MARYLAND WILDLIFE DIVERSITY CONSERVATION PLAN

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Maryland
Wildlife Diversity Conservation Plan

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Executive Summary

Maryland is blessed with a wide diversity of wildlife, including mammals, birds, reptiles, amphibians, fish, and invertebrates. This wide diversity is, in part, a result Maryland's diverse landscape that stretches for hundreds of miles from the mountains to the sea. Over 7,000 miles of coastline occur along Maryland's portion of Chesapeake Bay, the Coastal Bays, and the Atlantic Ocean. Nearly 8,800 miles of rivers and streams drain the state's landscape. The additional 475,800 acres of wetlands provide a wide range of aquatic habitats throughout the state. By any measure, Maryland is an ecologically diverse state with a rich natural heritage.

Maryland's fish and wildlife resources face a number of serious threats. Urban sprawl, point and non-point source pollution, rising sea level, habitat loss and fragmentation, and other changes to the landscape all impact and threaten the state's fish and wildlife and their habitats. Numerous conservation plans to address the needs of regional habitats, individual species, or general threats have been developed. However, none of them take a broader, statewide perspective that includes all of Maryland's wildlife diversity and habitats in a comprehensive approach to long-term conservation.

The purpose of this Wildlife Diversity Conservation Plan (WDCP) is to provide the framework and overall direction for wildlife diversity conservation efforts in Maryland for the next decade and beyond. The hope is that this WDCP will be implemented by not only the Maryland Department of Natural Resources (MD DNR) but by all those interested in fish and wildlife conservation in the state, including federal, state, and local government agencies, universities, non-governmental organizations (NGO), and the citizens of Maryland. The plan is comprehensive in nature, with plenty of actions for all interested partners and stakeholders.

The WDCP identifies 502 species of Greatest Conservation Need (GCN) to represent the full array of wildlife species in Maryland. These GCN species are primarily those animals at risk in the state. They include state and federally listed threatened and endangered species, rare species, species whose populations are in decline, endemic species, and those species for which Maryland constitutes a significant portion of their continental population. The GCN species include all vertebrate taxa and many invertebrate taxa. Since there are significant information gaps in our knowledge of the status of most of Maryland's invertebrate species, rare and unique natural vegetative communities are also targeted in this WDCP to serve as coarse filters for the conservation of invertebrates (in addition to the ones listed as GCN species).

Developing 502 individual species conservation plans is not an effective way to apply conservation at a landscape level. Key wildlife habitats that support these GCN species were identified and the WDCP addresses the threats and conservation actions for these key habitats as the core of the conservation plan. In total, 35 key wildlife habitats were identified that encompass a number of forest, wetland, and open terrestrial habitats, as well as streams, rivers, estuaries, and the ocean. Provided for each key wildlife habitat type is a description of the habitat, a list of the associated GCN species, threats to the habitat, conservation actions needed to address the threats, and inventory, monitoring, and research needs. The highest priority conservation actions for each key habitat type are identified.

A set of overarching conservation actions is provided in the WDCP. These include such actions as securing adequate funding, maintaining and disseminating appropriate data, collaborating with partners, utilizing public outreach to increase awareness, developing recreational opportunities related to wildlife diversity to enhance public appreciation for the conservation of wildlife diversity, and many more.

A general framework for monitoring and implementation strategies is also discussed. These strategies utilize existing monitoring and conservation programs by the MD DNR and all the appropriate partners as a baseline for expansion. In the absence of existing programs, new ones are recommended and will be developed over time. Based on these outcomes, this WDCP will be revised in 2015 or sooner if the situation warrants. Adaptive management strategies will be applied and incorporated as indicated.

The conservation actions identified in this WDCP are ambitious. With the involvement and cooperation of our many conservation partners, the full array of Maryland's diverse wildlife and habitats can be protected and enhanced for the benefit of all.

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The photographs used to highlight the key wildlife habitats in Chapter 4 were supplied or authorized by individuals listed in the table below. Other than the photographs that were offered by the MD DNR MBSS, all were taken by staff of the MD DNR NHP.

#	Key Wildlife Habitat	Photographer
1	Old Growth Forests	Ed Thompson
2	Early Successional Forests	Jim McCann
3	Maritime Forests and Shrublands	Paula Becker
4	Loblolly Pine - Oak Forests	Jim McCann
5	Mesic Deciduous Forests	R. Harrison Wiegand
6	Dry Oak - Pine Forests	R. Harrison Wiegand
7	Northern Conifer - Hardwood Forests	Jason Harrison
8	Floodplain Forests	Jason Harrison
9	Upland Depressional Swamps	Jason Harrison
10	Carolina Bays	Jason Harrison
11	Vernal Pools	Jim McCann
12	Forested Seepage Wetlands	Jason Harrison
13	Bog and Fen Wetland Complexes	Lynn Davidson
14	Nontidal Shrub Wetlands	Jim McCann
15	Tidal Shrub Wetlands	Jason Harrison
16	Nontidal Emergent Wetlands	Jim McCann
17	Tidal Marshes	Jason Harrison
18	Grasslands	Lynn Davidson
19	Barrens and Dry Glades	R. Harrison Wiegand
20	Cliffs and Rock Outcrops	Jim McCann
21	Caves, Mines, and Springs	Dan Feller
22	Coastal Beaches, Dunes, and Mudflats	Jim McCann
23	Coldwater Streams	R. Harrison Wiegand
24	Limestone Streams	Courtesy of MBSS
25	Highland Streams	Jim McCann
26	Piedmont Streams	Courtesy of MBSS
27	Coastal Plain Streams	Courtesy of MBSS
28	Blackwater Streams	Courtesy of MBSS
29	Highland Rivers	Jim McCann
30	Piedmont Rivers	R. Harrison Wiegand
31	Coastal Plain Rivers	Courtesy of MBSS
32	Oligohaline	Jason Harrison

#	Key Wildlife Habitat	Photographer
33	Mesohaline	Paula Becker
34	Polyhaline	David Brinker
35	Ocean	David Brinker

Introduction

Importance of Maryland's Wildlife Diversity

Maryland's landscape stretches for hundreds of miles from the mountains to the sea, supporting a rich diversity of habitats and fish and wildlife resources. Over 7,000 miles of coastline occur along Maryland's portion of Chesapeake Bay, the Coastal Bays, and the Atlantic Ocean (MD DNR 2000b, Burke et al. 2004). Nearly 8,800 miles of rivers and streams drain the state's landscape. The more than 21,000 acres of lakes and ponds and 475,800 acres of wetlands provide a wide range of aquatic habitats throughout the state. By any measure, Maryland is an ecologically diverse state with a rich natural heritage. It is especially impressive in its ability to support a tremendous variety of wildlife species.

The importance of Maryland's unique natural setting and its corresponding diversity of wildlife overall can be measured many ways. Perhaps the most significant thing to consider is that above and beyond the economic benefits associated with traditional ecological services, there is an existent and intrinsic value to Maryland's wildlife diversity that cannot be quantified (Costanza et al. 1997). It is the value of healthy ecosystems providing us with clean air, clean water, and fertile soil. It is the priceless value of a quality of life that is made available to the citizens of Maryland as a result of healthy, functional natural communities. It has been long understood that the more diverse an ecosystem is, the more resilient it will be, which is a desirable outcome given the pressures and challenges we face as a modern society.

There is of course remarkable economic importance associated with Maryland's wildlife diversity as well. From the Allegheny Plateau and the Appalachian Mountains to the waters of Chesapeake Bay and the Atlantic Ocean, wildlife-associated recreation generated $1.7 billion in revenue in 2001 (U.S. Department of Interior and U.S. Department of Commerce 2003). Over 700,000 fishermen and 145,000 hunters contributed to nearly half that total, while the remainder of the revenue was spent by over 1.5 million participants in wildlife watching activities in Maryland. The U.S. Department of Interior and U.S. Department of Commerce (2003) reported that 38% of Marylanders participated in wildlife-associated recreation in 2001. An estimated 22% of Maryland residents are bird watchers, and over one million residents and non-residents enjoy birding in the state (Pullis La Rouche 2001). Duda and Young (1993) recorded that 93% of Maryland residents participated in some type of outdoor activity in 1993. Of these, 18% went camping, 29% went hiking, and 9% went backpacking.

