (84.7 acres), Dredged Material Disposal (35.5 acres), and Conversion to Farmed Wetland (28.0 acres)	PFO (1,029.1 acres), PEM (140.8 acres), PSS (122.8 acres), E2FO (99.0 acres)
Prince Georges	Commercial/Industrial Development (32.2 acres), Roads/ Highways (32.0 acres), Sand & Gravel Pits (18.9 acres), and Housing (14.7 acres)	PFO (81.2 acres), PEM (20.6 acres), PSS (19.6 acres)
St. Marys	Housing (14.4 acres), Agriculture (11.8 acres), and Commercial Development (10.7 acres)	PFO (38.0 acres)

Table 8-6. Trends in nonvegetated wetlands in several Maryland counties based on recent U.S. Fish and Wildlife Service studies. Trends are from the early 1980s to the late 1980s/1990.

	GAINS		LOSSES		
County and Wetland Type	Created from Upland (acres)	Created in Vegetated Wetlands (acres)	Converted to Upland (acres)	Changed to Vegetated Wetlands (acres)	Changed to Other Nonveg. Wetlands (acres)
ANNE ARUNDEL					
Palustrine Unconsolidated Bottom	145.1	22.3	20.9	10.2	2.5
Palustrine Unconsolidated Shore	22.8	8.8	15.2	0.3	1.5
Estuarine Unconsolidated Shore	0.4	7.2	1.1	0.3	0.5
County Totals	168.3	38.3	37.2	10.8	4.5
CALVERT					
Palustrine Unconsolidated Bottom	27.6	42.8	0.8	10.2	0.2
Palustrine Unconsolidated Shore	0.0	0.0	0.0	1.3	0.0
Estuarine Unconsolidated Shore	0.0	0.0	0.0	0.0	3.9
County Totals	27.6	42.8	0.8	11.5	4.1
CHARLES					
Palustrine Unconsolidated Bottom	104.8	39.7	18.2	17.5	0.3
Palustrine Unconsolidated Shore	0.0	0.0	0.0	10.3	0.0
Estuarine Unconsolidated Shore	0.0	0.0	4.1	0.0	0.0
County Totals	104.8	39.7	22.3	27.8	0.3
DORCHESTER					
Palustrine Unconsolidated Bottom	125.47	134.62	8.30	10.04	0.00
Palustrine Unconsolidated Shore	15.60	12.26	0.00	0.00	0.00
Estuarine Unconsolidated Shore	0.00	23.68	0.00	12.64	12.39
County Totals	141.07	170.56	8.30	22.68	12.39
PRINCE GEORGES					
Palustrine Unconsolidated Bottom	167.5	69.9	15.1	28.0	8.7
Palustrine Unconsolidated Shore	19.1	0.3	11.2	6.6	8.0
County Totals	186.6	70.2	26.3	34.6	16.7
ST. MARYS					
Palustrine Unconsolidated Bottom	118.5	39.0	7.2	38.6	0.0
Palustrine Unconsolidated Shore	0.0	0.0	0.0	0.6	0.0
Estuarine Unconsolidated Shore*	1.5	2.3	0.0	0.0	0.0
County Totals	120.0	41.3	7.2	39.2	0.0

*Also, 6.4 acres of estuarine unconsolidated shore were gained from estuarine deepwater habitat due to coastal erosion and deposition and beach nourishment projects.

Table 8-7. Recent trends in palustrine vegetated wetlands in selected areas in Maryland based on U.S. Fish and Wildlife Service studies. Data are from 1980-82 to 1988/89.

Study Area (# of Quads)	Wetland Type	Acres Converted to Upland	Acres Changed to Other Veg. Wetlands	Acres of New Ponds	Source of New Ponds (Acres)
Lower Eastern Shore	PEM	11.55	579.11	47.74	Upland (45.55)
(5)	PFO	173.53*	1,678.22		Wetland (2.19)
	PSS	2.76	481.83		
	PVEG	187.84	2,739.16**		
Kent Island	PEM	3.67	3.50	51.98	Upland (44.77)
(2)	PFO	11.84	0.91		Wetland (7.21)
	PSS	7.93	0.00		
	PVEG	23.44	4.41		
North East	PEM	0.61	1.33	8.89	Upland (7.72)
(1)	PFO	0.00	3.93		Wetland (1.17)
	PVEG	0.61	5.26		
Fall Zone	PEM	0.80	0.00		
(2)	PFO	13.06*	7.72		
	PSS	2.25	0.00		
	PVEG	16.11	7.72		
Piedmont	PEM	56.56	33.47	84.94	Upland (75.22)
(6)	PFO	28.27	0.82		Wetland (9.72)
	PSS	3.62	0.00		
	PVEG	88.45	34.29		

* Temporarily flooded forested wetlands were most affected.

** Most of change to other vegetated wetlands is the result of timber harvest and subsequent successional patterns.

Wetland Protection

Introduction

Given the current status of Maryland's wetlands relative to their historical acreage and the wealth of values they provide, it would seem imperative that the remaining wetlands should be conserved. Yet most of these wetlands are not on public property, and, therefore, may be subjected to alternative uses. Techniques and procedures for protecting the remaining wetlands are numerous and include land-use regulations, direct acquisition, conservation easements, tax incentives, public education, and the efforts of private individuals and corporations. These techniques are discussed in detail in various sources including Kusler (1983), Burke and others (1989), Resmore and others (1982), and World Wildlife Fund (1992). This section briefly reviews some of the most important wetland protection programs in effect in Maryland and summarizes other important techniques for protecting wetlands.

Wetland Regulation

Wetland regulation is the most widely used means of controlling wetland impacts. Both Federal and state laws and regulations are used to manage the use of wetlands in Maryland. Dennison and Berry (1994) provide a good overview of Federal wetland regulations including a summary of pertinent legal cases and other Federal laws affecting wetlands. The most significant regulatory programs at the Federal level are the "Section 10" program (authorized by Section 10 of the Rivers and Harbors Act of 1899) administered by the U.S. Army Corps of Engineers (Corps) and the "Section 404" program (authorized by Section 404 of the Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977 and later amendments) administered jointly by the Corps and the U.S. Environmental Protection Agency (EPA). At the state level, the following regulatory programs are most important: (1) tidal wetlands licensing and permitting program (authorized by the 1970 Tidal Wetlands Act) administered by the Maryland Department of Natural Resources (DNR), (2) nontidal wetlands management and permitting program (authorized by the 1989 Nontidal Wetlands Protection Act, effective January 1991) administered by DNR, (3) "Section 401" Water Quality Certification program (authorized under Section 401 of the Clean Water Act) administered by Maryland Department of the Environment (MDE), and (4) "Section 307" Coastal Zone Consistency determination (authorized in Section 307 of the Coastal Zone Management Act of 1972, pursuant to Maryland's Federally approved Coastal Zone Management Plan) administered by DNR. (*Note:* Recently proposed organizational changes would place the state wetland regulatory programs under the MDE.) A brief overview of each program follows.

The *Section 10 program* requires a permit for dredging or the placement of fill or structures in navigable waters of the United States. The Baltimore District of the Corps has designated all tidal waters and their tributaries to the head of tide, and the Potomac River to Wills Creek in Cumberland as navigable waters. Issuance or denial of a Section 10 permit is largely based upon a balancing of project benefits and detriments in a public interest review.

The *Section 404 program* prohibits the discharge of dredged or fill material into "waters of the United States" and their adjacent wetlands without prior approval from the Secretary of the Army. Discharges of dredged or fill material resulting from normal farming, silviculture and ranching activities (including minor drainage); maintenance of existing structures; construction or maintenance of farm ponds or irrigation ditches, or drainage ditch maintenance; construction of temporary sediment basins; and construction or maintenance of farm or forest roads, or temporary mining roads, are not prohibited or otherwise subject to regulation under Section 404 unless the activity would bring wetlands into a new use that would convert them to upland. The Section 404 program requirements extend to all waters, regardless of their navigability. Often the Corps will combine Section 404 and Section 10 permit reviews where jurisdiction of the two programs overlap.

The U.S. Fish and Wildlife Service (Service) plays an active role in the permit process by reviewing permit applications and making recommendations based on environmental considerations, under authority of the Fish and Wildlife Coordination Act. Provisions in Section 404 of the Clean Water Act also give the Service the ability to "elevate" 404 decisions they disagree with, for administrative appeal through progressively higher levels. The National Marine Fisheries

Service (NMFS) also reviews permit applications regarding their impact to fisheries of Federal concern. NMFS is most active in evaluating impacts to coastal fisheries in Maryland and the Northeast. Issuance or denial of a permit under Section 404 constitutes a substantially more rigorous process than required under Section 10. The Corps must apply the stringent 404 (b)(1) environmental guidelines developed by EPA in addition to the public interest review test. Additionally, under Section 404 (c), EPA may block issuance of a Corps permit on the grounds of unacceptable adverse effects to municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas. EPA can also designate high-value areas as off-limits to all or certain discharges of dredge or fill material prior to a proposed permit.

The *Tidal Wetlands Act* prohibits a person from altering tidal wetlands without obtaining authorization from the state. Two types of wetlands are regulated: "state" wetland—which are all lands lying below the mean high water line; and "private" wetlands—which are those lands extending shoreward from the mean high water line which are subject to periodic tidal flooding and support aquatic growth. Persons wishing to alter a state wetland must obtain a license from the State Board of Public Works or from DNR. Activities in private wetlands require either an individual permit or general permit from the DNR. All regulated tidal wetlands are delineated on maps showing the legal boundaries of the DNR's jurisdictional authority. Exemptions in the law allow customary practices such as mosquito control, shellfishing, hunting, and trapping. The law also affirms the rights of waterfront landowners to control erosion of their land and to gain access to navigable waters from their land.

The *Nontidal Wetlands Protection Act* requires that (after December 31, 1990) a person may not conduct a regulated activity without first obtaining a permit from the DNR. "Regulated activity" does not include agricultural or forestry activities defined in the Act. Regulated activities do include excavation, dredging, changing drainage patterns, disturbing the water level or water table, filling, grading, and removal of vegetation in a nontidal wetland or within a 25-foot buffer. The buffer can be expanded, by regulation, to 100 feet for designated areas based on conditions such as steep slopes or highly erodible soils, and the presence of wetlands of special state concern. To maintain consistency, the Act used the Federal regulatory wetland definition to define wetlands. To determine the limits of wetlands on the ground, Federal field procedures are followed.

Forestry and agricultural activities do not require permits but must incorporate best management practices into soil conservation and water quality plans and sediment and erosion control plans, respectively. Forestry activities are not exempt from the permit requirements unless the area being harvested returns to forest *and* the area remains a jurisdictional wetland. Best management practices for forestry activities are made part of the sediment and erosion control plan (Table 9-1). These plans are developed by the local Soil Conservation Districts and are required for forestry activities that disturb greater than 5,000 square feet of land. The best management practices for forestry activities are intended to prevent nontidal wetlands from being converted to upland, and to control soil loss and minimize water quality degradation.

Agricultural activities are subject to the Soil Conservation and Water Quality Plan review process, also administered by

Table 9-1. Recommended best management practices for forestry in wetlands according to the state's nontidal wetlands program.

1. Locate major skid trails to the maximum extent feasible on soils that resist compaction, ruts, or other disturbances that adversely impact nontidal wetland hydrology.
2. Select the appropriate equipment to skid logs based on slope and the ability of the soil to resist erosion or other disturbances.
3. Locate and construct roads on uplands when feasible, following the natural contours of the land, using stabilization techniques to minimize erosion, maintaining a wetland's hydrology by constructing ditches to the minimum depth necessary and by using mats or other temporary structures to reduce compaction, and using the absolute minimum amount of fill material.
4. Locate stream crossings to the narrowest point, using appropriate structures to minimize impact and to allow for the unrestricted movement of aquatic life.
5. Locate log decks on uplands when feasible and as far away from wetlands or streams as possible, using the minimal size and numbet necessary for the operation, and utilizing diversion ditches to direct water away from the deck during use.
6. Regrade and revegetate areas affected by skid trails, log decks, and temporary roads after harvesting is completed.
7. Utilize equipment with high flotation tires, or harvest during winter when wetland soils are frozen or during the summer when they are drier.
8. Utilize natural regeneration as the preferred method in nontidal wetlands.
9. Manage wetlands with at least 20 percent of the live trees being Atlantic white cedar (*Chamaecyparis thyoides*), red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), American larch (*Larix laricina*), or bald cypress (*Taxodium distichum*) to maintain at least the same distribution after harvest.

local Soil Conservation Districts. This plan must include conditions and best management practices to protect wetlands, as well as compensatory mitigation for agricultural activities that cause a wetland loss. Best management practices are intended to protect the ecological integrity of, and to minimize the physical impact to nontidal wetlands. Many of the best management practices employed for agricultural activities are the same as those used in plan approval for forestry operations.

The Act exempts other activities from the permit process; however, notification and best management practices are required. These include activities with "minimal" impact, such as repair and maintenance of existing structures, certain utility installations, activities in isolated wetlands less than 1 acre in size and having no significant plant or wildlife value, and other activities defined by regulation.

The stated goal of the Act is no overall net loss of nontidal wetland acreage and function. The Act directs the DNR to require permit applicants to adopt mitigation practices specified by Departmental regulations. Mitigation practices include nontidal wetland creation, restoration and enhancement or, if these are not feasible, monetary compensation. Mitigation for losses of nontidal wetlands due to agricultural activities is also required.

The *401 Water Quality Certification program* is administered by Maryland Department of the Environment (MDE). Section 401 of the Clean Water Act gives Maryland and other states the authority to deny water quality certification for Federally permitted or licensed activities involving a discharge to waters of the U.S. (including wetlands) if the activity violates state water quality standards. The certification authority principally includes Federal authorizations under Sections 9 and 10 of the Rivers and Harbors Act, Sections 402 and 404 of the Clean Water Act, and Federal Energy Regulatory Commission (FERC) hydropower licenses. A denial of certification precludes a Federal agency from issuing an approval of the activity. Any nontidal wetland approval not subject to 401 certification must also comply with state water quality standards. Compliance with these standards is also reviewed by MDE.

Under *Section 307* of the Coastal Zone Management Act, activities undertaken by the Federal government or supported in whole or in part by Federal funds must be conducted in a

Figure 9-1. Public agencies at various levels of government have established wetland preserves, sanctuaries, refuges, and similar areas to conserve wetland resources. (Ralph Tiner photo)

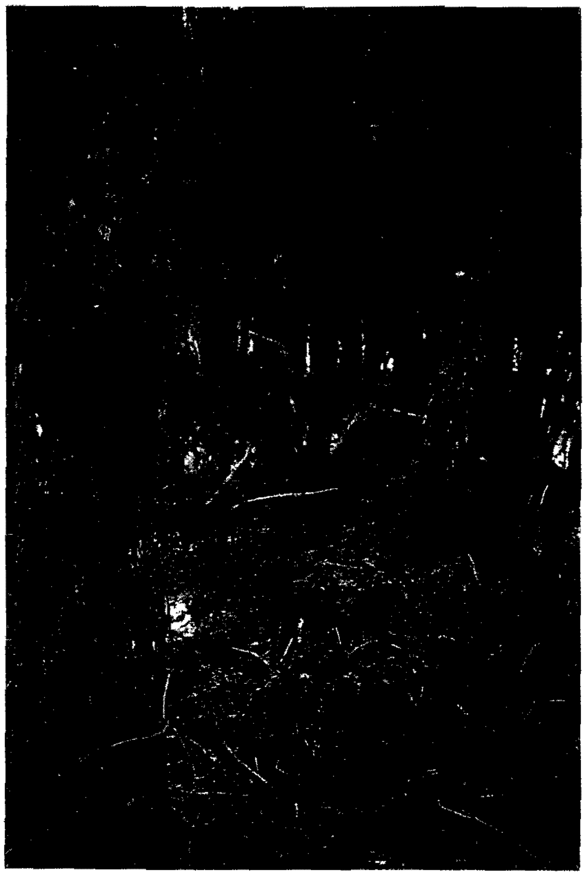

Figure 9-2. Non-profit organizations like the Nature Conservancy have been instrumental in preserving some of Maryland's finest wetlands for the future. Nassawango Creek sanctuary in Worcester County. (Ralph Tiner photo)

manner consistent with Maryland's Federally approved Coastal Zone Management Plan (CZMP). Under Section 307, the DNR routinely reviews Corps wetland permits and other Federal activities to ensure that projects are consistent with the CZMP. The Corps cannot grant a Section 404 permit until the state issues a coastal zone consistency determination or waives its right to certify the permit. The "veto" may not apply for projects involving national security interests.

Regulatory programs are essential to address impacts resulting from day to day activities in Maryland's wetlands. However, they are necessarily reactive in nature, and have not yet evolved to the point of addressing changes to the wetland resource base in a cumulative or holistic sense. While the importance of such programs must continue to be stressed, they must be complimented by a vigorous pursuit of non-regulatory approaches to wetland management. Successful and sound stewardship of Maryland's remaining wetlands depends upon effective campaigns on both fronts.

An important reason for Maryland's increased efforts to improve wetland protection has been the historic 1987 Chesapeake Bay Agreement (Citizens Program for the Chesapeake Bay 1984). The State of Maryland, along with the Federal government, Pennsylvania, Virginia, Chesapeake Bay Commission and the District of Columbia adopted the agreement which contained a commitment to "develop and begin to implement a Baywide policy for the protection of tidal and nontidal wetlands." Subsequently, the Bay Agreement signatories on January 5, 1989, adopted a detailed Chesapeake Bay Wetlands Policy which seeks to achieve a net resource gain in wetland acreage and function by protecting existing wetlands, rehabilitating degraded wetlands, restoring former wetlands, and creating artificial wetlands. The comprehensive policy prescribes a host of actions which the signatories are to undertake to increase protection including: (1) better wetland mapping and monitoring, (2) improving regulations, (3) identifying important wetlands for special protection and acquisition, (4) eliminating government programs counterproductive to wetland protection, (5) establishing private sector protection incentives, (6) improving mitigation practices and public education, and (7) evaluating cumulative wetland losses and best management practices (Chesapeake Bay Executive Council 1988). A detailed implementation plan covering how these actions are to be accomplished has been developed (Chesapeake Bay Executive Council 1990).

Wetland Acquisition

Wetlands may also be protected by direct acquisition or conservation easements. Many wetlands are owned by public agencies (e.g., Federal, state, and county governments) or by private environmental organizations, although the majority are privately owned. DNR's Nontidal Wetlands and Waterways Division has compiled a list of more than 300 nontidal wetlands of state concern. The Service has recently published an inventory of important natural resources (including many wetlands) on private lands that need special protection (Hall and Malcom 1990). Public agencies, private non-profit conservation organizations, and land trusts are working cooperatively to preserve these valuable natural treasures (Figures 9-1 and 9-2).

The Service's National Wildlife Refuge System is a collection of over 90 million acres of lands, wetlands and waters established through a system of nearly 450 Refuge sites strategically located to preserve and manage important wildlife habitats. Six National Wildlife Refuges (NWR) with a total of 27,501 acres are located in Maryland: Blackwater (15,687

Figure 9-3. Blackwater National Wildlife Refuge (Dorchester County) is the largest of the U.S. Fish and Wildlife Service's refuges in Maryland. (Ralph Tiner photo)

acres), Chincoteague (418), Eastern Neck (2,286), Martin (4,424), Patuxent (4,682) and Susquehanna (4). Located on Maryland's Eastern Shore, Blackwater NWR and Eastern Neck NWR contain large contiguous areas of tidal and nontidal wetlands which offer two of the most spectacular sites in Matyland for viewing migratory and resident waterfowl species (Figure 9-3).

At the state level, wetlands are similarly protected by direct acquisition (e.g., state wildlife management areas and state forests) and other means through the DNR's Program Open Space (POS) program. POS is designed to help the state and local governments acquire lands for recreation and open space use. Qualified projects may include additions to parks, forests, wildlife areas, beaches, wetlands and other natural areas. Acquisition of land and water sites may be accomplished via outright purchases, transfer negotiations, condemnation, or donation. Funds for POS are derived from issuance of state bonds and from a state real estate transfer tax of 0.5 percent on private purchases of residences or property. POS funds have been used to expand Maryland's Wildlife Management Areas. DNR maintains and manages over 85,000 acres on 36 separate Wildlife Management Areas from mountain meadows in Garrett County to productive marshes in Worcester County. Recently, POS funds were used to purchase an additional 450 acres of wetlands adjacent to Fishing Bay Wildlife Management Area in Dorchester County and 280 more wetland acres at Deal Island WMA in Somerset County.

Conservation organizations such as the Nature Conservancy and the Conservation Fund conduct acquisition programs designed in part to assist state and local acquisition efforts. In some cases they can purchase wetlands and hold them until public purchase is possible. This represents an important source of assistance in Maryland and elsewhere in the Nation, since raising funds for acquisition and actual acquisition is difficult and time consuming. The Nature Conservancy has acquired a number of sites throughout the state including: Nanjemoy Creek Great Blue Heron Sanctuary (Charles County), Nassawango Creek (Worcester County; Figure 9-2), and Otwell Woodland (Talbot County). At the state level, private conservation of wetlands and other lands is encouraged by the Maryland Environmental Trust and, at the local level, through approximately 20 privately organized "land trusts," located throughout the state, such as the Severn River Land Trust in Anne Arundel County.

Future Actions

In an effort to maintain and enhance remaining wetlands, many opportunities are available to both government and the private sector. Their joint efforts will determine the future course of our Nation's wetlands. Major options have been outlined below.

Government Options:

1. Strengthen Federal, state and local wetlands protection.
2. Ensure proper implementation of existing laws and policies through adequate staffing and improved surveillance and enforcement programs.
3. Increase wetland acquisition to preserve functions of existing wetland systems. Identify large tracts of remaining wetlands and strive to connect them together, thereby linking presently isolated tracts into an interconnected network of wetlands.
4. Identify wetland landscapes in need of restoration and initiate large-scale proactive restoration efforts to restore ecosystem functions.
5. Develop measures and programs to maintain and establish vegetated buffers around wetlands and along waterbodies. This could produce significant water quality benefits and enhance wildlife habitat values.
6. Instead of wetland trend studies, develop and initiate monitoring programs to provide more real-time assessment of wetlands for analyzing and modifying current wetland protection policies.
7. Conduct research to increase our knowledge of the hydrology and functions of seasonally saturated wetlands and isolated temporarily flooded wetlands on the Coastal Plain.
8. Develop outreach programs to encourage private landowners to protect their wetlands and/or to minimize wetland alteration during activities such as timber harvest.
9. Eliminate government-sponsored wetland channelization or ditching programs and seek other more environmentally acceptable means of reducing flood damages, e.g., natural valley storage approach.
10. Locate stormwater detention basins outside of wetlands and streams.
11. Scrutinize cost-benefit analyses and justifications for flood control projects that involve channelization or other alteration of wetlands and watercourses.
12. Provide tax incentives to private landowners to encourage wetland preservation.
13. Increase support for the Federal and state conservation easement programs.
14. Enhance existing wetlands through improving water quality.
15. Periodically update wetlands inventory maps in areas experiencing significant wetland change.
16. Increase public awareness of wetland values and the status of wetlands through various media and environmental education programs.
17. Develop a comprehensive statewide wetlands protection and management strategy involving all levels of government, private sector organizations, and interested citizens.
18. Develop and implement watershed management plans (including wetland protection and wetland restoration) for guiding land-use decisions.

Private Options:

1. Rather than drain or fill wetlands, seek more environmentally compatible, alternative uses of those areas, e.g., timber harvest, waterfowl production, fur harvest, hay and forage, and hunting leases.
2. Donate wetlands to private or public conservation agencies for tax purposes.
3. Maintain wetlands as open space and seek appropriate tax relief.
4. When selling property that includes wetlands, consider incorporating into the property transfer, a deed restriction or a covenant preventing future alteration and destruction of the wetlands and an appropriate buffer zone.
5. Develop a personal wetland conservation ethic and work in concert with government agencies and other organizations to help educate the public on wetland

values, threats, and losses (e.g., organize a "Wetland Day" event in your local town).

6. Locate agricultural sediment ponds and other ponds outside of wetlands and streams and where possible manage them for wetland and aquatic species.

7. Purchase Federal and state duck stamps which support wetlands acquisition.

8. Support in various ways, public and private efforts to protect and enhance wetlands.

Public and private cooperation is needed to secure a promising future for our remaining wetlands. In Maryland, as competition for wetlands between development and environmental interest increases, ways have to be found to achieve economic growth, while minimizing adverse environmental impacts. This is vital to preserving wetland values for our future generations and for fish and wildlife species.

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APPENDICES.

Listings of Maryland's Wetland Plants by Life Form

Plant Species That Occur In Maryland's Wetlands

AQUATICS

Regional Indicator	Scientific Name
OBL	*Armoracia aquatica* (A. Eat.) Wiegand
OBL	*Brasenia schreberi* J.F. Gmel.
OBL	*Cabomba caroliniana* Gray
OBL	*Callitriche heterophylla* Pursh
OBL	*Callitriche stagnalis* Scop.
OBL	*Callitriche verna* L.
OBL	*Ceratophyllum demersum* L.
OBL	*Ceratophyllum muricatum* Cham.
OBL	*Elodea canadensis* Michx.
OBL	*Elodea nuttallii* (Planch.) H. St. John
OBL	*Heteranthera reniformis* Ruiz & Pavon
OBL	*Hottonia inflata* Elliott
OBL	*Hydrocotyle ranunculoides* L.F.
OBL	*Hydrocotyle umbellata* L.
OBL	*Lemna minor* L.
OBL	*Lemna perpusilla* Torr.
OBL	*Lemna valdiviana* Philippi
OBL	*Ludwigia peploides* (H.B.K.) Raven
OBL	*Ludwigia uruguayensis* (Cambess.) H. Hara
OBL	*Megalodonta beckii* (Torr.) Greene
OBL	*Myriophyllum brasiliense* Cambess.
OBL	*Myriophyllum heterophyllum* Michx.
OBL	*Myriophyllum humile* (Raf.) Morong
OBL	*Myriophyllum pinnatum* (Walter) B.S.P.
OBL	*Myriophyllum tenellum* Bigel.
OBL	*Myriophyllum verticillatum* L.
OBL	*Najas flexilis* (Willd.) Rostk. & W.L.E. Schmidt
OBL	*Najas gracillima* (A. Braun) Magnus
OBL	*Najas guadalupensis* (Spreng.) Morong
OBL	*Nasturtium officinale* R. BR. In W.T. Ait.
OBL	*Nelumbo lutea* (Willd.) Pers.
OBL	*Nuphar luteum* (L.) Sibth. & J.E. Smith
OBL	*Nymphaea odorata* Soland. In Ait.
OBL	*Nymphoides aquatica* (Walter Ex J.F. Gmel.) Kuntze
OBL	*Nymphoides cordata* (Elliott) Fernald
OBL	*Oenanthe aquatica* (L.) Lam.
OBL	*Orontium aquaticum* L.
OBL	*Podostemum ceratophyllum* Michx.
OBL	*Polygonum amphibium* L.
OBL	*Potamogeton amplifolius* Tuckerman

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

AQUATICS

Regional Indicator	Scientific Name
OBL	*Potamogeton crispus* L.
OBL	*Potamogeton diversifolius* Raf.
OBL	*Potamogeton epihydrus* Raf.
OBL	*Potamogeton foliosus* Raf.
OBL	*Potamogeton illinoensis* Morong
OBL	*Potamogeton natans* L.
OBL	*Potamogeton nodosus* Poir.
OBL	*Potamogeton pectinatus* L.
OBL	*Potamogeton perfoliatus* L.
OBL	*Potamogeton pulcher* Tuckerman
OBL	*Potamogeton pusillus* L.
OBL	*Potamogeton richardsonii* (Ar. Benn.) Rydb.
OBL	*Potamogeton robbinsii* Oakes
OBL	*Potamogeton spirillus* Tuckerman
OBL	*Potamogeton X mysticus* Morong
OBL	*Potamogeton zosteriformis* Fernald
OBL	*Proserpinaca palustris* L.
OBL	*Proserpinaca pectinata* Lam.
OBL	*Ranunculus aquatilis* L.
OBL	*Ranunculus hederaceus* L.