While Marylanders generated $862.7 million from wildlife-watching activities, the Total Industrial Output (TIO), which includes direct, indirect, and induced effects, totaled $1.773 billion (Caudill 2003). The ratio of the TIO to direct expenditures in Maryland was 2.05, which means for every $1.00 direct spending associated with wildlife-watching, an additional $1.05 of economic activity is generated. The TIO of $1.773 billion produced 24,667 full and part-time jobs, and generated $29.2 million in state sales tax and $24.3 million in state income tax revenue (Caudill 2003). Another factor to consider is that net economic value is measured as participants' willingness to pay for wildlife-related recreation over and above what they actually spend to participate. This value increased from $40/day in 1985 to $66/day in 2001 (adjusted to 2001 dollars for comparison) for wildlife-watching activities by Maryland residents. In 2001, the net economic value for a Maryland resident was $362 (Aiken and Pullis La Rouche 2003).

Not to be overlooked from an economic perspective is the Chesapeake Bay itself. It is the largest estuary in North America and is known to host over 3,000 species of plants and animals. Maryland shares the Bay with Virginia, and another four states contribute to its watershed. The world's largest population of osprey is found in the Bay ecosystem, and finfish and shellfish harvests were valued at almost $175 million in 2001 (Pyzik et al. 2004). An increasing number of people are boating on the state's waters, with nearly half a million pleasure boats and crafts registered in Maryland and Virginia in 2001. Commercial and recreational fisheries in the state's estuaries and marine waters provide tourism and recreation, which adds significantly to the state's economy. Commercial fisheries landings add an average of $54.5 million to the state's economy every year (NMFS Fisheries Statistics Division, personal communication February 3, 2005).

It is also important to note that over 12 million people visit the Maryland Coastal Bays and ocean coast every year, creating a $2 billion tourism industry (MD DNR 2004c). The natural resources of the Coastal Bays provide over $500 million in annual value to the state's economy (Greeley-Polhemus Group 2001). Nearly one million of those visitors to the Coastal Bays enjoyed wildlife observation, an activity worth $45.1 million/year. Hunting, fishing, and crabbing in the Coastal Bays were also worth an additional $3.5 million annually. Overall, it was estimated that 5,680 full-time jobs were supported by the fish and wildlife resources which were located within the Coastal Bays in recent years (Greeley-Polhemus Group 2001).

No matter how you try to quantify it the value of Maryland's wildlife diversity is enormous. The rich bounty we are fortunate to have stemming from our natural heritage not only functions as an economic engine, it is provides us all with benefits regarding quality of life issues. Maryland's diverse wildlife resources deserve to be understood, respected, and protected.

Need for a Comprehensive Plan

Maryland's invaluable natural resources face a number of serious threats. Population growth, development, and subsequent impacts including point and non-point source pollution, rising sea level, and habitat loss and fragmentation all impact and threaten the state's fish and wildlife. Numerous conservation plans to address the needs of regional habitats, individual species, or general threats have been developed. However, none of them take a statewide, comprehensive perspective that includes all of Maryland's wildlife diversity and habitats in a systems approach to long-term conservation.

The Maryland Department of Natural Resources (MD DNR) is now faced with an historic opportunity and challenge. For the first time in its near 90-year history, a new State Wildlife Grant (SWG) program is providing MD DNR with a unique chance to comprehensively conserve wildlife diversity. This new funding has allowed our state to develop a Wildlife Diversity Conservation Plan (WDCP). A plan that identifies those wildlife species in greatest conservation need (GCN) and focuses resources to those actions needed to conserve them and their key habitats. This is the time to proactively keep common species common and reverse the decline of rare species to prevent them from becoming endangered. Failing to do so will compromise the long-term viability of our state's diverse wildlife resources.

Looking back it is clear that MD DNR has a track record of success in wildlife management. Within the last century, MD DNR has restored the decimated populations of white-tailed deer, wild turkey, beaver, and striped bass, just to name a few. This was accomplished by applying sound scientific principles while utilizing the help of many conservation partners. Above all, restoring game species was possible because of dedicated, long-term funding from user-fees, licenses and a federal excise tax on guns, ammunition, and fishing equipment.

No such dedicated funding existed however for nongame wildlife species in the past. In fact, since 1988, donations by Maryland taxpayers to the Chesapeake Bay and Endangered Species Fund have provided the only consistent source of state funding for MD DNR's endangered species conservation efforts, averaging approximately $500,000 annually. Unfortunately, these private citizen donations can not be guaranteed over time and even at current levels will not be enough going forward for the costly, last ditch efforts required when species decline to the level of needing regulatory protection. Consider also that since the passage of the federal Nongame Act in 1980, not a single dollar has been available and the act remains unfunded. In short, Maryland's historic nongame and endangered species conservation programs have severely lacked adequate funding to perform even basic activities, such as inventory, research, management, and recovery efforts.

Fortunately, in recent years the U.S. Congress has made federal funding available to the state's fish and wildlife agencies for the conservation of species of greatest conservation need. This funding source, called the State Wildlife Grant (SWG), has provided Maryland with $650,000 to $1,015,000 annually since 2002. One of the conditions of this new federal funding source is the development of a Maryland WDCP.

Now is the time to prevent additional species from becoming threatened or endangered and to plan into the future. One important component of the WDCP is its efforts to use the best available scientific data to determine which wildlife species are in greatest need of conservation while identifying the actions necessary to prevent their populations from declining. It is through this tool that we have the opportunity to inform important conservation partners and the greater public about how we must work together to ensure that common species remain common.

Purpose of the Plan

The purpose of this document is to provide the framework and overall direction for wildlife diversity conservation efforts in Maryland for the next decade and beyond. This WDCP process identified those species and their key habitats in greatest need of conservation within the context of the full array of wildlife and habitats in Maryland. This document provides the blueprint from which to further develop, refine, and implement an effective, coordinated approach to statewide wildlife diversity conservation.

Background and Approach

For over a decade the International Association of Fish and Wildlife Agencies' Teaming With Wildlife (TWW) coalition, comprised of state wildlife agencies and their governmental and nongovernmental partners in conservation, has encouraged Congressional support for new sources of federal funding to complement state wildlife conservation programs. This support came in the form of substantial annual appropriations to States under the Wildlife Conservation and Restoration Program (WCRP) and SWG in federal Fiscal Years 2001, 2002 and 2003. Under the new federal WCRP and SWG programs, Congress provided an historic opportunity for the state fish and wildlife agencies and their partners to design and implement a comprehensive vision for the conservation of America's wildlife. As a condition of SWG (FY02), each State, Territory, and the District of Columbia must complete a comprehensive WDCP by October 1, 2005. This WDCP will also meet the obligation under WCRP (FY01) to produce a comprehensive wildlife conservation strategy.

Maryland's WDCP represents the results of a broad and inclusive approach to compile and present the best available current information on the status of wildlife conservation in the state while involving the diversity of Maryland's public and private stakeholders. This 18-month effort required planning and research followed by iterative internal and external stakeholder input. MD DNR's Wildlife and Heritage Service (WHS) led the effort to collect the best available information and research from the many existing plans, programs and priorities to identify species in greatest need of conservation and the key wildlife habitats they depend upon. It then coordinated with local, state, and federal agencies and NGO conservation partners for input and collaboration to refine and finalize the lists. Threats were identified and conservation actions developed to address these threats to the GCN species and their key habitats using a similar process. WHS reviewed and compiled the best available information, which was then presented to public and private stakeholders for refinement and finalization.

The conservation actions identified in this WDCP represent an essential foundation for the future of wildlife conservation, as well as a stimulus to engage federal, state, local, public and private conservation partners to strategically think about their individual and coordinated roles in prioritizing state wildlife conservation efforts. The development of the WDCP at the state level is the critical first step in defining the capabilities and needs of MD DNR and its partners to accomplish wildlife conservation goals. This WDCP also identifies the measures that will be used to evaluate the results achieved and the threats and needs that remain for effective wildlife conservation in Maryland. The WDCP process provides an opportunity for

MD DNR to provide effective and visionary leadership in wildlife conservation. Strategic implementation, periodic review, and resulting adaptive management make this document a long-term tool for wildlife conservation in Maryland.

Chapter 1: Overview of Wildlife Conservation in Maryland

This chapter addresses **Element #3** and summarizes threats and problems facing Maryland's species of greatest conservation need and their habitats. Sources of information are cited in the text and can also be found in Appendix 1a. Appendix 1b is a compilation of threats to species from existing national, international, regional, state, and local plans, including detailed information regarding sources and intensity of threats to watersheds and rivers and crosswalked matrices of threats and conservation actions for terrestrial habitats, and overarching statewide threats. "Priority research and survey needs, and resulting products" are described in Chapter 4 within the text for each key wildlife habitat.

Loss of Species and Wildlife Diversity

Landscapes are dynamic, constantly shifting due to storms, floods, fires, and other natural sources of habitat change. Habitat changes have also been imposed for thousands of years by humans. There is evidence that Native Americans altered the habitat in Maryland by burning areas for hunting, and their likely strategy was to maintain openings in areas naturally predisposed to fire (Pyne 1982). Although landscape changes have always been part of the natural process, the colonization of Maryland in 1634 and subsequent new settlements by European immigrants impacted the ecological balance drastically due to the rapid increase of human-related activities and made it more difficult for species and systems to acclimate to such rapid changes. Changes to our native forests, grasslands, and wetlands came as a result of settlement and these changes affected wildlife populations. Forests were cleared to make way for crops and livestock. Trees were felled to build cabins, furniture, ships, and to provide fuel for heat and cooking. Competition from non-native European species began when colonists brought plants and animals from their homeland. Livestock grazed on native grasslands and marshes, and the gradual conversion of native habitats to accommodate the settlers came at the expense of wildlife populations.

European settlers heavily utilized many wildlife species for food and clothing. Wild turkey, passenger pigeon, and white-tailed deer were hunted extensively for subsistence[1]. Other species were considered vermin and killed to reduce livestock losses or to reduce crop damage. Beaver and other furbearing mammals were trapped for their valuable fur. Small game and songbirds were regular sources of food for the expanding human population in Maryland. Market hunting of waterfowl and other wildlife in the 1800s was a common event that supplied the growing cities with fresh meat. Fish, shellfish, and other aquatic species were harvested as well.

With the industrial revolution came pollution that further degraded Maryland's streams and waterways. The remaining forests were logged to produce lumber and charcoal. Coal was extracted to power the factories and railroads. Wetlands were ditched to enhance agricultural

[1] All scientific names of animal and plant species used in this document can be found in Appendix 3.

production. Canals were dug for commerce and transportation. Rivers were dammed for water supplies, flood control, and power plants. Channels were dredged through the estuaries to enhance shipping ports. Highways were cut through mountains, and road networks fragmented habitats.

The combination of loss and degradation of habitat, subsistence hunting, and vermin control resulted in highly diminished wildlife populations throughout the state by the early 1900s. Some species disappeared from Maryland, and a few of these even became extinct rangewide. Elk, bison, wolves, and cougars have disappeared from the state, while the passenger pigeon and Carolina parakeet are now extinct. Some species benefited from the changes to the Maryland landscape, though these were outnumbered by the declining species.

Many of these same alterations to our environment have continued through modern times, exacerbated by Maryland's ever-growing human population. As our human population burgeons and land use pressures intensify, it is increasingly important that we protect our vanishing native species and their habitats. There is clear consensus that the loss and degradation of habitats across the state from Maryland's development and growing economy (including unplanned growth in population and consumption) remains the primary overarching threat to species of greatest conservation need as is true nationwide (Trauger et al. 2003).

Extinct and Extirpated Species

The U.S. Congress recognized man's impact on wildlife in its preamble to the Endangered Species Act: "The Congress finds and declares that various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation" (USFWS 1973).

Several species have become extinct in modern times in Maryland. The Carolina parakeet once ranged throughout the eastern United States as far north as the Great Lakes, but became extinct in the 1920s due to destruction of its forest habitat, killing by farmers who considered it a nuisance species, and hunting for its feathers (Cornell Lab of Ornithology 2003). The passenger pigeon is another modern extinction, suffering from severe overharvesting.

An estimated 135 species (111 plants and 24 animals) have been extirpated from Maryland (see Table 1.1). Six of the 24 animals are mammals. One of these species is the eastern cougar, which disappeared from Maryland in the 1800s (Paradiso 1969) and which is listed as an endangered species by the U.S. Fish and Wildlife Service (USFWS 1982a). The southern distribution of the lynx was historically south into western Maryland (Lee 1984). Gray wolves were once so common that they were hunted for a bounty in the late 1700's and early 1800's. The last wolves were purged from the state in the late 1800's. Although both species were apparently present throughout central and western Maryland, the last American bison was shot in 1775 in Garrett County (Paradiso 1969) and the last American elk vanished around 1850 (Lee 1984). The pine marten had a historic range primarily in western Maryland, as did the fisher, which had the opportunity to return to Maryland as a result of a release of 23 animals in West Virginia near the Maryland border in the winter of 1969 (Childs et al. 1989). The snowshoe hare historically was found in the mountains of Maryland, but the release of Canadian individuals has not restored the population and no hares have been seen in three decades (Webster et al. 1985).

The Swainson's thrush no longer breeds in Maryland's mountains and forested wetlands (Robbins and Blom 1996). The federally-endangered red-cockaded woodpecker is also extirpated as a breeding species (Robbins and Blom 1996, USFWS 2003b). The Bachman's sparrow is considered extirpated from Maryland's pine woodlands and grasslands as the northern extent of its range has apparently contracted (NatureServe 2005). Several butterfly species are currently listed as endangered-extirpated in the state, likely due primarily to habitat loss (MD DNR 2003a). The Maryland darter, this state's only endemic vertebrate, may now be extinct. It was last reported in a single riffle of Deer Creek in Harford County in 1988 (MD DNR, unpubl. data).

Endangered and Threatened Species

MD DNR's Natural Heritage Program (NHP), currently part of the Wildlife and Heritage Service, is the state's leading program for wildlife diversity conservation. NHP identifies, ranks, and conserves rare and endangered species and natural communities throughout the state. It currently monitors the status of over 1,100 native plants and animals. More than 600 species and subspecies are listed in state regulation as endangered, threatened, in need of conservation, or endangered-extirpated in Maryland (COMAR 08.03.08 and 08.02.12). Most of the state-endangered species are plants (265), and 79 are animals. An additional 79 plants and 20 animals are recognized as threatened in the state. Only a small fraction of all species (38) are also ferderally-listed as endangered or threatened (Table 1.1).

Table 1.1 Summary of Federal and State Listed Species

Federal Listed Species

Category	Plants	Animals
Endangered	5	24
Threatened	4	5
Total	**9**	**29**

State Listed Species*

Category	Plants	Animals
Endangered	265	79
Threatened	79	20
In Need of Conservation	n/a	29
Endangered Extirpated	111	24
Total	**455**	**152**

* Summary of State Listed Species only includes species listed in COMAR 08.03.08. **Source: MD DNR website**

Of the eleven state-endangered mammals, six are federally-listed whales that are occasional visitors or that seasonally migrate through Maryland's marine waters. The federally-endangered Delmarva fox squirrel is endemic to the Eastern Shore region and reintroductions by MD DNR and others have expanded its population and distribution on the peninsula (Therres and Willey 2002).

Eighteen bird species are state-listed as threatened or endangered, including the federally-listed piping plover that nests on Assateague Island. Many of the state-listed birds are coastal species (e.g., Wilson's plover, least tern, royal tern, gull-billed tern, black skimmer), but others like the threatened Henslow's sparrow and endangered short-eared owl are grassland species in significant decline. The secretive Swainson's warbler is a woodland bird that regularly breeds only in the Pocomoke watershed on the Eastern Shore, while the northern goshawk only breeds in western Maryland's forests.

Five of the sixteen threatened and endangered reptiles and amphibians are federally-listed seaturtles, which forage in Maryland's estuaries during warmer summer months. The endangered northern coal skink is a mountain species about which little is known; the last known occurrence in Maryland was in 1976. The hellbender, a state-endangered amphibian, is one of the country's largest amphibians and is threatened by degraded water quality in its fluvial habitat.

The MD DNR Fisheries Service and the Maryland Biological Stream Survey (MBSS) also monitors certain species that are state-listed as endangered or threatened. There are thirteen threatened and endangered fish in Maryland, of which the shortnose sturgeon and Maryland darter are also federally-listed. The bridle shiner, also endangered, is declining at an alarming rate in the state. The unlawful acquisition for the pet trade and the use of pesticides and herbicides adjacent to their habitats threaten the state-threatened blackbanded sunfish.