Regional Indicator	Scientific Name
OBL	*Ranunculus trichophyllus* D. Chaix
OBL	*Ruppia maritima* L.
OBL	*Sagittaria stagnorum* Small
OBL	*Spirodela polyrhiza* (L.) Schleid.
OBL	*Utricularia cornuta* Michx.
OBL	*Utricularia fibrosa* Walter
OBL	*Utricularia geminiscapa* L. Benj.
OBL	*Utricularia gibba* L.
OBL	*Utricularia inflata* Walter
OBL	*Utricularia juncea* Vahl
OBL	*Utricularia macrorhiza* Leconte
OBL	*Vallisneria americana* Michx.
OBL	*Wolffia columbiana* Karst.
OBL	*Wolffia papulifera* C.H. Thomps.
OBL	*Wolffia punctata* Griseb.
OBL	*Wolffiella floridana* (J.D. Smith) C.H. Thomps.
NI	*Wolffiella gladiata* (Hegelm.) Hegelm.
OBL	*Zannichellia palustris* L.
OBL	*Zostera marina* L.
OBL	*Zosterella dubia* (Jacq.) Small

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX B.

Ferns & Allies

Plant Species That Occur In Maryland's Wetlands

FERNS & ALLIES

Regional Indicator	Scientific Name
FACU	*Adiantum capillus-veneris* L.
FAC-	*Adiantum pedatum* L.
FACU	*Asplenium platyneuron* (L.) Oakes
FAC	*Athyrium filix-femina* (L.) Roth
FAC	*Athyrium pycnocarpon* (Spreng.) Tidest.
FAC	*Athyrium thelypteroides* (Michx.) Desv.
OBL	*Azolla caroliniana* Willd.
FAC	*Botrychium biternatum* (Savigny) Under.
FAC	*Botrychium dissectum* Spreng.
FACW	*Botrychium lanceolatum* (S.G. Gmel.) Rupr.
FACU	*Botrychium matricariifolium* A. Braun
FACU	*Botrychium multifidum* (J.F. Gmel.) Rupr.
FACU	*Botrychium simplex* E. Hitchc.
FACU	*Botrychium virginianum* (L.) Swartz
FAC	*Cystopteris bulbifera* (L.) Bernh.
FACU	*Cystopteris fragilis* (L.) Bernh.
OBL	*Dryopteris celsa* (W. Palmer) Small
FACW+	*Dryopteris clintoniana* (D.C. Eat.) P. Dowel
FACW+	*Dryopteris cristata* (L.) Gray
FAC+	*Dryopteris goldiana* (HOOK.) Gray
FACU	*Dryopteris intermedia* (Willd.) Gray
FACU-	*Dryopteris marginalis* (L.) Gray
FAC+	*Dryopteris spinulosa* (O.F. MUELL.) WATT
NI	*Dryopteris X australis* (Wherry) Small
FACW	*Dryopteris X boottii* (Tuckerman) Underw.
FAC	*Dryopteris X triploidea* Wherry
FAC	*Dryopteris X uliginosa* Druce
FAC	*Equisetum arvense* L.
OBL	*Equisetum fluviatile* L.
FACW	*Equisetum hyemale* L.
FACW	*Equisetum sylvaticum* L.
NI	*Equisetum X ferrissii* Clute
OBL	*Isoetes engelmannii* A. Braun
OBL	*Isoetes riparia* Engelm. Ex A. Braun
FACW+	*Lycopodium alopecuroides* L.
FAC	*Lycopodium annotinum* L.
FACW+	*Lycopodium appressum* (Chapm.) Lloyd & Underw.
FACW+	*Lycopodium carolinianum* L.
FAC	*Lycopodium clavatum* L.
FACU-	*Lycopodium complanatum* L.
FACU	*Lycopodium dendroideum* MICHX.
OBL	*Lycopodium inundatum* L.
FACW-	*Lycopodium lucidulum* Michx.
FACU	*Lycopodium obscurum* L.
FACU-	*Lycopodium porophilum* Lloyd & Underw.
FAC	*Lycopodium selago* L.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

FERNS & ALLIES

Regional Indicator	Scientific Name
NI	*Lycopodium X copelandii* Eiger
FACW	*Lygodium palmatum* (Bernh.) Swartz
OBL	*Marsilea quadrifolia* L.
FACW	*Matteuccia struthiopteris* (L.) Todaro
FACW	*Onoclea sensibilis* L.
FACW	*Ophioglossum vulgatum* L.
FACW	*Osmunda cinnamomea* L.
FAC	*Osmunda claytoniana* L.
OBL	*Osmunda regalis* L.
FACU-	*Polystichum acrostichoides* (Michx.) Schott
FACU	*Pteridium aquilinum* (L.) Kuhn
NI	*Salvinia auriculata* Aubl.
FACW	*Selaginella apoda* (L.) Spring
FAC	*Thelypteris hexagonoptera* (Michx.) Weatherby
FAC	*Thelypteris noveboracensis* (L.) Nieuwl.
FACW	*Thelypteris simulata* (Davenp.) Nieuwl.
FACW+	*Thelypteris thelypteroides* (Michx.) J. Holub
FACW+	*Woodwardia areolata* (L.) T. Moore
OBL	*Woodwardia virginica* (L.) J.E. Smith

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX C.

Grasses

Plant Species That Occur In Maryland's Wetlands

GRASSES

Regional Indicator	Scientific Name
FACU-	*Agropyron repens* (L.) Beauv.
FACU	*Agropyron trachycaulum* (Link) Malte Ex H.F. Lewis
FACW	*Agrostis alba* L.
NI	*Agrostis gigantea* Roth
FAC	*Agrostis hyemalis* (Walter) B.S.P.
FACU	*Agrostis perennans* (Walter) Tuckerman
FAC	*Agrostis scabra* Willd.
FACW	*Agrostis stolonifera* L.
OBL	*Alopecurus aequalis* Sobol.
FACW	*Alopecurus carolinianus* Walter
OBL	*Alopecurus geniculatus* L.
FACW	*Alopecurus myosuroides* Huds.
FACW	*Alopecurus pratensis* L.
FACU-	*Ammophila breviligulata* Fernald
FACW	*Amphicarpum purshii* Kunth
FAC	*Andropogon gerardii* Vitman
FACW+	*Andropogon glomeratus* (Walter) B.S.P.
FACU	*Andropogon ternarius* Michx.
FACU	*Andropogon virginicus* L.
FACU	*Anthoxanthum odoratum* L.
FACU	*Arrhenatherum elatius* (L.) J. & K. Presl
NI	*Arthraxon hispidus* (Thunb.) Makino
FACW	*Arundinaria gigantea* (Walter) Walter Ex Muhl.
FACU-	*Arundo donax* L.
FACW	*Axonopus furcatus* (Fluegge) A. Hitchc.
FAC	*Briza media* L.
FACW	*Briza minor* L.
FACW	*Bromus ciliatus* L.
FACU-	*Bromus japonicus* Thunb.
FAC-	*Bromus kalmii* Gray
FACW	*Bromus latiglumis* (Shear) Hitchc.
FACU	*Bromus purgans* L.
NI	*Bromus rubens* L.
FACW+	*Calamagrostis canadensis* (Michx.) Beauv.
OBL	*Calamagrostis cinnoides* (Muhl.) Barton
FACU	*Chasmanthium latifolium* (Michx.) H. Yates
FAC	*Chasmanthium laxum* (L.) H. Yates
FACW+	*Cinna arundinacea* L.
FACW	*Cinna latifolia* (Trevir.) Griseb.
OBL	*Coelorachis rugosa* (Nutt.) Nash
FACU	*Cynodon dactylon* (L.) Pers.
FACU	*Dactylis glomerata* L.
FACU-	*Danthonia compressa* Aust.
FACU	*Danthonia sericea* Nutt.
FACW	*Deschampsia cespitosa* (L.) Beauv.
FACU	*Dichanthelium aciculare* (Desv. Ex Poir.) Gould & C.A. Clark
FAC	*Dichanthelium acuminatum* (Swartz) Gould & C.A. Clark
FACU	*Dichanthelium boreale* (Nash) Freckm.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

GRASSES

Regional Indicator	Scientific Name
FAC+	*Dichanthelium clandestinum* (L.) Gould
FACU+	*Dichanthelium commutatum* (J.A. Schultes) Gould
FAC	*Dichanthelium dichotomum* (L.) Gould
FACU-	*Dichanthelium latifolium* (L.) Harvill
FACU	*Dichanthelium oligosanthes* (J.A. Schultes) Gould
FACU	*Dichanthelium ovale* (Elliott) Gould & C.A. Clark
FACU-	*Dichanthelium ravenelii* (Scribn.) Gould
FACU	*Dichanthelium sabulorum* (Lam.) Gould & C.A. Clark
OBL	*Dichanthelium scabriusculum* (Elliott) Gould & C.A. Clark
FACW	*Dichanthelium scoparium* (Lam.) Gould
FACU	*Dichanthelium sphaerocarpon* (Elliott) Gould
FACU-	*Digitaria sanguinalis* (L.) Scop.
FACW+	*Distichlis spicata* (L.) Greene
FACU	*Echinochloa crusgalli* (L.) Beauv.
FACW+	*Echinochloa muricata* (Beauv.) Fernald
FACW+	*Echinochloa walteri* (Pursh) A. Heller
FACU-	*Eleusine indica* (L.) Gaertn.
FACU+	*Elymus canadensis* L.
FACW	*Elymus riparius* Wiegand
FACU-	*Elymus villosus* Muhl. Ex Willd.
FACW-	*Elymus virginicus* L.
FACU	*Eragrostis cilianensis* (All.) Link Ex Mosher
FACW	*Eragrostis frankii* C.A. Meyer
OBL	*Eragrostis hypnoides* (Lam.) B.S.P.
FAC	*Eragrostis pectinacea* (Michx.) Nees
FACU	*Eragrostis pilosa* (L.) Beauv.
FACW	*Eragrostis refracta* (Chapm.) Scribn.
FAC	*Erianthus alopecuroides* (L.) Elliott
OBL	*Erianthus brevibarbis* Michx.
FAC	*Erianthus contortus* Baldw. Ex Elliott
FACW+	*Erianthus giganteus* (Walter) F.T. Hubb. Non Muhl.
FAC	*Eulalia viminea* (Trin.) Kuntze
FACU	*Festuca arundinacea* Schreb.
FACU	*Festuca obtusa* Biehler
FAC	*Festuca paradoxa* Desv.
FACU-	*Festuca pratensis* Huds.
FACU	*Festuca rubra* L.
OBL	*Glyceria acutiflora* Torr.
OBL	*Glyceria canadensis* (Michx.) Trin.
OBL	*Glyceria melicaria* (Michx.) F.T. Hubb.
OBL	*Glyceria obtusa* (Muhl.) Trin.
OBL	*Glyceria septentrionalis* A. Hitchc.
OBL	*Glyceria striata* (Lam.) A. Hitchc.
FACU	*Gymnopogon brevifolius* Trin.
FACW	*Hierochloe odorata* (L.) Beauv.
FACU	*Holcus lanatus* L.
FAC	*Hordeum jubatum* L.
FAC	*Hordeum pusillum* Nutt.
OBL	*Leersia lenticularis* Michx.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

GRASSES

Regional Indicator	Scientific Name
OBL	*Leersia oryzoides* (L.) Swartz
FACW	*Leersia virginica* Willd.
FACW	*Leptochloa fascicularis* (Lam.) Gray
FACU-	*Lolium perenne* L.
FACU	*Miscanthus sinensis* Anderss.
FACU-	*Muhlenbergia capillaris* (Lam.) Trin.
FAC	*Muhlenbergia frondosa* (Poir.) Fernald
FACW	*Muhlenbergia glomerata* (Willd.) Trin.
FACW	*Muhlenbergia mexicana* (L.) Trin.
FAC	*Muhlenbergia racemosa* (Michx.) B.S.P.
FAC	*Muhlenbergia schreberi* J.F. Gmel.
FAC+	*Muhlenbergia sylvatica* Torr. Ex Gray
FACW+	*Muhlenbergia torreyana* (J.A. Schultes) A. Hitchc.
FACU-	*Panicum amarum* Elliott
FAC	*Panicum anceps* Michx.
FAC-	*Panicum capillare* L.
FACW-	*Panicum dichotomiflorum* Michx.
FACU	*Panicum flexile* (Gatt.) Scribn.
FAC	*Panicum gattingeri* Nash
FACW+	*Panicum hemitomon* J.A. Schultes
OBL	*Panicum longifolium* Torr.
FACW+	*Panicum rigidulum* Bosc Ex Nees
FAC-	*Panicum tuckermanii* Fernald
FACW	*Panicum verrucosum* Muhl.
FAC	*Panicum virgatum* L.
FACW	*Paspalum boscianum* Fluegge
FAC+	*Paspalum dilatatum* Poir.
OBL	*Paspalum dissectum* (L.) L.
FACW	*Paspalum floridanum* Michx.
OBL	*Paspalum fluitans* (Elliott) Kunth
FAC+	*Paspalum laeve* Michx.
FAC	*Paspalum pubiflorum* Rupr. Ex Fourn.
OBL	*Paspalum repens* Bergius
FACU+	*Paspalum setaceum* Michx.
FACW+	*Phalaris arundinacea* L.
FACU	*Phalaris canariensis* L.
FACW	*Phalaris caroliniana* Walter
FACU	*Phleum pratense* L.
FACW	*Phragmites australis* (Cav.) Trin. Ex
FACW-	*Poa alsodes* Gray
FACU	*Poa annua* L.
FAC	*Poa autumnalis* Muhl. Ex Elliott
FACU	*Poa compressa* L.
FAC	*Poa nemoralis* L.
FACW	*Poa palustris* L.
FACU	*Poa pratensis* L.
FACW	*Poa sylvestris* Gray
FACW	*Poa trivialis* L.
FACW+	*Polypogon monspeliensis* (L.) Desf.
OBL	*Puccinellia distans* (L.) Parlat.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