The most endangered animal taxa in Maryland, however, are among the invertebrates. More than 40 species are designated as threatened or endangered. Several of these species (e.g., Franz's cave isopod, Shenandoah cave amphipod, Hoffmaster's cave planarian) are highly specialized subterranean species found in springs, mines, and caves in the Maryland mountains. Freshwater mussels are of major concern, including the federally-endangered dwarf wedge mussel, which is found only in a limited number of streams and rivers from New Brunswick, Canada to North Carolina. Other endangered invertebrate species in Maryland include several tiger beetles (e.g., the federally-listed northeastern beach and puritan tiger beetles) and numerous butterflies and moths (e.g., bog copper, mottled duskywing, and great purple hairstreak).

Declining Species (and our opportunity to reverse that trend)

Twenty-nine animal species are listed as in need of conservation in Maryland (COMAR 08.03.08.09), as well as a number of commercial fish species (COMAR 08.02.12). These 29 species include 8 invertebrates, 3 fish, 3 reptiles and amphibians, 8 birds and 7 mammals. Although the state officially recognizes over 150 animal species in regulation, many other species are disappearing to the point that they may be added to the list within the next couple of decades. Nearly half of all freshwater mussels are imperiled globally and two-thirds are rare or imperiled nationally (Abell et al. 2000, Hoffman Black et al. 2001). Williams et al. (1993) found that only 23.6% of the freshwater mussel species in the U.S. and Canada are showing stable populations, with over 70% of the species in need of conservation. The majority (65%) of the nation's freshwater crayfish are rare or imperiled and 37% of freshwater fish are at risk of extinction (Abell et al. 2000). The mud sunfish population, for example, is experiencing declines due to habitat loss, which has led to its extirpation in New York and Pennsylvania and its designation as a regional species of concern (Northeast Endangered Species and Wildlife Diversity Technical Committee 1999).

Amphibians are exhibiting alarming rates of decline, with one in three species globally threatened (Stuart et al. 2004). Gibbons et al. (2000) states that reptiles are exhibiting dramatic declines similar to that of the amphibians, with habitat loss and degradation, environmental pollution, unsustainable use, disease, introduced invasive species and global climate change the leading causes for declining populations.

Numerous bird species are showing population declines nationally, regionally and locally. Nearly half of the shorebirds assessed in the U.S. Shorebird Conservation Plan showed significant or apparent population declines (Brown et al. 2001). A recent assessment by the National Audubon Society found that 85% of grassland birds are declining (Butcher 2004). The short-eared owl population, for example, has declined by 69% nationally. The American bittern has been designated a regional species of concern due to its population decline, largely due to loss and degradation of its wetland habitat (Northeast Endangered Species and Wildlife Diversity Technical Committee 1999). Partners in Flight (PIF) has ranked 30 forest birds, 12 shrub/early successional birds, 10 grassland/agricultural birds, 7 wetland birds, and 1 urban/suburban bird (the chimney swift) as priority species for Maryland (Rosenberg 2004). In order to reverse declining population trends of these birds, PIF calls for Maryland to double its statewide populations of red-headed woodpecker, cerulean warbler, rusty blackbird, northern bobwhite, golden-winged warbler, field sparrow, short-eared owl, loggerhead shrike, grasshopper sparrow, Henslow's sparrow, and eastern meadowlark, and to make significant increases in the populations of several other species. Brinker et al. (2001) have documented declining populations of nesting water birds in Maryland.

The eastern small-footed myotis may be the least common cave bat in the Northeast and is vulnerable to extirpation by chance events to isolated colonies that concentrate the species in hibernacula. Its population is susceptible to habitat loss, human disturbance, and conversion of its roosting and foraging habitat. The New England cottontail is another mammal exhibiting population declines, leading to its designation as a regional species of concern as well as a species in need of conservation in Maryland (Northeast Endangered Species and Wildlife Diversity Technical Committee 1999). The range of the New England cottontail has declined by 75% since 1960, with maturation of its forest habitat a leading threat.

This WDCP represents an opportunity to reverse these declining population trends for numerous species in greatest need of conservation. Butcher (2004) identified SWG conservation plans as one of the means to address declining bird population trends, and the PIF has already recommended population goals specific to Maryland (Rosenberg 2004). By incorporating existing population assessments and conservation plans into the development of the MD WDCP, DNR and its conservation partners have the opportunity to implement conservation actions that will have positive effects on population levels.

Our Changing Landscape

Maryland’s natural landscape has been significantly altered by the human population increase and associated human activities. At the time of European colonization, Maryland was 95% forest and 5% tidal wetland (Besley 1916, Powell and Kingsley 1980). By 1993 both the state’s forests and wetlands had been reduced by half (Weber 2003). Human development currently drives land cover changes in Maryland: in the 30-year period prior to 2002, urban land use statewide nearly doubled (Table 1.2), and a 19% increase in developed land occurred between 1985 and 1990 (Regional Economics Studies Institute 1997 as cited in Weber 2003). Urban land use is predicted to increase by over 25% from 1997 levels by 2020 (Weber 2003). Forest cover is expected to decline by 9% during the same time period. This trend of development sprawl has led the state to establish an Office of Smart Growth and develop detailed plans (e.g., Priority Places Strategy) to guide land use planning statewide, including resource conservation and restoration areas (http://www.smartgrowth.state.md.us/). Figure 2.4 identifies the land cover and land use of Maryland, including developed land, which is shown in red.

Table 1.2 Land Use Changes in Maryland, 1973-2002 (Source: MD Department of Planning 2005)

Land Use Category		1973	2002	Change
Low Density Residential	*Urban Development*	197,152	571,807	374,655
Medium Density Residential		188,411	300,559	112,148
High Density Residential		48,945	76,908	27,964
Commercial		74,231	97,992	23,761
Industrial		16,290	57,683	41,393
Institutional		62,076	99,972	37,896
Other Developed Land		67,425	93,467	26,042
Sum of above		*654,530*	*1,298,388*	*643,858*
Agriculture		2,521,993	2,118,368	-403,625
Forest		2,827,495	2,578,099	-249,396
Water		1,681,348	1,685,876	4,528
Wetlands		231,416	232,388	972
Barren Lands		9,763	13,427	3,664
Total		**7,926,545**	**7,926,545**	**0**

While the western part of the state continues to have the largest blocks of forest, habitats are now becoming fragmented as development moves into the area and converts the contiguous habitat into smaller patches like those in the eastern and southern portions of the state (Weber and Aviram 2002). An assessment of development patterns in the state from 1997 to 2000 determined that western Maryland suffered the highest losses (over 8,600 acres) of forests that were formerly large, contiguous forest blocks. Furthermore, an analysis of the risk of forest loss based on these development patterns found that the most likely counties to be further developed (to the detriment of these large forest blocks) are Cecil, Garrett, Howard, Montgomery, St. Mary’s and Washington (Weber 2004). The areas least likely to be developed are the lower Eastern Shore and Allegany County in western Maryland.

Current Threats

A number of problems threaten Maryland's fish and wildlife resources and their habitats. Many of these threats are statewide, or even regional or global in scope. Other threats affect singular species or key habitats. The foundation for the process of identifying problems impacting those species and habitats identified as in greatest conservation need during the development of this WDCP was a compilation of numerous existing conservation programs, plans, and references, and represents a long established knowledge base and expertise. Appendix 1a lists the major state, regional and national resources used in this threats assessment. Some resources were focused on species or taxa, while others were focused on the ecosystem (ecoregion or vegetative community) levels.

Some threats like global warming, climate change, sea-level rise, habitat loss and fragmentation are global and national problems. Olson and Dinerstein (2002) cite threats to global biodiversity as human disturbance, habitat loss and fragmentation, and decline of water quality. Among the greatest threats affecting imperiled or federally-listed species are habitat degradation and loss, non-native species, pollution, over-exploitation, and disease (Wilcove et al. 2000). Freshwater habitats are threatened by non-native species, dams, pollution and habitat degradation (Master et al. 1998, Abell et al. 2000, Olson and Dinerstein 2002). Coastal and marine habitats are threatened nationally by pollution, coastal development, overfishing, climate change, habitat alteration, bycatch, invasive species, and aquaculture (Pew Oceans Commission 2003). Terrestrial habitats are globally threatened by habitat degradation, wildlife exploitation, and habitat conversion resulting from agriculture, incompatible silviculture or development (Olson and Dinerstein 2002).

In the northeastern United States and Maryland, regional and localized threats add to the national and international threats mentioned above. The commercial trade in reptiles and amphibians has been identified as a regional threat to herpetofauna. Development, human disturbance, catastrophic oil spills, and inadequate funding for surveys and management threaten the region's shorebirds (Clark and Niles 2000, Brown et al. 2001).

Table 1.3 lists recurring threats gleaned from existing national, state, and regional conservation plans. These overarching threats affect Maryland's fish and wildlife populations statewide and were compiled from numerous sources. For example, The Nature Conservancy's (TNC) Threats Assessment and Viability Analysis (The Nature Conservancy 2000) for its ecoregional target species were reviewed and integrated for Maryland's Ecoregions (Thorne et al. 2001, Barbour et al. 2003, Samson et al. 2003). A summary of threat assessments from Partners in Flight (PIF) Bird Conservation Plans for Maryland's Bird Conservation Regions (BCR) (Rosenberg 2004) and other related regional/international plans applicable to Maryland was prepared for and integrated into the WDCP threats assessment. The Chesapeake 2000 Agreement addresses the threats that affect the Chesapeake Bay watershed and its habitats. The Coastal Bays' Comprehensive Conservation and Management Plan (CCMP) performed the same for the Coastal Bays watershed along the state's Atlantic coast (MD DNR 1999). Standardized protocols for aquatic biological monitoring and stressor assessment were used in the recent MBSS to assess water quality and stressors in the state's non-tidal streams (Boward et al. 1999).

After the results of the WDCP threats assessment were compiled, additional input was solicited during workshops that were held with stakeholders and MD DNR staff. The resulting threats were associated with key habitats to facilitate analysis and conservation action development. Some threats were specific to one habitat or applied only to closely related key habitats (see Chapter 4), while others emerged from this process as an overarching problem applicable to most if not all habitats across Maryland (Table 1.3).

Table 1.3 Overarching Statewide Threats to Wildlife.

Statewide Threats
o Climate change, including global warming and sea-level rise
o Human population increase and associated impacts
o Pollution, including biological and chemical contaminants, pathogens, and diseases
o Development, including residential and commercial, urban sprawl, road construction and salt application, impervious surfaces, impoundments, and conversion to other land uses, that results in erosion, sedimentation, nutrient enrichment, habitat loss and/or fragmentation, and isolation of local populations
o Pesticide and/or herbicide use and contamination that directly or indirectly affects GCN species, such as non-target impacts of gypsy moth and mosquito control on GCN, or results in pollution or degradation of water quality
o Lack of scientific understanding of appropriate habitat requirements and management needs for all GCN species
o Incompatible forestry practices that result in habitat loss, fragmentation, degradation, or imbalanced vegetation structure and species composition
o Invasive and/or non-native species that result in habitat loss or degradation
o Excessive human use and/or disturbance, including off-road ATV use, boats, jet skis and ORVs
o Incompatible agricultural practices that result in habitat loss, fragmentation, and degradation, including ditching and channelization, livestock overgrazing, inadequate riparian buffers, liming practices, and pond construction

MD DNR's Role in Wildlife and Habitat Conservation

Maryland has one of the nation's oldest natural resources conservation programs. Conservation of the state's fish and wildlife resources began with the establishment of the State Oyster Police in 1868, which expanded its role many times over the following century and is now known as the Natural Resources Police within MD DNR.

Conservation of Maryland's oysters began in 1830 in response to harvesting pressure. In 1874, a Commission of Fisheries was created to study and submit a report on the status of Maryland's fisheries resources. The State Oyster Police Force was brought under the jurisdiction of the new Commission and renamed the State Fishery Force.

In 1890, formal conservation of Maryland's natural resources began when the first laws for uniformity in the protection of game birds and game animals were placed on the statute books by the General Assembly. Prior to 1890, an inconsistent assortment of county game and fish legislation made protection of natural resources difficult. Pressure on the legislature brought about the Act of 1896, which created the Office of the State Game Warden. In 1916, the Conservation Commission was created combining the State Fisheries Force and the Office of the State Game Warden. In 1918, the first statewide hunting license law was enacted. State officials anticipated that the licensing requirements would generate approximately $35,000 the first year, but it actually produced revenue of $61,770. Nine years later in 1927, the legislature enacted the resident and nonresident angler's license, which was required by all persons over the age of 14 desiring to fish the non-tidal waters of the state.

In 1922, a one-man commission called the State Conservation Department was created. Two years later the Governor appointed a second commissioner, who completed the first survey of the oyster bars of Maryland in 1907 and drew up the Potomac River Compact of 1912. The reorganization and change of direction in Maryland's conservation program incorporated the State Fishery Force into its overall activity and calling them the Maryland Patrol and Inspection Fleet.

Another title change occurred in 1935, when the Conservation Department became the Conservation Commission. In 1937 the patrol vessels of the State Fishery Force were armed with 30 caliber machine guns for the purpose of maintaining order on Maryland oyster grounds. The Conservation Commission was later divided to form the Game and Inland Fish Commission, and the Tidewater Fisheries Commission. The Board of Natural Resources was created in 1941 as an umbrella organization for all state conservation agencies. This Board consolidated the state's conservation programs within one organization, later to become known as the Department of Natural Resources (Vaughn 2003).

The first state legislation designed to protect endangered species was the Maryland Endangered Species Act of 1971 and the first full-time staff position devoted to nongame and endangered species was authorized by the Maryland General Assembly in 1973 (Taylor 1984). The Act was significantly strengthened in 1975 by the passage of the Nongame and Endangered Species Conservation Act (Annotated Code of Maryland, Natural Resources

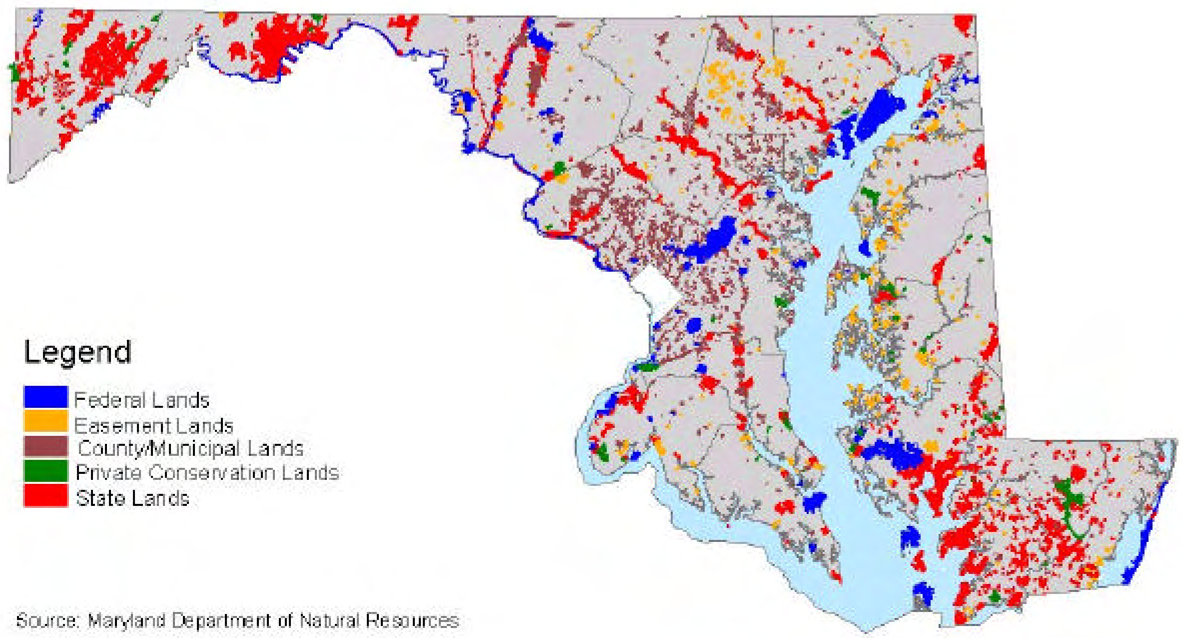
Article, Section 10-2A-01). One of the primary cornerstones of biodiversity conservation in Maryland, this law authorizes the state to establish a list of threatened and endangered species and to develop conservation programs for these species (Therres 1998). By 1979, MD DNR's Nongame and Endangered Species Program increased to 3 full-time staff (Taylor 1984).