GRASSES

Regional Indicator	Scientific Name
OBL	*Puccinellia fasciculata* (Torr.) Bickn.
OBL	*Puccinellia pallida* (Torr.) R.T. Clausen
FACU-	*Schizachne purpurascens* (Torr.) Swallen
FACU-	*Schizachyrium scoparium* (Michx.) Nash
FAC	*Setaria geniculata* (Lam.) Beauv.
FAC	*Setaria glauca* (L.) Beauv.
FACU	*Setaria italica* (L.) Beauv.
FACW	*Setaria magna* Griseb.
FAC	*Setaria verticillata* (L.) Beauv.
FACU	*Sorghum halepense* (L.) Pers.
OBL	*Spartina alterniflora* Loiseleur
OBL	*Spartina caespitosa* A.A. Eat.
OBL	*Spartina cynosuroides* (L.) Roth
FACW+	*Spartina patens* (Ait.) Muhl.
OBL	*Spartina pectinata* Link
FAC-	*Sphenopholis obtusata* (Michx.) Scribn.
OBL	*Sphenopholis pensylvanica* (L.) A. Hitchc.
FACU-*	*Sporobolus neglectus* Nash
FACU*	*Tridens flavus* (L.) A. Hitchc.
FACW	*Tripsacum dactyloides* (L.) L.
FACU-	*Uniola paniculata* L.
OBL	*Zizania aquatica* L.
OBL	*Zizaniopsis miliacea* (Michx.) Doell & Aschers.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX D.

Sedges

Plant Species That Occur In Maryland's Wetlands

SEDGES

Regional Indicator	Scientific Name
FACU	*Bulbostylis capillaris* (L.) C.B. Clarke
FAC	*Carex abscondita* Mackenz.
FACW	*Carex albolutescens* Schweinitz
FAC	*Carex amphibola* Steud.
FACW	*Carex annectens* (Bickn.) Bickn.
OBL	*Carex aquatilis* Wahlenb.
FACW+	*Carex atlantica* L.H. Bailey
OBL	*Carex baileyi* Britton
OBL	*Carex barrattii* Schweinitz & Torr.
FAC	*Carex blanda* Dewey
FACW	*Carex bromoides* Schkuhr
FACW	*Carex brunnescens* (Pers.) Poir.
OBL	*Carex bullata* Schkuhr
FACW	*Carex bushii* Mackenz.
OBL	*Carex buxbaumii* Wahlenb.
OBL	*Carex canescens* L.
FACU	*Carex caroliniana* Schweinitz
FAC+	*Carex cephaloidea* Dewey
FACU	*Carex cephalophora* Muhl. Ex Willd.
OBL	*Carex collinsii* Nutt.
OBL	*Carex comosa* Boott
FACU	*Carex complanata* Torr. & Hook.
FACW	*Carex conjuncta* Boott
FACU	*Carex conoidea* Schkuhr
OBL	*Carex crinita* Lam.
FACW	*Carex cristatella* Britton
FAC-	*Carex davisii* Schweinitz & Torr.
FAC	*Carex debilis* Michx.
OBL	*Carex decomposita* Muhl.
FACW+	*Carex divisa* Huds.
OBL*	*Carex echinata* Murray
OBL	*Carex emoryi* Dewey
OBL	*Carex exilis* Dewey
OBL	*Carex extensa* S. Goodenough
FAC	*Carex festucacea* Schkuhr Ex Willd.
FAC	*Carex flaccosperma* Dewey
NI	*Carex foenea* Willd.
OBL	*Carex frankii* Kunth
OBL	*Carex gigantea* Rudge
OBL	*Carex glaucescens* Elliott
FACU*	*Carex gracillima* Schweinitz
FACW+	*Carex granularis* Muhl. Ex Willd.
FACW+	*Carex grayi* J. Carey
OBL	*Carex hormathodes* Fernald
OBL	*Carex howei* Mackenz.
OBL	*Carex hyalinolepis* Steud.
OBL	*Carex hystericina* Muhl. Ex Willd.
OBL	*Carex interior* L.H. Bailey
FACW+	*Carex intumescens* Rudge
OBL	*Carex joorii* L.H. Bailey

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

SEDGES

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
OBL	*Carex lacustris* Willd.	FACU	*Carex sparganioides* Muhl. Ex Willd.
OBL	*Carex laevivaginata* (Kuekenth.) Mackenz.	FACW	*Carex squarrosa* L.
OBL	*Carex lanuginosa* Michx.	OBL	*Carex straminea* Willd.
OBL	*Carex lasiocarpa* Ehrh.	OBL	*Carex stricta* Lam.
FACU*	*Carex laxiflora* Lam.	FACW-	*Carex styloflexa* Buckley
OBL	*Carex leptalea* Wahlenb.	FACU	*Carex swanii* (Fernald) Mackenz.
OBL	*Carex longii* Mackenz.	FAC	*Carex tenera* Dewey
OBL	*Carex louisianica* L.H. Bailey	OBL	*Carex tenuiflora* Wahlenb.
FACW+	*Carex lupuliformis* Sartw. EX Dewey	FACW	*Carex tetanica* Schkuhr
OBL	*Carex lupulina* Muhl. Ex Willd.	FACW	*Carex torta* Boott
OBL	*Carex lurida* Wahlenb.	FACW+	*Carex tribuloides* Wahlenb.
FAC	*Carex meadii* Dewey	OBL	*Carex trichocarpa* Muhl. Ex Willd.
OBL	*Carex michauxiana* Boeck.	OBL	*Carex trisperma* Dewey
FACU	*Carex normalis* Mackenz.	FACW+	*Carex typhina* Michx.
FACU*	*Carex novae-angliae* Schweinitz	OBL	*Carex venusta* Dewey
FACU	*Carex polymorpha* Muhl.	OBL	*Carex verrucosa* Muhl.
OBL	*Carex prasina* Wahlenb.	OBL	*Carex vesicaria* L.
FACW	*Carex projecta* Mackenz.	OBL	*Carex vulpinoidea* Michx.
FACW+	*Carex retrorsa* Schweinitz	OBL	*Carex walterana* L.H. Bailey
OBL	*Carex rostrata* J. Stokes	OBL	*Carex X alata* Torr.
OBL	*Carex sartwellii* Dewey	FACU	*Carex X molestac* Mackenz.
OBL	*Carex scabrata* Schweinitz	OBL	*Carex X stipata* Muhl. Ex Willd.
FACW	*Carex scoparia* Schkuhr Ex Willd.	OBL	*Cladium mariscoides* (Muhl.) Torr.
FACW	*Carex seorsa* E.C. Howe	OBL	*Cyperus acuminatus* Torr. & Hook.
FAC	*Carex shortiana* Dewey	FACW+	*Cyperus aristatus* Rottb.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

SEDGES

Regional Indicator	Scientific Name
FACW	*Cyperus brevifolius* (Rottb.) Hassk.
FAC+	*Cyperus compressus* L.
FACW+	*Cyperus dentatus* Torr.
FACW	*Cyperus diandrus* Torr.
FACW+	*Cyperus erythrorhizos* Muhl.
FACW	*Cyperus esculentus* L.
FACW	*Cyperus ferax* L.C. Rich.
FACW	*Cyperus ferruginescens* Boeck.
OBL	*Cyperus filicinus* Vahl
OBL	*Cyperus flavescens* L.
FAC	*Cyperus fuscus* L.
FACW	*Cyperus iria* L.
FACU	*Cyperus lancastriensis* T. Porter Ex Gray
FACW	*Cyperus odoratus* L.
FACU	*Cyperus ovularis* (Michx.) Torr.
FACW	*Cyperus polystachyos* Rottb.
FACW	*Cyperus pseudovegetus* Steud.
FACU+	*Cyperus refractus* Engelm. Ex Boeck.
FAC-	*Cyperus retrorsus* Chapm.
FACW+	*Cyperus rivularis* Kunth
FACW	*Cyperus strigosus* L.
FACW	*Cyperus tenuifolius* (Steud.) Dandy
FACW	*Cyperus virens* Michx.
FACW	*Dichromena colorata* (L.) Hitchc.
OBL	*Dulichium arundinaceum* (L.) Britton

Regional Indicator	Scientific Name
OBL	*Eleocharis acicularis* (L.) Roem. & Schultes
OBL	*Eleocharis flavescens* (Poir.) Urban
OBL	*Eleocharis geniculata* (L.) Roem. & Schultes
OBL	*Eleocharis halophila* Fernald
OBL	*Eleocharis albida* Torr.
FACW+	*Eleocharis compressa* Sullivant
FACW+	*Eleocharis engelmannii* Steud.
OBL	*Eleocharis equisetoides* (Elliott) Torr.
OBL	*Eleocharis erythropoda* Steud.
OBL	*Eleocharis fallax* Weatherby
FACW+	*Eleocharis intermedia* J.A. Schultes
OBL	*Eleocharis microcarpa* Torr.
OBL	*Eleocharis obtusa* (Willd.) J.A. Schultes
OBL	*Eleocharis olivacea* Torr.
OBL	*Eleocharis palustris* (L.) Roem. & Schultes
OBL	*Eleocharis parvula* (Roem. & J.A. Schultes) Link Ex Bluff & Fingerh.
OBL	*Eleocharis quadrangulata* (Michx.) Roem.
OBL	*Eleocharis robbinsii* Oakes
OBL	*Eleocharis rostellata* (Torr.) Torr.
OBL	*Eleocharis smallii* Britton
FACW+	*Eleocharis tenuis* (Willd.) J.A. Schultes
FACW+	*Eleocharis tortilis* (Link) J.A. Schultes
OBL	*Eleocharis tricostata* Torr.
OBL	*Eleocharis tuberculosa* (Michx.) Roem.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

SEDGES

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
OBL	*Eriophorum gracile* W. Koch	OBL	*Rhynchospora pallida* M.A. Curt.
OBL	*Eriophorum virginicum* L.	OBL	*Rhynchospora rariflora* (Michx.) Elliott
FAC	*Fimbristylis annua* (All.) Roem. & Schultes	FACW+	*Rhynchospora torreyana* Gray
FACW+	*Fimbristylis autumnalis* (L.) Roem. Schultes	OBL	*Scirpus acutus* Muhl. Ex Bigel.
FACW+	*Fimbristylis caroliniana* (Lam.) Fernald	OBL	*Scirpus americanus* Pers.
OBL	*Fimbristylis castanea* (Michx.) Vahl	OBL	*Scirpus atrovirens* Willd.
NI	*Fimbristylis dichotoma* (L.) Vahl	OBL	*Scirpus cylindricus* (Torr.) Britton
NI	*Fimbristylis perpusilla* R.M. Harper Ex Small & Britton	FACW+	*Scirpus cyperinus* (L.) Kunth
		OBL	*Scirpus etuberculatus* (Steud.) Kuntze
OBL	*Fimbristylis puberula* (Michx.) Vahl	OBL	*Scirpus expansus* Fernald
OBL	*Fuirena pumila* Torr.	OBL	*Scirpus fluviatilis* (Torr.) Gray
OBL	*Fuirena squarrosa* Michx.	OBL	*Scirpus georgianus* R.M. Harper
FACW+	*Hemicarpha micrantha* (Vahl) Pax	OBL	*Scirpus polyphyllus* Vahl
OBL	*Psilocarya nitens* (Vahl) A. Wood	FACW+	*Scirpus pungens* Vahl
OBL	*Psilocarya scirpoides* Torr.	OBL	*Scirpus purshianus* Fernald
OBL	*Rhynchospora alba* (L.) Vahl	OBL	*Scirpus robustus* Pursh
OBL	*Rhynchospora capitellata* (Michx.) Vahl	OBL	*Scirpus smithii* Gray
OBL	*Rhynchospora cephalantha* Gray	OBL	*Scirpus subterminalis* Torr.
OBL	*Rhynchospora chalarocephala* Fernald & S.	OBL	*Scirpus torreyi* Olney
OBL	*Rhynchospora corniculata* (Lam.) Gray	OBL	*Scirpus validus* Vahl
OBL	*Rhynchospora fusca* (L.) W.T. Ait.	FACW	*Scleria minor* (Britton) W. Stone
FACW	*Rhynchospora globularis* (Chapm.) Small	FACU-	*Scleria nitida* Willd.
OBL	*Rhynchospora glomerata* (L.) Vahl	FACU+	*Scleria oligantha* Michx.
OBL	*Rhynchospora gracilenta* Gray	FACU+	*Scleria pauciflora* Muhl. Ex Willd. Nomen
OBL	*Rhynchospora inundata* (Oakes) Fernald	OBL	*Scleria reticularis* Michx.
OBL	*Rhynchospora macrostachya* Torr.	FAC	*Scleria triglomerata* Michx.
FACW+	*Rhynchospora microcephala* (Britton) Britton	OBL	*Scleria verticillata* Muhl. Ex Willd.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information),+ (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX E.
Rushes

Plant Species That Occur in Maryland's Wetlands

RUSHES

Regional Indicator	Scientific Name
OBL	*Juncus acuminatus* Michx.
FACW+	*Juncus balticus* Willd.
FACW	*Juncus biflorus* Elliott
FACW	*Juncus brachycarpus* Engelm.
OBL	*Juncus brachycephalus* (Engelm.) Buchenau
OBL	*Juncus brevicaudatus* (Engelm.) Fernald
FACW	*Juncus bufonius* L.
OBL	*Juncus caesariensis* Coville
OBL	*Juncus canadensis* J. Gay
FACW+	*Juncus coriaceus* Mackenz.
OBL	*Juncus debilis* Gray
FACW	*Juncus dichotomus* Elliott
FACW	*Juncus diffusissimus* Buckley
FACW+	*Juncus effusus* L.
FACW+	*Juncus gerardii* Loiseleur
OBL	*Juncus longii* Fernald
FACW	*Juncus marginatus* Rostk.
OBL	*Juncus megacephalus* M.A. Curt.
OBL	*Juncus militaris* Bigel.
OBL	*Juncus melocarpus* E. Meyer
FAC	*Juncus platyphyllus* (Wiegand) Fernald
OBL	*Juncus polycephalus* Michx.
OBL	*Juncus repens* Michx.
OBL	*Juncus roemeranus* Scheele
FACW	*Juncus scirpoides* Lam.
FACU	*Juncus secundus* Beauv.
OBL	*Juncus subcaudatus* (Engelm.) Coville & Blake
FAC-	*Juncus tenuis* Willd.
FACW	*Juncus torreyi* Coville
FAC	*Luzula acuminata* Raf.
FACU	*Luzula bulbosa* (A. Wood.) Rydb.
FACU	*Luzula echinata* (Small) F.J. Herm.
FACU	*Luzula multiflora* (Ehrh. Ex Hoffm.) Lej.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information, + (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX F.
Forbs

Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FACU-	*Acalypha rhomboidea* Raf.	FAC	*Ampelamus albidus* (Nutt.) Britton
FACU-	*Acalypha virginica* L.	FACW	*Anemone canadensis* L.
FACU	*Achillea millefolium* L.	FACU	*Anemone quinquefolia* L.
OBL	*Acorus calamus* L.	NI	*Anemone riparia* Fernald
FACU	*Aegopodium podagraria* L.	NI	*Anemone virginiana* L.
FAC	*Agalinis fasciculata* (Elliott) Raf.	OBL	*Angelica atropurpurea* L.
FACW	*Agalinis linifolia* (Nutt.) Britton	FACW	*Apios americana* Medic.
FACW+	*Agalinis maritima* (Raf.) Raf.	FAC	*Aplectrum hyemale* (Willd.) Torr.
FACU	*Agalinis obtusifolia* (Raf.) Pennell	FACU	*Apocynum cannabinum* L.
FACW-	*Agalinis purpurea* (L.) Raf.	FAC	*Apocynum sibiricum* Jacq.
FAC	*Agalinis tenuifolia* (Vahl) Raf.	FAC	*Aquilegia canadensis* L.
FAC	*Agalinis virgata* Raf.	FACU	*Arabis hirsuta* (L.) Scop.
FACU	*Agastache nepetoides* (L.) Kuntze	FACU	*Arabis lyrata* L.
FACU-	*Ageratina altissima* (L.) R.M. King & H. Rob.	FACU	*Aralia nudicaulis* L.
FACU	*Agrimonia gryposepala* Wallr.	FAC	*Arenaria serpyllifolia* L.
FAC	*Agrimonia parviflora* Soland. In Ait.	FACU-	*Allium vineale* L.
FACU	*Agrimonia rostellata* Wallr.	FACW+	*Althaea officinalis* L.
FACU-	*Agrimonia striata* Michx.	OBL	*Amaranthus cannabinus* (L.) Sauer
FACW	*Aletris aurea* Walter	FACW*	*Amaranthus pumilus* Raf.
FAC	*Aletris farinosa* L.	FACU	*Amaranthus retroflexus* L.
OBL	*Alisma plantago-aquatica* L.	FACU	*Amaranthus spinosus* L.
OBL	*Alisma subcordatum* Raf.	FACU	*Ambrosia artemisiifolia* L.
FACU-	*Alliaria petiolata* (M. Bieb.) Cavara & Grande	FAC	*Ambrosia trifida* L.
FACU	*Allium canadense* L.	FAC	*Amianthium muscaetoxicum* (Walter) Gray
FACU+	*Allium tricoccum* Ait.	NI	*Ammannia latifolia* L.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

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Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
OBL	*Arethusa bulbosa* L.	FAC	*Aster prenanthoides* Muhl.
FACW	*Arisaema dracontium* (L.) Schott	OBL	*Aster puniceus* L.
FACW-	*Arisaema triphyllum* (L.) Schott	OBL	*Aster radula* Ait.
NI	*Armoracia rusticana* P. Gaertn., B. Meyer & Scherb.	FACW	*Aster simplex* Willd.
FACU	*Arnica acaulis* (Walter) B.S.P.	OBL	*Aster subulatus* Michx.
FACU	*Artemisia annua* L.	OBL	*Aster tenuifolius* L.
FACU-	*Artemisia biennis* Willd.	FACW	*Aster tradescanti* L.
FACU	*Artemisia stellerana* Besser	FACW	*Aster umbellatus* Mill.
FACU	*Aruncus dioicus* (Walter) Fernald	FAC	*Aster vimineus* Lam.
FACU*	*Asclepias exaltata* L.	NI	*Aster X lanceolatus* Willd.
OBL	*Asclepias incarnata* L.	FACU	*Astilbe biternata* (Ventenat) Britton
OBL	*Asclepias lanceolata* Walter	FAC	*Astragalus canadensis* L.
FACU	*Asclepias purpurascens* L.	FAC-	*Atriplex arenaria* Nutt.
OBL	*Asclepias rubra* L.	FACW	*Atriplex patula* L.
FACU	*Asclepias variegata* L.	FACU	*Atriplex rosea* L.
FACU	*Asparagus officinalis* L.	OBL	*Bacopa caroliniana* (Walter) B. Rob.
FAC	*Aster dumosus* L.	OBL	*Bacopa cyclophylla* Fernald
FACU	*Aster ericoides* L.	OBL	*Bacopa monnieri* (L.) Wettst.
FACU	*Aster gracilis* Nutt.	NI	*Bacopa rotundifolia* (Michx.) Wettst.
FACW-	*Aster lateriflorus* (L.) Britton	OBL	*Bacopa stragula* Fernald
FACW+	*Aster nemoralis* Ait.	FACU	*Barbarea vulgaris* R. BR.
FACW-	*Aster novae-angliae* L.	OBL	*Bartonia paniculata* (Michx.) Muhl.
FACW+	*Aster novi-belgii* L.	FACW	*Bartonia virginica* (L.) B.S.P.
FAC	*Aster ontarionis* Wiegand	FACW-	*Bidens aristosa* (Michx.) Britton
FACW	*Aster praealtus* Poir.	FACW	*Bidens bidentoides* (Nutt.) Britton

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Regional Indicator	Scientific Name
OBL	*Bidens cernua* L.
FACW+	*Bidens connata* Muhl. Ex Willd.
OBL	*Bidens coronata* (L.) Britton
FACW	*Bidens discoidea* (Torr. & Gray) Britton
FACW	*Bidens frondosa* L.
OBL	*Bidens laevis* (L.) B.S.P.
OBL	*Bidens mariana* Blake
OBL	*Bidens mitis* (Michx.) Sherff
FACW	*Bidens polylepis* Blake
OBL	*Bidens tripartita* L.
FACU-	*Blephilia hirsuta* (Pursh) Benth.
FACW+	*Boehmeria cylindrica* (L.) Swartz
FACW	*Boltonia asteroides* (L.) L'HER.
FACU	*Buchnera americana* L.
FACU	*Cakile edentula* (Bigel.) Hook.
NI	*Cakile maritima* Scop.
OBL	*Calla palustris* L.
FACW+	*Callitriche deflexa* A. Braun
FACW+	*Calopogon tuberosus* (L.) B.S.P.
OBL	*Caltha palustris* L.
FAC-	*Calystegia sepium* (L.) R. BR.
FAC	*Camassia scilloides* (Raf.) Cory
FAC	*Campanula americana* L.
OBL	*Campanula aparinoides* Pursh
FACU	*Campanula rotundifolia* L.
FACU	*Cannabis sativa* L.

Regional Indicator	Scientific Name
FACU	*Capsella bursa-pastoris* (L.) Medic.
FACU	*Cardamine angustata* O. Schulz
OBL	*Cardamine bulbosa* (Schreb. Ex Muhl.) B.S.P.
FACU	*Cardamine concatenata* (Michx.) O. Schwarz
FACU*	*Cardamine diphylla* (michx.) A. Wood
FACW+	*Cardamine douglassii* (Torr.) Britton
FACU	*Cardamine hirsuta* L.
OBL	*Cardamine longii* Fernald
FACU	*Cardamine parviflora* L.
OBL	*Cardamine pensylvanica* Muhl. Ex Willd.
OBL	*Cardamine pratensis* L.
OBL	*Cardamine rotundifolia* Michx.
FACU	*Cassia fasciculata* Michx.
FAC	*Cassia hebecarpa* Fernald
FAC+	*Cassia marilandica* L.
FACU-	*Cassia nictitans* L.
FAC	*Castilleja coccinea* (L.) Spreng.
FAC	*Centaurium pulchellum* (Swartz) Druce
FACW+	*Centaurium spicatum* (L.) Fritsch
FAC-	*Centaurium umbellatum* Gilib. Ex Fernald
FACW	*Centella asiatica* (L.) Urban
FACW	*Centella erecta* (L.F.) Fernald
FACW	*Centunculus minimus* L.
FAC	*Cerastium nutans* Raf.
FACU-	*Cerastium vulgatum* L.
FACW	*Chaerophyllum procumbens* (L.) Crantz

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FAC	*Desmodium canadense* (L.) DC.	FACU	*Erechtites hieraciifolia* (L.) Raf. Ex DC.
FACW	*Diodia virginiana* L.	FACU	*Erigeron annuus* (L.) Pers.
FACW	*Dioscorea hirticaulis* H.H. Bartlett	FACU	*Erigeron philadelphicus* L.
NI	*Dipsacus sylvestris* Huds.	FACU	*Erigeron pulchellus* Michx.
FACU	*Dodecatheon meadia* L.	FACU+	*Erigeron strigosus* Muhl. Ex Willd.
OBL	*Drosera capillaris* Poir.	OBL	*Eriocaulon compressum* Lam.
OBL	*Drosera filiformis* Raf.	OBL	*Eriocaulon decangulare* L.
OBL	*Drosera intermedia* Hayne	OBL	*Eriocaulon parkeri* B. Rob.
OBL	*Drosera rotundifolia* L.	OBL	*Eriocaulon septangulare* With.
FACU-	*Duchesnea indica* (Andrz.) Focke	NI	*Eryngium campestre* L.
OBL	*Echinodorus cordifolius* (L.) Griseb.	FAC	*Eryngium yuccifolium* Michx.
FAC	*Echinocystis lobata* (Michx.) Torr. & Gray	FAC	*Erythronium umbilicatum* C.R. Parks & J.W. Hardin
OBL	*Echinodorus parvulus* Engelm.	FACW	*Eupatoriadelphus fistulosus* (Barratt Ex Hook.)
OBL	*Echinodorus rostratus* (Nutt.) Engelm.	FACW	*Eupatoriadelphus maculatus* (L.) R.M. King & H. Rob
FAC	*Eclipta alba* (L.) Hassk.	FAC	*Eupatoriadelphus purpureus* (L.) R.M. King & H. Rob
OBL	*Elatine americana* (Pursh) Arn.	FACU-	*Eupatorium capillifolium* (Lam.) Small
OBL	*Elatine minima* (Nutt.) Fisch. & C.A. Meyer	OBL	*Eryngium aquaticum* L.
FACU	*Elephantopus carolinianus* Raeusch.	FACW+	*Eupatorium leucolepis* (DC.) Torr. & Gray
FAC	*Elephantopus nudatus Gray*	FACW+	*Eupatorium perfoliatum* L.
FACU	*Ellisia nyctelea* L.	FACW	*Eupatorium pilosum* Walter
FAC	*Epilobium angustifolium* L.	FAC-	*Eupatorium rotundifolium* L.
FAC-	*Epilobium ciliatum* Raf.	FAC-	*Eupatorium serotinum* Michx.
OBL	*Epilobium coloratum* Biehler	FACU	*Euphorbia commutata* Engelm.
OBL	*Epilobium leptophyllum* Raf.	FACU	*Euphorbia humistrata* Engelm.
OBL	*Epilobium strictum* Muhl. Ex Spreng.	FACU-	*Euphorbia maculata* L.