1979 also brought the establishment of the Maryland Natural Heritage Program (NHP), one of the earliest programs developed in the international network of NHP and Conservation Data Centers. In 1984 NHP published a symposium proceedings on the threatened and endangered plants and animals of Maryland; it was the first of its kind that focused on species in need of conservation (Norden et al. 1984). NHP assumed the lead role for coordinating endangered species conservation in Maryland in 1987, however throughout the 1980's and into the mid-1990's, MD DNR had two programs sharing responsibilities for nongame and endangered species conservation (Therres 1998).

In 1996 the two programs were combined within NHP, which is currently the Department's lead program responsible for the identification, ranking, protection and management of nongame, rare and endangered species and natural communities in Maryland. NHP seeks to sustain populations of rare plants and animals through the maintenance of healthy natural ecosystems. This is accomplished through field surveys, research into natural history requirements, restoration of degraded habitats, technical assistance and data distribution to conservation partners and landowners, and public education. The Program also works with other agencies within the Department and with private organizations to purchase properties and easements with habitats that support rare species and natural communities.

Today the Department oversees nearly 450,000 acres of land throughout the state, with MD DNR's State Forest and Park Service managing 93 sites for natural, historical, cultural and recreational resources (Figure 1.1). The Department's regional foresters provide technical assistance and incentive programs to urban communities and private landowners to manage forest habitats better. Through the Chesapeake Bay Program (CBP), MD DNR monitors and works to restore the Bay's water quality, habitats and ecological health. The Fisheries Service manages the state's fisheries and shellfish, including the use of fish hatcheries to stock many of the state's streams and lakes. The WHS within MD DNR manages the health and recreational enjoyment of the state's wildlife, including the conservation of rare plants and animals under the coordination of the NHP, and the management of game species. WHS oversees the management of 41 Wildlife Management Areas (WMAs), ranging in size from under 20 acres to over 29,000 acres. The WMA system encompasses nearly 105,000 acres, with WMAs located in 17 of Maryland's 23 counties. In additional to conservation of wildlife habitat via land ownership, MD DNR conserves land and wildlife habitat through a number of easement programs, such as the Conservation Reserve Enhancement Program (CREP), Rural Legacy Program, and Forest Legacy Program, and through working directly with landowners to provide technical guidance on managing fish and wildlife habitats.

Figure 1.1 Protected Lands and Government-owned Lands in Maryland (Source: MD DNR)



In the late 1990's, MD DNR's Chesapeake and Coastal Watershed Services undertook an extensive data analysis project to evaluate the status of Maryland's remaining forests and wetlands utilizing a system of ecological factors to rank and prioritize their conservation value. The results of this analysis, called the Green Infrastructure Assessment, can be found online at: http://www.dnr.state.md.us/greenways/gi/gi.html. In 2001, Maryland established the GreenPrint Program to protect land within the identified Green Infrastructure network (Weber 2003). Weber (2003) found that only 27% of Maryland's Green Infrastructure, or network of large forested or wetland hubs and connecting corridors, are currently protected from development and conversion to other land uses.

The Department has successfully restored rockfish (striped bass) to the state's waters, allowing anglers to harvest more than 2 million pounds of the species in 2004. Bald eagles, once listed as an endangered species, have successfully returned to breeding in most of Maryland's counties with 383 nesting pairs documented in 2004; an increasing number of bald eagles are overwintering in Maryland as well. MD DNR and its partners have successfully restored wild turkey to most of the state's suitable habitat over the last two decades. Following two centuries of overharvest and habitat loss, wildlife managers and sportsmen restored native white-tailed deer to all available deer habitat by the 1960s. Current wildlife management efforts to maintain the deer population include an annual harvest of over 100,000 individuals in the last few years, and hunting is being encouraged to balance the rapid increase in deer population (MD DNR 1998).

The multiple programs and services within MD DNR cooperate on conservation projects, sharing their areas of expertise to apply the best available information and resources to the state's conservation needs. Through the MD DNR web site (www.dnr.state.md.us) all of the programs and services within MD DNR contribute to on-going public education and involvement to promote citizen's awareness and participation in natural resource conservation.

MD DNR's Partners in Wildlife and Habitat Conservation

The MD DNR collaborates with numerous partners in natural resource conservation efforts (Appendix 4b). Nearly all of the species and habitats in greatest need of conservation in Maryland extend beyond the state's borders – making partnerships a necessity for successful natural resource conservation. Migratory species often move beyond international boundaries during the different seasons, creating a need for multinational collaboration to achieve conservation goals. At the national level, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) are the lead agencies for the conservation of federal trust species found in Maryland and elsewhere. The USFWS, National Park Service (NPS), National Oceanic and Atmospheric Administration (NOAA), and the Bureau of Land Management (BLM) are also landowners in Maryland, managing key habitats on the ground to protect fish and wildlife resources. MD DNR regularly collaborates with these federal agencies and others (e.g., Department of Defense, U.S. Army Corps of Engineers) to implement restoration projects and manage habitats on their lands. The U.S. Army Corps of Engineers, for example, is instrumental in assisting the state to restore habitats like Poplar Island in Chesapeake Bay. The Environmental Protection Agency (EPA) and U.S. Geological Survey (USGS) are key partners with Maryland in improving the water quality and resources of Chesapeake Bay, as are the five other states and the local governments in the Bay's watershed. The USFWS, NOAA, U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) provide technical and financial assistance to the state, its partners and its citizens to manage, enhance and restore fish and wildlife resources and habitats.

At the regional level, MD DNR participates in the Atlantic Flyway Council, Atlantic States Marine Fisheries Commission (ASMFC), and the Mid-Atlantic Fisheries Management Council (MAFMC). The Atlantic Flyway Council consists of the Atlantic coast states and USFWS. They oversee waterfowl management within the flyway. The ASMFC is a 155 state compact that manages migratory species within state waters. The MAFMC includes states from North Carolina through New York and sets fisheries rules for twelve species of game fish. Each organization has developed several management plans. MD DNR is a member of the Northeastern Association of Fish and Wildlife Agencies and the Southeastern Association of Fish and Wildlife Agencies. MD DNR also participates in several informal regional coordination efforts.

At the state level, MD DNR collaborates with the MD Department of Environment (MDE) on water quality issues, wetland conservation, and Bay restoration projects. The MD Department of Transportation, State Highway Administration (SHA) and other state agencies work with MD DNR to protect fish and wildlife resources by avoiding, minimizing and mitigating for impacts during the construction of state projects. The Maryland Department of Agriculture (MDA) oversees the state's aquaculture programs, manages pest species and animal health, and collaborates with MD DNR and private landowners in nutrient management, land preservation, invasive species management, habitat restoration, and wildlife enhancement projects. MD DNR maintains an ongoing partnership with universities and academic experts. To mention just a few, MD DNR collaborates with University of Maryland Eastern Shore on the Gap Analysis Program (GAP) and with University of Maryland Center for Environmental Science, Appalachian Lab on various research projects.

At the local level, MD DNR collaborates with county and municipal agencies through various planning and zoning efforts, including the development of their Comprehensive Plans, as well as more detailed Land Preservation and Recreation Plans. Technical guidance is frequently provided to assist with the conservation of the state's fish and wildlife resources and the key habitats they depend upon, such as through the establishment of Habitat Protection Areas within the Chesapeake Bay Critical Area Program.

The successful conservation of fish and wildlife resources in Maryland would not be possible without partnerships with non-governmental organizations (NGO), private industry and the public (Appendix 5e). Just to name a few, TNC, National Audubon Society, Audubon Naturalist Society, Maryland Ornithological Society, Maryland Natural History Society, Chesapeake Bay Foundation, Alliance for the Chesapeake Bay, Sierra Club, Trout Unlimited, Potomac River Fisheries Commission, and other NGO's are not only stakeholders in the protection of the state's natural resources, but also valuable partners in planning, funding and implementing conservation projects. Industry representatives such as timber and development interests assist the state in conserving fish and wildlife resources on private lands. But perhaps most important of all partners, the citizens of Maryland provide the state with opportunities to protect natural resources on private property and benefit from grass-roots efforts to monitor threats, assess ecosystem health, enhance key habitats and improve species populations.

This chapter has briefly summarized the history of land use in Maryland, has identified the overarching threats currently faced by the wildlife within the state (addressing **Element #3**), and has provided a broad overview of the role of MD DNR and some of its partners regarding wildlife and habitat conservation in Maryland . The next chapter will provide information on the physical landscape of Maryland and its regional context, which will lay the groundwork for identifying the GCN species and key wildlife habitats found in the state.

Chapter 2: Maryland's Land and Waterscape

This chapter presents an overview of Maryland's landscape and regional context and lays the groundwork for identifying Maryland's wildlife and GCN species, which are discussed in Chapter 3 (**Element #1**), and the key wildlife habitats essential to their conservation, which are included in Chapter 4 (**Element #2**). This chapter provides the most current information available about the physical layout and attributes of Maryland and provides a comparison in relation to a regional context. Sources of information can be found in this chapter and in Appendix 1a. Appendix 2 provides a crosswalk of Maryland's key habitats. Descriptions of habitat locations and relative conditions are described in Chapter 4 and linked to prioritized conservation actions for each habitat. Chapter 4 also identifies where insufficient information gaps exists and identifies future conservation actions that will be taken to obtain the information.

Maryland's wildlife distribution and abundance are intricately connected to and ultimately dependent on the ecological health and diversity of its habitats. The state's varied physiographic features, geology and the resulting soil types, topography, and climate support a range of vegetative communities that provide diverse habitats for its wildlife. This habitat diversity directly influences the distribution of wildlife species in the state, especially for many at the northern or southern edges of their North American range and endemic species with specific habitat requirements.

Maryland is a state of geographic diversity. Often called "America in Miniature," Maryland is 12,386 square miles of mountains, valleys, rolling hills, coastal flatlands and beaches, and it contains more than 8,800 miles of freshwater streams (Boward et al. 1999). From the barrier islands, bald cypress swamps and Carolina bays of the Eastern Shore to the mountain bogs, caves and eastern hemlock forests of the Allegheny Plateau, the state encompasses a tremendous diversity of habitats that support an impressive variety of species.

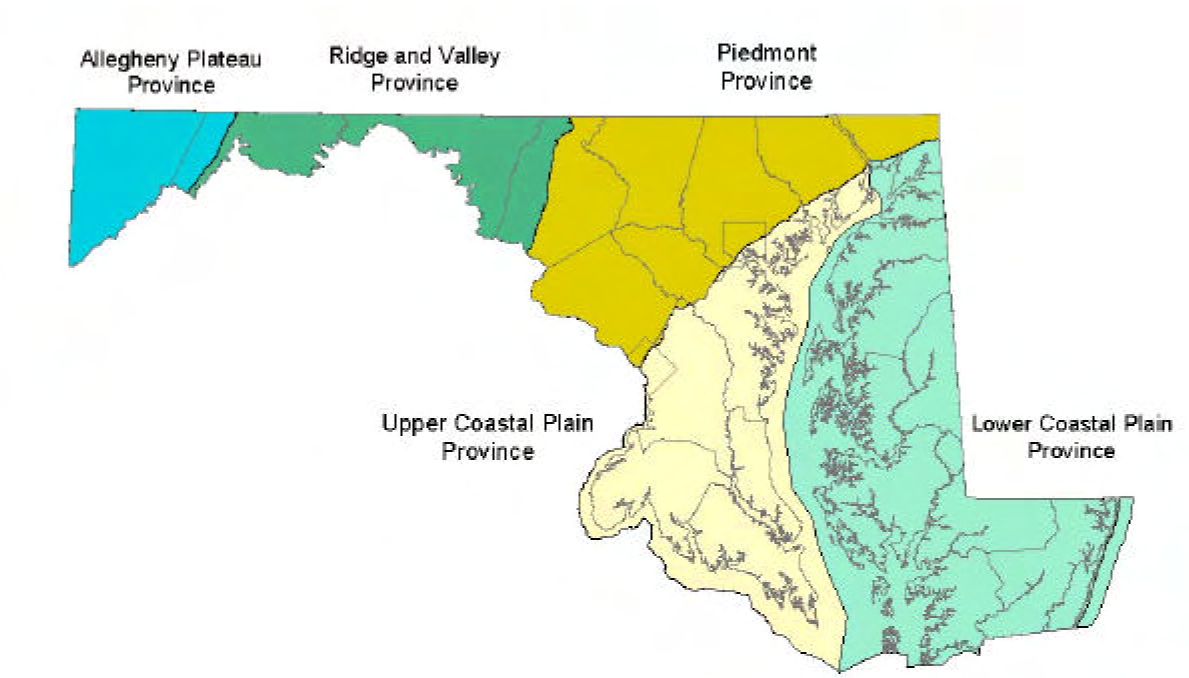
The Chesapeake Bay is the largest and most productive estuary in the United States. The Bay is nearly 200 miles long and is fed by 48 major rivers, 100 smaller rivers, and thousands of tiny streams and creeks (CBP 2004a). The Bay's diverse and complex watershed covers 64,000 square miles. The headwaters of Chesapeake Bay are within Maryland, which also hosts 1,726 square miles of the Bay's waters, or 38% of its surface area (MGS 2001a). All but two of Maryland's 18 major river basins drain into Chesapeake Bay. The watershed is also a major population center where 15 million people live, work, and recreate. Population in the watershed is expected to increase to 18 million by the year 2020 (MDP 2004). Maryland's coastal population is also forecast to increase 15% by 2015 (NPA Data Services 1999).

Maryland's Landscape

Physiography and Topography

Maryland's diverse landscape literally flows from the mountains to the sea, giving it a wide range of topographic features. The state's landscape can be divided into physiographic regions or provinces based primarily on soil types and the underlying geology. This has been done a number of different ways by different authors, some of which split out a narrow Blue Ridge province along the boundary between Washington and Frederick Counties (MD DNR Geologic Survey website) or split an Upper Chesapeake region from Maryland's Coastal Plain (Robbins and Blom 1996). For the purposes of this WDCP, Maryland has been divided into five distinct physiographic provinces: (1) Lower Coastal Plain, (2) Upper Coastal Plain, (3) Piedmont, (4) Ridge and Valley, and (5) Allegheny Plateau (Figure 2.1). These provinces extend in belts of varying width along the eastern edge of the North American continent from Newfoundland to the Gulf of Mexico. Many aquatic species found in the Atlantic Ocean can also be found in the Coastal Bays or the Chesapeake Bay. Therefore, for simplicity the Atlantic Continental Shelf Province distinguished by the Maryland Geologic Survey has been merged with the Lower Coastal Plain.

Figure 2.1 Physiographic Provinces in Maryland. (Source: MD DNR NHP)



The Coastal Plain is divided into two provinces – the Upper Coastal Plain and the Lower Coastal Plain – and they are the two largest of Maryland's physiographic provinces (Roth et al. 1999). The Lower Coastal Plain physiographic province includes all of the Coastal Plain east of the Chesapeake Bay and Elk River. This province is known best as Maryland's "Eastern Shore" and easily identified by its by flat, low-lying landscape dissected by the many tidal tributaries that drain into the Chesapeake Bay and Coastal Bays on the Atlantic coast. Elevations are usually less than 60 feet above sea level. The western portion of the Coastal Plain is known as the Upper Coastal Plain due to its generally higher elevations. The Upper Coastal Plain includes the remainder Coastal Plain that is west of the Chesapeake Bay and the Elk River, and continues westward to the higher elevations of the Piedmont at a geologic feature called the Fall Zone or Fall Line. This is an irregular line that roughly runs along Interstate 95 (Pyzik et al. 2004). From its western edge, the Upper Coastal Plain generally grades downward to sea level at the waters of Chesapeake Bay, although occasional cliff formations are found along the Chesapeake Bay shoreline. The highest point in the Upper Coastal Plain Province is approximately 440 feet in upper Prince George's County and the lowest point in the Lower Coastal Plain Province is 174 feet below sea level at Bloody Point Hole in the bottom of Chesapeake Bay (near Kent Island, Queen Anne's County) (MGS 2004b).