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Regional Indicator	Scientific Name
FACU-	*Euphorbia obtusata* Pursh
FACU	*Euphorbia polygonifolia* L.
FAC	*Euphorbia purpurea* Fernald
FAC	*Euthamia graminifolia* (L.) Nutt.
FACU	*Euthamia minor* (Michx.) Greene
FAC	*Filaginella uliginosa* (L.) Opiz
FACW	*Filipendula rubra* (J. Hill) B. Rob.
FAC	*Floerkea proserpinacoides* Willd.
FACU	*Fragaria virginiana* Duchesne
FACU	*Galium aparine* L.
OBL	*Galium asprellum* Michx.
FACU	*Galium boreale* L.
FACW+	*Galium obtusum* Bigel.
OBL	*Galium tinctorium* L.
FACW+	*Galium trifidum* L.
FACU	*Galium triflorum* Michx.
FACU	*Gaura biennis* L.
FACW	*Gentiana andrewsii* Griseb.
FACW	*Gentiana autumnalis* L.
OBL	*Gentiana catesbaei* Walter
FACW	*Gentiana clausa* Raf.
OBL	*Gentiana linearis* Froel.
FACW	*Gentiana saponaria* L.
FAC	*Gentianella quinquefolia* (L.) Small R.M. King & H. Rob.
OBL	*Gentianopsis crinita* (Froel.) MA
FACU	*Geranium maculatum* L.
FAC	*Geum aleppicum* Jacq.
FACU	*Geum canadense* Jacq.
FAC+	*Geum laciniatum* Murray
OBL	*Geum rivale* L.
FACU	*Geum vernum* (Raf.) Torr. & Gray
FAC-	*Geum virginianum* L.
OBL	*Glaux maritima* L.
FACU	*Glecoma hederacea* L.
FACU-	*Goodyera pubescens* (Willd.) R. BR.
FACU+	*Goodyera repens* (L.) R. BR. In W.T. Ait.
FACU-	*Goodyera tesselata* Loddig.
OBL	*Gratiola aurea* Pursh
OBL	*Gratiola neglecta* Torr.
FACU	*Gratiola pilosa* Michx.
FACW	*Gratiola ramosa* Walter
OBL	*Gratiola virginiana* L.
OBL	*Gratiola viscidula* Pennell
FACU	*Grindelia squarrosa* (Pursh) Dunal
FACU	*Hackelia virginiana* (L.) I. Johnst.
FAC-	*Hasteola suaveolens* (L.) Pojark.
FACW+	*Helenium autumnale* L.
FAC-	*Helenium flexuosum* Raf.

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Regional Indicator	Scientific Name
FACW	*Helianthus angustifolius* L.
FAC-	*Helianthus annuus* L.
FACW	*Helianthus giganteus* L.
FACW	*Helianthus grosseserratus* M. Martens
FAC	*Helianthus tuberosus* L.
FAC+	*Heliotropium indicum* L.
OBL	*Helonias bullata* L.
OBL	*Hemianthus micranthemoides* Nutt.
FACU-	*Heracleum lanatum* Michx.
FACU-	*Heuchera americana* L.
OBL	*Hibiscus laevis* All.
OBL	*Hibiscus moscheutos* L.
FACU	*Hieracium traillii* Greene
FACU	*Honkenya peploides* (L.) Ehrh.
FACU	*Houstonia caerulea* L.
NI	*Houstonia minima* L.C. Beck
FAC	*Houstonia serpyllifolia* Michx.
FACU-	*Hybanthus concolor* (T.F. Forst.) Spreng.
OBL	*Hydrocotyle americana* L.
OBL	*Hydrocotyle verticillata* Thunb.
FACU	*Hydrophyllum canadense* L.
FAC	*Hydrophyllum virginianum* L.
OBL	*Hypericum adpressum* W. Barton
FACW	*Hypericum canadense* L.
FACW-	*Hypericum denticulatum* Walter
FACW	*Hypericum dissimulatum* Bickn.
OBL	*Hypericum ellipticum* Hook.
OBL	*Hypericum gymnanthum* Engelm. & Gray
FACW	*Hypericum mutilum* L.
FAC-	*Hypericum punctatum* Lam.
FAC	*Hypericum pyramidatum* Ait.
FAC	*Hypoxis hirsuta* (L.) Coville
FACW	*Impatiens capensis* Meerb.
FACW	*Impatiens pallida* Nutt.
FACU	*Ipomoea pandurata* (L.) G.F.W. Meyer
FACW-	*Iresine rhizomatosa* Standl.
OBL	*Iris pseudacorus* L.
OBL	*Iris versicolor* L.
OBL	*Iris virginica* L.
FACU	*Isotria medeoloides* (Pursh) Raf.
FACU	*Isotria verticillata* (Muhl. Ex Willd.) Raf.
OBL	*Justicia americana* (L.) Vahl
FAC	*Kickxia elatine* (L.) Dumort.
OBL	*Kosteletzkya virginica* (L.) K. Presl Ex Gray
FACU	*Krigia biflora* (Walter) Blake
FAC	*Krigia dandelion* (L.) Nutt.
FACU	*Lactuca biennis* (Moench) Fernald
FACU-	*Lactuca canadensis* L.
FACU-	*Lactuca floridana* (L.) Gaertn.
FAC-	*Lactuca serriola* L.

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FACW	*Laportea canadensis* (L.) Wedd.	FACW	*Liparis loeselii* (L.) L.C. Rich.
FACW+	*Lathyrus palustris* L.	FACW	*Listera australis* Lindl.
FACW	*Lathyrus venosus* Muhl. Ex Willd.	FACW+	*Listera cordata* (L.) R. BR.
FACU	*Leontodon leysseri* (Wallr.) G. Beck	FACW	*Listera smallii* Wiegand
FAC	*Lepidium densiflorum* Schrad.	OBL	*Lobelia canbyi* Gray
FACU-	*Lepidium virginicum* L.	FACW+	*Lobelia cardinalis* L.
FAC	*Lespedeza angustifolia* (Pursh) Elliott	OBL	*Lobelia elongata* Small
FACU-	*Lespedeza capitata* Michx.	OBL	*Lobelia glandulosa* Walter
FACU	*Lespedeza stipulacea* Maxim.	FACU	*Lobelia inflata* L.
FACU	*Lespedeza striata* (Thunb.) Hook. & Arn.	FACW	*Lobelia nuttallii* J.A. Schultes
FAC+	*Liatris spicata* (L.) Willd.	FACW-	*Lobelia puberula* Michx.
FAC	*Ligusticum canadense* (L.) Britton	FACW+	*Lobelia siphilitica* L.
OBL	*Lilaeopsis chinensis* (L.) Kuntze	FAC-	*Lobelia spicata* LAM.
FAC+	*Lilium canadense* L.	FACU-	*Lotus corniculatus* L.
FACU+	*Lilium philadelphicum* L.	FACW+	*Ludwigia alternifolia* L.
FACW+	*Lilium superbum* L.	OBL	*Ludwigia brevipes* (B. Long Ex Britton, A. BR. & Small) E. Eames
OBL	*Limonium carolinianum* (Walter) Britton		
OBL	*Limosella subulata* E. Ives	OBL	*Ludwigia decurrens* Walter
OBL	*Lindernia anagallidea* Michx.) Pennell	OBL	*Ludwigia glandulosa* Walter
OBL	*Lindernia Dubia* (L.) Pennell	OBL	*Ludwigia hirtella* RAF.
FAC	*Linum floridanum* (Planch.) Trelease	OBL	*Ludwigia linearis* Walter
FACU	*Linum medium* (Planch.) Britton	OBL	*Ludwigia palustris* (L.) Elliott
FACW	*Linum striatum* Walter	OBL	*Ludwigia sphaerocarpa* Elliott
FACU	*Linum virginianum* L.	FACU	*Lychnis flos-cuculi* L.
FACU-	*Liparis liliifolia* (L.) L.C. Rich. Ex Ker-Gawl.	OBL	*Lycopus americanus* Muhl. Ex W. Barton

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OBL	*Lycopus amplectens* Raf.
OBL	*Lycopus europaeus* L.
OBL	*Lycopus rubellus* Moench
OBL	*Lycopus virginicus* L.
FACW	*Lysimachia ciliata* L.
OBL	*Lysimachia hybrida* Michx.
FAC	*Lysimachia lanceolata* Walter
OBL	*Lysimachia nummularia* L.
OBL	*Lysimachia punctata* L.
FACW+	*Lysimachia quadriflora* Sims
FACU-	*Lysimachia quadrifolia* L.
OBL	*Lysimachia terrestris* (L.) B.S.P.
FAC+	*Lysimachia vulgaris* L.
OBL	*Lythrum lineare* L.
FACW+	*Lythrum salicaria* L.
FAC-	*Maianthemum canadense* Desf.
FAC	*Malaxis unifolia* Michx.
FAC	*Marshallia grandiflora* Beadle & F. Boynt.
FACU	*Matricaria matricarioides* (Less.) T. Porter
FACU-	*Mazus japonicus* (Thunb.) Kuntze
OBL	*Mecardonia acuminata* (Walter) Small
FACU	*Melampyrum lineare* Desr.
FACU	*Melanthium latifolium* Desv.
FACW+	*Melanthium virginicum* L.
FACU-	*Melilotus alba* Medic.
FACU-	*Melilotus officinalis* Lam.
OBL	*Mentha aquatica* L.
FACW	*Mentha arvensis* L.
FACU	*Mentha longifolia* L.
NI	*Mentha pulegium* L.
FACW	*Mentha rotundifolia* (L.) Huds.
FACW+	*Mentha spicata* L.
FACW+	*Mentha X piperita* L.
OBL	*Menyanthes trifoliata* L.
FACW	*Mertensia virginica* (L.) Pers.
OBL	*Mimulus alatus* Ait.
OBL	*Mimulus ringens* L.
FACU-	*Mirabilis nyctaginea* (Michx.) Macmil.
FACU	*Mitchella repens* L.
FACU	*Mitella diphylla* L.
FAC	*Moehringia lateriflora* (L.) Fenzl
FAC	*Mollugo verticillata* L.
FAC+	*Monarda didyma* L.
FACU-	*Monotropa uniflora* L.
OBL	*Murdannia keisak* (Hassk.) Hand.-Mazz.
OBL	*Myosotis laxa* Lehm.
FAC	*Myosotis macrosperma* Engelm.
OBL	*Myosotis scorpioides* L.
FAC-	*Myosotis verna* Nutt.
FACW	*Myosoton aquaticum* (L.) Moench

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FACW+	*Narthecium americanum* Ker-Gawl.	FACU	*Penstemon pallidus* Small
FACU	*Nepeta cataria* L.	FACU+	*Perilla frutescens* (L.) Britton
FACU-	*Oenothera biennis* L.	FACW	*Petunia parviflora* Juss.
FAC	*Oenothera fruticosa* L.	FACW	*Phacelia ranunculacea* (Nutt.) Constance
FACU-	*Oenothera laciniata* J. Hill	FACU	*Phlox carolina* L.
FACU-	*Oenothera parviflora* L.	FACU	*Phlox divaricata* L.
FAC-	*Oenothera perennis* L.	FAC	*Phlox glaberrima* L.
FACW	*Oldenlandia uniflora* L.	FACW	*Phlox maculata* L.
FACU	*Ornithogalum umbellatum* L.	FACU	*Phlox paniculata* L.
FACU	*Orobanche uniflora* L.	FACU	*Phlox pilosa* L.
FACU-	*Osmorhiza claytonii* (Michx.) C.B. Clarke	OBL	*Phyla lanceolata* (Michx.) Greene
FACU	*Osmorhiza longistylis* (Torr.) DC.	FAC+	*Phyllanthus caroliniensis* Walter
FACU	*Oxalis corniculata* L.	FACU-	*Physalis pubescens* L.
FAC-	*Oxalis montana* RAF.	FACW	*Physostegia purpurea* (Walter) Blake
OBL	*Oxypolis canbyi* (Coult. & Rose) Fernald	FAC+	*Physostegia virginiana* (L.) Benth.
OBL	*Oxypolis rigidior* (L.) Raf.	FACU+	*Phytolacca americana* L.
NI	*Parietaria floridana* Nutt.	FACW+	*Pilea fontana* (Lunell) Rydb.
FACU-	*Parietaria pensylvanica* Muhl. Ex Willd.	FACW	*Pilea pumila* (L.) Gray
OBL	*Parnassia asarifolia* Ventenat	OBL	*Plantago cordata* Lam.
FACU	*Pedicularis canadensis* L.	FACU	*Plantago major* L.
FACW	*Pedicularis lanceolata* Michx.	FACU	*Plantago rugelii* Decne.
OBL	*Peltandra virginica* (L.) Kunth	OBL	*Platanthera blephariglottis* (Willd.) Lindl.
FACW	*Penstemon alluviorum* Pennell	FACW	*Platanthera ciliaris* (L.) Lindl.
FAC	*Penstemon digitalis* Nutt.	FACW+	*Platanthera cristata* (Michx.) Lindl.
FACU	*Penstemon laevigatus* Soland.	FACW	*Platanthera flava* (L.) Lindl.

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Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FACW	*Platanthera grandiflora* (Bigel.) Lindl.	OBL	*Polygonum arifolium* L.
FACW	*Platanthera lacera* (Michx.) G. Don	FACU	*Polygonum aviculare* L.
FAC	*Platanthera orbiculata* (Pursh) Lindl.	FACW	*Polygonum careyi* Olney
FACW	*Platanthera peramoena* Gray	FACU-	*Polygonum cespitosum* Blume Ex B. Rob. & Fernald
FACW	*Platanthera psychodes* (L.) Lindl.	FACU-	*Polygonum cuspidatum* Siebold & Zuccar.
FACW+	*Platanthera X clavellata* (Michx.) Luer	OBL	*Polygonum densiflorum* Meisn.
FACW	*Pluchea camphorata* (L.) DC.	FACU	*Polygonum erectum* L.
OBL	*Pluchea foetida* (L.) DC.	FACU	*Polygonum glaucum* Nutt.
FACU	*Podophyllum peltatum* L.	OBL	*Polygonum hydropiper* L.
OBL	*Pogonia ophioglossoides* (L.) Juss.	OBL	*Polygonum hydropiperoides* Michx.
FACU	*Polanisia dodecandra* (L.) DC.	FACW+	*Polygonum lapathifolium* L.
FACU	*Polemonium reptans* L.	OBL	*Polygonum opelousanum* Riddell Ex Small
FACW	*Polemonium van-bruntiae* Britton	FACU-	*Polygonum orientale* L.
OBL	*Polygala brevifolia* Nutt.	FACW	*Polygonum pensylvanicum* L.
FACW+	*Polygala cruciata* L.	FAC*	*Polygonum perfoliatum* L.
OBL	*Polygala cymosa* Walter	FACW	*Polygonum persicaria* L.
FACW+	*Polygala lutea* L.	OBL	*Polygonum punctatum* Elliott
FACW	*Polygala mariana* Mill.	FAC	*Polygonum ramosissimum* Michx.
FAC	*Polygala nuttallii* Torr. & Gray	OBL	*Polygonum robustius* (Small) Fernald
FACU	*Polygala paucifolia* Willd.	OBL	*Polygonum sagittatum* L.
FACW+	*Polygala ramosa* Elliott	OBL	*Polygonum setaceum* Baldw.
FACU	*Polygala sanguinea* L.	FAC	*Polygonum virginianum* L.
FACU	*Polygala senega* L.	OBL	*Pontederia cordata* L.
FACU	*Polygonatum biflorum* (Walter) Elliott	FAC	*Portulaca oleracea* L.
FACU	*Polygonatum commutatum* (J.A. & J.H. Schultes) A. Dietr.	FACU	*Potentilla norvegica* L.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
NI	*Potentilla rivalis* Nutt.	FACU	*Ranunculus micranthus* Nutt.
FACU-	*Potentilla simplex* Michx.	FAC	*Ranunculus parviflorus* L.
FACU	*Prenanthes alba* L.	OBL	*Ranunculus pensylvanicus* L.F.
FACU-	*Prenanthes altissima* L.	OBL	*Ranunculus pusillus* Poir.
FAC	*Prenanthes autumnalis* Walter	FAC+	*Ranunculus recurvatus* Poir.
NI	*Prionopsis ciliata* (Nutt.) Nutt.	FAC	*Ranunculus repens* L.
FACU	*Proboscidea louisianica* (Mill.) Thell.	OBL	*Ranunculus sceleratus* L.
OBL	*Ptilimnium capillaceum* (Michx.) Raf.	OBL	*Ranunculus septentrionalis* Poir.
OBL	*Ptilimnium fluviatile* (Rose) Mathiasu	OBL	*Rhexia aristosa* Britton
FACW	*Pycnanthemum flexuosum* (Walter) B.S.P.	OBL	*Rhexia mariana* L.
FACW	*Pycnanthemum muticum* (Michx.) Pers.	OBL	*Rhexia nashii* Small
FACU	*Pycnanthemum setosum* Nutt.	OBL	*Rhexia petiolata* Walter
FAC	*Pycnanthemum verticillatum* (Michx.) Pers.	OBL	*Rhexia virginica* L.
FAC	*Pycnanthemum virginianum* (L.) TH. Durand B.D.Jacks.	OBL	*Rorippa palustris* (L.) Besser
FAC	*Pyrola rotundifolia* L.	OBL	*Rorippa sessiliflora* (Nutt.) A. Hitchc.
FAC	*Pyrola secunda* L.	FACW	*Rorippa sylvestris* (L.) Besser
FACW-	*Ranunculus abortivus* L.	OBL	*Rotala ramosior* (L.) Koehne
FAC+	*Ranunculus acris* L.	FAC	*Rudbeckia fulgida* Ait.
FAC	*Ranunculus allegheniensis* Britton	FACU-	*Rudbeckia hirta* L.
OBL	*Ranunculus ambigens* S. Wats.	FACW	*Rudbeckia laciniata* L.
FACW	*Ranunculus carolinianus* DC.	FACU	*Rudbeckia triloba* L.
FACU	*Ranunculus fascicularis* Muhl. Ex Bigel.	FAC	*Ruellia strepens* L.
OBL	*Ranunculus flabellaris* Raf.	FACW-	*Rumex altissimus* A. Wood
FAC	*Ranunculus hispidus* Michx.	FACU	*Rumex crispus* L.
OBL	*Ranunculus laxicaulis* (Torr. & Gray) Darby	FACU-	*Rumex hastatulus* Baldw.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FACW	*Rumex maritimus* L.	FACW+	*Sanguisorba canadensis* L.
FACU-	*Rumex obtusifolius* L.	FAC	*Sanguisorba minor* Scop.
FACW-	*Rumex pulcher* L.	FACU	*Sanicula gregaria* Bickn.
OBL	*Rumex verticillatus* L.	NI	*Sanicula marilandica* L.
FAC+	*Sabatia angularis* (L.) Pursh	FACU-	*Saponaria officinalis* L.
FACW	*Sabatia campanulata* (L.) Torr.	OBL	*Sarracenia purpurea* L.
OBL	*Sabatia difformis* (L.) Druce	OBL	*Saururus cernuus* L.
OBL	*Sabatia dodecandra* (L.) B.S.P.	OBL	*Saxifraga micranthidifolia* (Haw.) Steud.
FACW+	*Sabatia stellaris* Pursh	OBL	*Saxifraga pensylvanica* L.
FAC	*Sagina decumbens* (Elliott) Torr. & Gray	FAC-	*Saxifraga virginiensis* Michx.
FACW-	*Sagina procumbens* L.	FACU	*Schwalbea americana* L.
OBL	*Sagittaria brevirostra* Mackenz. & Bush	FACU-	*Scleranthus annuus* L.
OBL	*Sagittaria calycina* Engelm.	OBL	*Sclerolepis uniflora* (Walter) B.S.P.
OBL	*Sagittaria engelmanniana* J.G. Smith	FACU+	*Scrophularia lanceolata* Pursh
OBL	*Sagittaria falcata* Pursh	FACU-	*Scrophularia marilandica* L.
OBL	*Sagittaria graminea* Michx.	OBL	*Scutellaria galericulata* L.
OBL	*Sagittaria latifolia* Willd.	FACW	*Scutellaria integrifolia* L.
OBL	*Sagittaria rigida* Pursh	FACW+	*Scutellaria lateriflora* L.
OBL	*Sagittaria subulata* (L.) Buchenau	FAC	*Scutellaria nervosa* Pursh
OBL	*Salicornia bigelovii* Torr.	FACU	*Scutellaria ovata* J. Hill
OBL	*Salicornia europaea* L.	FACW	*Senecio aureus* L.
FACU	*Salsola kali* L.	OBL	*Senecio glabellus* Poir.
FACU-	*Salsola pestifer* A. Nels.	FACU-	*Senecio obovatus* Muhl. Ex Willd.
OBL	*Samolus parviflorus* Raf.	FAC	*Senecio pauperculus* Michx.
NI	*Sanguinaria canadensis* L.	FACU	*Senecio tomentosus* Michx.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FACU	*Senecio vulgaris* L.	FACU+	*Solidago nuttallii* Greene
FACW	*Sesuvium maritimum* (Walter) B.S.P.	OBL	*Solidago patula* Muhl. Ex Willd.
FACU	*Sicyos angulatus* L.	FACU-	*Solidago puberula* Nutt.
FAC	*Sida hermaphrodita* (L.) Rusby	FAC	*Solidago rugosa* Mill.
FAC	*Silene nivea* (Nutt.) Otth	FACW	*Solidago sempervirens* L.
FACU	*Silphium perfoliatum* L.	FACU-	*Solidago spathulata* DC.
FACU-	*Sisymbrium altissimum* L.	FACW	*Solidago stricta* Ait.
FACW-	*Sisyrinchium angustifolium* Mill.	OBL	*Solidago uliginosa* Nutt.
FACU	*Sisyrinchium arenicola* Bickn.	FAC	*Sonchus asper* (L.) J. Hill
FACW	*Sisyrinchium atlanticum* Bickn.	OBL	*Sparganium americanum* Nutt.
FAC+	*Sisyrinchium mucronatum* Michx.	OBL	*Sparganium androcladum* (Engelm.) Morong
OBL	*Sium suave* Walter	OBL	*Sparganium chlorocarpum* Rydb.
FACU-	*Smilacina racemosa* (L.) Desf.	OBL	*Sparganium eurycarpum* Engelm. Ex Gray
FACW	*Smilacina stellata* (L.) Desf.	OBL	*Spergularia marina* (L.) Griseb.
FACU-	*Solanum americanum* Mill.	FACU	*Spergularia rubra* (L.) J. & K. Presl
FAC-	*Solanum dulcamara* L.	NI	*Spiranthes brevilabris* Lindl.
FACU-	*Solanum nigrum* L.	FACW	*Spiranthes cernua* (L.) L.C. Rich.
NI	*Solanum tuberosum* L.	FACU-	*Spiranthes grayi* Ames
FACU-	*Solidago altissima* L.	FACU-	*Spiranthes lacera* (Raf.) Raf.
FACU	*Solidago caesia* L.	OBL	*Spiranthes laciniata* (Small) Ames
FACU	*Solidago canadensis* L.	FACW	*Spiranthes lucida* (H.H. Eat.) Ames
OBL	*Solidago elliottii* Torr. & Gray	OBL	*Spiranthes odorata* (Nutt.) Lindl.
FACW	*Solidago fistulosa* Mill.	OBL	*Spiranthes praecox* (Walter) S. Wats.
FACU	*Solidago flexicaulis* L.	FAC	*Spiranthes vernalis* Engelm. & Gray
FACW	*Solidago gigantea* Ait.	FACW	*Stachys aspera* Michx.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name
FAC+	*Stachys clingmanii* Small
FAC	*Stachys cordata* Riddell
NI	*Stachys eplingii* J. Nels.
OBL	*Stachys hispida* Pursh
FACW+	*Stachys hyssopifolia* Michx.
FAC	*Stachys latidens* Small Ex Britton
OBL	*Stachys palustris* L.
FACW+	*Stachys tenuifolia* Willd.
OBL	*Stellaria alsine* J.F.C. Grimm
FACU-	*Stellaria graminea* L.
FACW	*Stellaria longifolia* Muhl. Ex Willd.
FACU-	*Stellaria longipes* Goldie
FAC+	*Streptopus amplexifolius* (L.) DC.
FAC-	*Streptopus roseus* Michx.
FACW	*Stenanthium gramineum* (Ker-Gawl.) Morong
OBL	*Suaeda linearis* (Elliott) Moq.
OBL	*Suaeda maritima* (L.) Dumort.
OBL	*Symplocarpus foetidus* (L.) Salisb.
FACU-	*Taraxacum officinale* G.H. Weber
FACW-	*Teucrium canadense* L.
FACW	*Thalictrum dasycarpum* Fisch. & Ave-Lall.
FAC	*Thalictrum dioicum* L.
FACW+	*Thalictrum pubescens* Pursh
FACU	*Thalictrum steeleanum* B. Boivin
NI	*Thlaspi arvense* L.
FAC-	*Tiarella cordifolia* L.
FACU	*Tipularia discolor* (Pursh) Nutt.
OBL	*Tofieldia glutinosa* (Michx.) Pers.
OBL	*Tofieldia racemosa* (Walter) B.S.P.
OBL	*Toxicodendron vernix* (L.) Kuntze
FAC	*Tradescantia ohiensis* Raf.
FACU	*Tradescantia virginiana* L.
OBL	*Trapa natans* L.
FACW-	*Trautvetteria caroliniensis* (Walter) Vail
OBL	*Triadenum fraseri* (Spach) Gleason
OBL	*Triadenum tubulosum* (Walter) Gleason
OBL	*Triadenum virginicum* (L.) Raf.
OBL	*Triadenum walteri* (J.F. Gmel.) Gleason
FAC	*Trientalis borealis* Raf.
FACU-	*Trifolium hybridum* L.
FACU-	*Trifolium pratense* L.
FACU-	*Trifolium repens* L.
OBL	*Triglochin maritimum* L.
OBL	*Triglochin striatum* Ruiz & Pavon
FACW	*Trillium cernuum* L.
FACU-	*Trillium erectum* L.
FAC	*Trillium flexipes* Raf.
FACW	*Trillium pusillum* Michx.
NI	*Trillium sessile* L.
FACU*	*Trillium undulatum* Willd.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

FORBS

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FAC	*Triodanis perfoliata* (L.) Nieuwl.	FACU-	*Veronica peregrina* L.
FACU	*Tussilago farfara* L.	OBL	*Veronica scutellata* L.
OBL	*Typha angustifolia* L.	FAC+	*Veronica serpyllifolia* L.
OBL	*Typha domingensis* Pers.	FACU	*Veronicastrum virginicum* (L.) Farw.
OBL	*Typha latifolia* L.	FACW	*Viola affinis* Leconte
OBL	*Typha X glauca* Godr.	FACU	*Viola appalachiensis* Henry
FACU	*Urtica dioica* L.	FACU	*Viola bicolor* Pursh
OBL	*Utricularia subulata* L.	FACW	*Viola blanda* Willd.
FACU	*Uvularia perfoliata* L.	FAC	*Viola brittoniana* Pollard
FACU	*Uvularia puberula* Michx.	FACW	*Viola conspersa* Reichenb.
FACU-	*Uvularia sessilifolia* L.	FACW+	*Viola cucullata* Ait.
FACW	*Valeriana pauciflora* Michx.	FACW	*Viola incognita* Brainerd
FAC	*Valerianella radiata* (L.) Dufr.	FAC	*Viola labradorica* Schrank
FAC	*Valerianella umbilicata* (Sullivant) A. Wood	OBL	*Viola lanceolata* L.
FACU*	*Valerianella woodsiana* (Torr. & Gray) Walpers	OBL	*Viola pallens* (Banks) Brainerd
FACW+	*Veratrum viride* Ait.	FAC	*Viola papilionacea* Pursh
FACW+	*Verbena hastata* L.	FACU	*Viola pensylvanica* Michx.
FACU-	*Verbena officinalis* L.	FAC+	*Viola primulifolia* L.
FACU	*Verbena urticifolia* L.	FACU-	*Viola pubescens* Ait.
FAC	*Verbesina alternifolia* (L.) Britton	FACU	*Viola rostrata* Pursh
FACW+	*Vernonia noveboracensis* (L.) Michx.	FAC+	*Viola rotundifolia* Michx.
OBL	*Veronica americana* Schweinitz Ex Benth.	FACW	*Viola sagittata* Ait.
OBL	*Veronica anagallis-aquatica* L.	FACU	*Viola septentrionalis* Greene
NI	*Veronica arvensis* L.	FAC-	*Viola sororia* Willd.
FACU-	*Veronica officinalis* L.	FACW	*Viola striata* Ait.

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

FORBS

Regional Indicator	Scientific Name
FACU	*Xanthium spinosum* L.
FAC	*Xanthium strumarium* L.
FACW+	*Xyris caroliniana* Walter
OBL	*Xyris difformis* Chapm.
OBL	*Xyris fimbriata* Elliott
OBL	*Xyris smalliana* Nash
OBL	*Xyris torta* J.E. Smith
NI	*Youngia japonica* (L.) DC.
OBL	*Zigadenus leimanthoides* Gray
FAC	*Zizia aptera* (Gray) Fernald
FAC	*Zizia aurea* (L.) W. Koch

Symbology: OBL (Obligate Wetland), FACW (Facultative Wetland), FAC (Facultative), FACU (Facultative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX H.
Shrubs

Plant Species That Occur In Maryland's Wetlands

SHRUBS

Regional Indicator	Scientific Name
FAC	*Alnus crispa* (Dryand. In Ait.) Pursh
NI	*Alnus incana* (L.) Moench
FAC	*Amelanchier canadensis* (L.) Medic.
FACU	*Amelanchier obovalis* (Michx.) Ashe
FACU	*Amelanchier spicata* (Lam.) K. Koch
FACW	*Amelanchier X intermedia* Spach
FACW	*Amorpha fruticosa* L.
FACW	*Aronia arbutifolia* (L.) Elliott
FAC	*Aronia melanocarpa* (Michx.) Elliott
FACW	*Aronia prunifolia* (Marsh.) Rehder.
FACU	*Ascyrum hypericoides* L.
FACU	*Ascyrum stans* Michx.
FACW	*Baccharis halimifolia* L.
FACU	*Berberis thunbergii* Dc.
FACU	*Berberis vulgaris* L.
FACU+	*Callicarpa americana* L.
NI	*Calycanthus floridus* L.
OBL	*Chamaedaphne calyculata* (L.) Moench
FAC+	*Clethra alnifolia* L.
FACW	*Cornus amomum* Mill.
FAC-	*Cornus canadensis* L.
FAC	*Cornus foemina* Mill.
FACW+	*Cornus stolonifera* Michx.
FACU-	*Corylus americana* Walter
FACU-	*Corylus cornuta* Marshall
FAC	*Dirca palustris* L.
NI	*Elaeagnus commutata* Bernh. Ex Rydb.
FAC	*Euonymus americanus* L.
FACW	*Gaultheria hispidula* (L.) Muhl. Ex Torr.
FACU	*Gaultheria procumbens* L.
FACU	*Gaylussacia baccata* (Wangenh.) K. Koch
FAC	*Gaylussacia dumosa* (Andr.) Torr. & Gray
FAC	*Gaylussacia frondosa* (L.) Torr. & Gray
FACU	*Hydrangea arborescens* L.
FAC+	*Hypericum densiflorum* Pursh
FACU	*Hypericum prolificum* L.
FACW-	*Ilex glabra* (L.) Gray
OBL	*Ilex laevigata* (Pursh) A. Gray
OBL	*Itea virginica* L.
FACW+	*Iva frutescens* L.
FAC	*Kalmia angustifolia* L.
NI	*Lespedeza cuneata* (Dum. Cours.) G. Don
FACW	*Leucothoe racemosa* (L.) Gray
FACU	*Ligustrum vulgare* L.
FAC	*Linnaea borealis* L.
FACU	*Lonicera canadensis* Marshall
FACW	*Lyonia ligustrina* (L.) Dc.
FAC-	*Lyonia mariana* (L.) D. Don
FACW+	*Lythrum alatum* Pursh
FAC-	*Menziesia pilosa* (Michx. Ex Lam.) Juss.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

SHRUBS

Regional Indicator	Scientific Name
FAC	*Myrica heterophylla* Raf.
FAC	*Myrica pensylvanica* Loiseleur
OBL	*Nemopanthus mucronatus* (L.) Trelease
FACW-	*Physocarpus opulifolius* (L.) Maxim.
NI	*Quercus prinoides* Willd.
FAC	*Rhamnus frangula* L.
FAC	*Rhododendron arborescens* (Pursh) Torr.
FAC	*Rhododendron atlanticum* (Ashe) Rehd.
FACW	*Rhododendron canadense* (L.) B.S.P.
FACW	*Rhododendron canescens* (Michx.) Sweet
FAC	*Rhododendron periclymenoides* (Michx.) Shinners
FAC	*Rhododendron prinophyllum* (Small) Millais
OBL	*Rhododendron viscosum* (L.) Torr.
FACW	*Ribes americanum* Mill.
FACW	*Ribes glandulosum* Grauer
OBL	*Ribes triste* Pallas
FACU	*Rosa micrantha* J.E. Smith
FACU	*Rosa multiflora* Thunb.
OBL	*Rosa palustris* Marshall
FAC	*Rosa virginiana* Mill.
FACU-	*Rubus allegheniensis* T. Porter
FACU	*Rubus argutus* Link
FACU	*Rubus enslenii* Tratt.
FACW	*Rubus hispidus* L.
FAC-	*Rubus idaeus* L.
FAC	*Rubus longii* Fernald
FAC	*Rubus probabilis* L.H. Bailey
FACW+	*Rubus setosus* Bigel.
NI	*Rubus strigosus* Michx.
NI	*Rubus subtractus* L.H. Bailey
FACU	*Rubus trivialis* Michx.
FACW	*Rubus vigil* L.H. Bailey
OBL	*Salicornia virginica* L.
FACW	*Salix bebbiana* Sarg.
FACW	*Salix discolor* Muhl.
FACW	*Salix eriocephala* Michx.
OBL	*Salix exigua* Nutt.
FACU	*Salix humilis* Marshall
NI	*Salix purpurea* L.
OBL	*Salix sericea* Marshall
FACW-	*Sambucus canadensis* L.
FACU	*Sambucus racemosa* L.
FACU	*Smilax bona-nox* L.
FACW+	*Spiraea alba* Du Roi
NI	*Spiraea betulifolia* Pallas
FACU-	*Spiraea japonica* L.F.
FAC+	*Spiraea latifolia* (Ait.) Borkh.
FACW	*Spiraea tomentosa* L.
FACU-	*Symphoricarpos albus* (L.) Blake
FAC	*Taxus canadensis* Marshall

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

SHRUBS

Regional Indicator	Scientific Name
FACU	*Toxicodendron quercifolia* (Michx.) Greene
FAC-	*Toxicodendron rydbergii* (Small Ex Rydb.) Greene
FACU-	*Vaccinium angustifolium* Ait.
OBL	*Vaccinium caesariense* Mackenz.
FACW-	*Vaccinium corymbosum* L.
OBL	*Vaccinium macrocarpon* Ait.
FAC	*Vaccinium marianum* S. Wats.
FAC	*Vaccinium myrtilloides* Michx.
OBL	*Vaccinium oxycoccos* L.
FACU-	*Vaccinium stamineum* L.
FACW	*Verbena scabra* Vahl
FACW	*Viburnum cassinoides* L.
FAC	*Viburnum lantanoides* Michx.
FACW-	*Viburnum recognitum* Fernald
FACW	*Xanthorhiza simplicissima* Marshall

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

APPENDIX I.

Trees

Plant Species That Occur In Maryland's Wetlands

TREES

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FAC+	*Acer negundo* L.	FAC	*Catalpa speciosa* (Warder Ex Barney) Warder Ex Engelm.
FACU	*Acer pensylvanicum* L.	FACW	*Celtis laevigata* Willd.
FAC	*Acer rubrum* L.	FACU	*Celtis occidentalis* L.
FACW	*Acer saccharinum* L.	NI	*Celtis reticulata* Torr.
FACU-	*Acer saccharum* Marshall	OBL	*Cephalanthus occidentalis* L.
FACU-	*Acer spicatum* Lam.	FACU-	*Cercis canadensis* L.
NI	*Ailanthus altissima* (Mill.) Swingle	OBL	*Chamaecyparis thyoides* (L.) B.S.P.
FACW-	*Alnus glutinosa* (L.) Gaertn.	FAC+	*Chionanthus virginicus* L.
OBL	*Alnus maritima* (Marsh.) Muhl.	FACU-	*Cornus florida* L.
FACW+	*Alnus rugosa* (Du Roi) Spreng.	FACU	*Crataegus crus-galli* L.
OBL	*Alnus serrulata* (Ait.) Willd.	FACU	*Crataegus mollis* Scheele
FAC-	*Amelanchier arborea* (Michx. F.) Fern.	FAC	*Crataegus phaenopyrum* (L.F.) Medic.
FAC	*Aralia spinosa* L.	FACW	*Crataegus viridis* L.
FACU+	*Asimina triloba* (L.) Dunal	FAC-	*Diospyros virginiana* L.
FAC+	*Betula alba* L.	FACU	*Elaeagnus angustifolia* L.
FAC	*Betula alleghaniensis* Britton	FACU	*Euonymus atropurpureus* Jacq.
FACU	*Betula lenta* L.	FACU	*Fagus grandifolia* Ehrh.
FACW	*Betula nigra* L.	FACU	*Fraxinus americana* L.
FAC	*Betula populifolia* Marshall	FACW	*Fraxinus nigra* Marshall
FAC	*Carpinus caroliniana* Walter	FACW	*Fraxinus pennsylvanica* Marshall
FACU+	*Carya cordiformis* (Wangenh.) K. Koch	FAC-	*Gleditsia triacanthos* L.
FACU-	*Carya glabra* (Mill.) Sweet	FAC-	*Hamamelis virginiana* L.
FAC	*Carya laciniosa* (Michx. F.) Loud.	FACW	*Ilex decidua* Walter
NI	*Carya ovalis* (Wangenh.) Sarg.	FACU+	*Ilex opaca* Soland. In Ait.
FACU-	*Carya ovata* (Mill.) K. Koch	FACW+	*Ilex verticillata* (L.) Gray

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

Plant Species That Occur In Maryland's Wetlands

TREES

Regional Indicator	Scientific Name	Regional Indicator	Scientific Name
FACU+	*Juglans cinerea* L.	FAC	*Populus deltoides* W. Bartram Ex Marshall
FACU	*Juglans nigra* L.	FACU-	*Populus grandidentata* Michx.
FACU	*Juniperus virginiana* L.	FACW+	*Populus heterophylla* L.
FACU	*Kalmia latifolia* L.	FACU	*Populus tremula* L.
FACW	*Larix laricina* (Du Roi) K. Koch	FACU-	*Prunus americana* Marshall
FACW-	*Lindera benzoin* (L.) Blume	FACU-	*Prunus pensylvanica* L.F.
FAC	*Liquidambar styraciflua* L.	FACU	*Prunus serotina* Ehrh.
FACU	*Liriodendron tulipifera* L.	FACU	*Prunus virginiana* L.
FACU	*Magnolia tripetala* (L.) L.	FAC	*Ptelea trifoliata* L.
FACW+	*Magnolia virginiana* L.	FACU-	*Quercus alba* L.
FACU	*Morus rubra* L.	FACW+	*Quercus bicolor* Willd.
FAC	*Myrica cerifera* L.	FACU-	*Quercus falcata* Michx.
FAC	*Nyssa sylvatica* Marshall	FAC	*Quercus imbricaria* Michx.
FACU-	*Ostrya virginiana* (Mill.) K. Koch	FACW-	*Quercus laurifolia* Michx.
NI	*Oxydendrum arboreum* (L.) DC.	OBL	*Quercus lyrata* Walter
FACW	*Persea borbonia* (L.) Spreng.	FAC-	*Quercus macrocarpa* Michx.
FACW-	*Picea mariana* (Mill.) B.S.P.	FACW	*Quercus michauxii* Nutt.
FACU	*Picea rubens* Sarg.	FAC	*Quercus nigra* L.
FACU	*Pinus resinosa* Soland. In Ait.	FACW	*Quercus palustris* Muenchh.
FACU	*Pinus rigida* Mill.	FAC+	*Quercus phellos* L.
OBL	*Pinus serotina* Michx.	FACU-	*Quercus rubra* L.
FACU	*Pinus strobus* L.	FAC+	*Quercus shumardii* Buckley
FAC-	*Pinus taeda* L.	FAC	*Rhododendron maximum* L.
FACW-	*Platanus occidentalis* L.	NI	*Rhus copallinum* L.
FACW	*Populus balsamifera* L.	FACU-	*Robinia pseudoacacia* L.

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Plant Species That Occur In Maryland's Wetlands

TREES

Regional Indicator	Scientific Name
FACW	*Salix alba* L.
FACW-	*Salix babylonica* L.
OBL	*Salix caroliniana* Michx.
FAC+	*Salix fragilis* L.
FACW	*Salix lucida* Muhl.
FACW+	*Salix nigra* Marshall
FACU-	*Sassafras albidum* (Nutt.) Nees
FACU	*Sorbus americana* Marshall
FAC	*Staphylea trifolia* L.
FAC+	*Symplocos tinctoria* (L.) L'Her.
OBL	*Taxodium distichum* (L.) L.C. Rich.
FACW	*Thuja occidentalis* L.
FACU	*Tilia americana* L.
FACU	*Tsuga canadensis* (L.) Carriere
FACU	*Ulmus alata* Michx.
FACW-	*Ulmus americana* L.
FAC	*Ulmus rubra* Muhl.
FAC	*Viburnum dentatum* L.
FAC	*Viburnum lentago* L.
OBL	*Viburnum nudum* L.
FACU	*Viburnum prunifolium* L.

Symbology: OBL (Obligate Wetland, FACW (Facultative Wetland), FAC (Facultative), FACU (Faculative Upland), NI (No indicator assigned), * (Limited ecological information), + (Higher portion of frequency range) and - (Lower portion of frequency range).

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.