Covering 29% of the state, the Piedmont extends from the Fall Line at the edge of the Upper Coastal Plain west to Catoctin Mountain, which forms the boundary with the Ridge and Valley physiographic province (Roth et al. 1999). As the different rocks found underlying the Piedmont weather and erode at different rates, they form the distinct topography of the Piedmont – rolling hills with deeply incised stream valleys. The Piedmont Province ranges from approximately 100 to 1000 feet in elevation, with its highest point being Sugarloaf Mountain (1,282 feet) in Frederick County (MGS 2004b).

The Ridge and Valley Province is characterized by high topographic relief between the mountain ridges and the river valleys, generally ranging from 200 to 2000 feet in elevation (Roth et al. 1999). The Ridge and Valley Province covers roughly 17% of Maryland's landscape. Warrior Mountain in Allegany County forms the highest point in the province at 2,185 feet above sea level (MGS 2001b). Elevations in the Ridge and Valley Province are slightly less than the Allegheny Plateau to the west. The Great Valley is a broad lowland between the province's mountain ridges and ranges from about 500 to 600 feet in elevation (Roth et al. 1999). The state's highest cascading waterfall – the 78 foot-tall Cunningham Falls – is found in the Blue Ridge Mountains in Frederick County (MGS 2001b). The lowest elevation in this physiographic province is 250 feet along the Potomac River at Harper's Ferry in Washington County.

The Allegheny Plateau Province has the state's highest elevations (generally 2000 to over 3000 feet), with parallel mountain ranges sometimes separated by dramatic gorges and whitewater rivers (Roth et al. 1999, MGS 2001b). The state's highest point is found on Backbone Mountain in Garrett County, at an elevation of 3,360 feet above sea level (MGS 2004b). Garrett County shows 2,400 feet in relief, with lowest elevation at 960 feet along the Potomac River at Bloomington. The state's highest free-falling waterfall – Muddy Creek Falls – is located in Swallow Falls State Park in the Allegheny Plateau. Dans Rock in Allegany County separates the Allegheny Plateau province from the Ridge and Valley province and has the County's highest elevation at 2,895 feet of relief.

Each of these physiographic provinces has characteristic habitats and associated wildlife species. The bats, freshwater crustaceans and other highly specialized wildlife of caves are found in the Allegheny Plateau and Ridge and Valley Provinces, while the blue crab, oysters and submerged aquatic vegetation beds are located in the estuaries of the Coastal Plain. The woodland songbird assemblages that are characteristic of the forests of the Ridge and Valley are often slightly different than those of the Allegheny Plateau or the other provinces. Black bear are returning to the habitats of the Allegheny Plateau and Ridge and Valley. The rivers and streams of the mountain provinces are more likely to have coldwater fish communities than the warmer streams of the Piedmont and Coastal Plain, which support spawning anadromous fish. Grassland suites of birds are more likely to be found in the Piedmont and Allegheny Plateau, whereas waterfowl and shorebirds are most abundant in the Coastal Plain. Seabirds and highly migratory fishes like tuna, swordfish and marlin are limited to the Atlantic coast off the Lower Coastal Plain Province.

Regional Context

Several organizations have divided the nation and region into biologically-based units called ecoregions, providing a regional context for Maryland's ecological communities. Some organizations promote ecoregional planning in order to assemble a portfolio of public and private conservation areas that collectively conserve the full biological diversity of an ecoregion. Each portfolio is meant to encompass multiple examples of all native species and ecological communities in sufficient number, distribution, and quality to insure their long-term persistence within the ecoregion.

Within its boundaries, Maryland covers three distinct ecoregions as defined by Bailey (1995): (1) the Mid-Atlantic Coastal Plain, (2) the Mid-Atlantic Piedmont, and (3) the Mid-Atlantic Ridge and Valley. These three ecoregions essentially mimic the aforementioned Maryland physiographic provinces, with the exception that both the Allegheny Plateau and Ridge and Valley physiographic provinces fall within the Mid-Atlantic Ridge and Valley Ecoregion and the Upper and Lower Coastal Plain provinces fall within the Mid-Atlantic Coastal Plain Ecoregion. Partners in Flight (PIF) has developed bird conservation plans for each of these physiographic areas, each of which assesses the abundance and distribution of avian species and recommends population targets for the conservation of individual species (Watts 1999, Kearney 2003, Rosenberg 2003). Eastern Maryland also falls within the U.S. Forest Service's Southeastern Mixed Forest Ecological Province and western Maryland falls within the Appalachian Oak Forest Ecological Province (McNab and Avers 1994, Bailey 1995, LaBranche et al. 2003).

TNC modified the Bailey (1995) ecoregions and has placed Maryland's landscape into four ecoregions: (1) Chesapeake Bay Lowlands, (2) Lower New England/Northern Piedmont, (3) Piedmont [the southern continuation of the Lower New England/Northern Piedmont], and (4) Central Appalachian Forest. The Chesapeake Bay Lowlands encompasses the Maryland Coastal Plain, the two Piedmont Ecoregions contain the Maryland Piedmont physiographic province, and the Central Appalachian Forest closely follows the Maryland Ridge and Valley and Allegheny plateau provinces. TNC has prepared conservation plans for each of these ecoregions to facilitate effective ecoregion level conservation planning (Thorne et al. 2001, Barbour et al. 2003, Samson et al. 2003). Each of these plans summarizes the status and trends of the vegetative communities within the ecoregion, assesses threats to their conservation, identifies conservation needs, and sets priority targets for management of the ecoregion and its fish and wildlife resources.

Considering Maryland in a regional context is biologically justifiable and more practical and efficient in directing and prioritizing limited resources for effective conservation. For example, failure to base bird conservation objectives on regional or local science would open land managers and biologists to criticism and would ignore the value of population objectives from the PIF Initiative (Rosenberg 2004).

Table 2.1 Correlation of Maryland's Physiographic Provinces to other Ecoregional Schemes and Planning Efforts. The following at least roughly correspond to the same areas.

Physiographic Province	Name of Ecoregion	Planning Effort/Regional Scheme
Lower Coastal Plain	Mid-Atlantic Coastal Plain (44)	Partners in Flight Physiographic Area
	New England/Mid-Atlantic Coast (Bird Conservation Region 30)	PIF/North American Bird Conservation Initiative (NABCI)
	Southeastern Mixed Forest Ecological Province	U.S. Forest Service
	Chesapeake Bay Lowlands	TNC Ecoregional Planning Units
	Outer Coastal Plain Mixed Province (232)	Bailey's Ecoregions
Upper Coastal Plain	Mid-Atlantic Coastal Plain (44)	Partners in Flight Physiographic Area
	New-England/Mid-Atlantic Coast (BCR 30)	PIF/NABCI
	Southeastern Mixed Forest Ecological Province	U.S. Forest Service
	Chesapeake Bay Lowlands	TNC Ecoregional Planning Units
	Outer Coastal Plain Mixed Province (232)	Bailey's Ecoregions
Piedmont	Mid-Atlantic Piedmont (10)	Partners in Flight Physiographic Area
	Piedmont (BCR 29)	PIF/NABCI
	Southeastern Mixed Forest Ecological Province	U.S. Forest Service

Physiographic Province	Name of Ecoregion	Planning Effort/Regional Scheme
	Lower New England/Northern Piedmont (LNE/NP)	TNC Ecoregional Planning Units
	Piedmont (southern continuation of LNE/NP)	TNC Ecoregional Planning Units
	Eastern Broadleaf Forest (Oceanic) Province (221)	Bailey's Ecoregions
Ridge and Valley	Mid-Atlantic Ridge and Valley (12)	Partners in Flight Physiographic Area
	Appalachian Mountains (BCR 28)	PIF/NABCI
	Appalachian Oak Forest Ecological Province	U.S. Forest Service
	Central Appalachian Forest	TNC Ecoregional Planning Units
	Central Appalachian Broadleaf Forest – Coniferous Forest – Province (M221)	Bailey's Ecoregions
Alleghany Plateau	Mid-Atlantic Ridge and Valley (12)	Partners in Flight Physiographic Area
	Appalachian Mountains (BCR 28)	PIF/NABCI
	Appalachian Oak Forest Ecological Province	U.S. Forest Service
	Central Appalachian Forest	TNC Ecoregional Planning Units
	Central Appalachian Broadleaf Forest – Coniferous Forest – Province (M221)	Bailey's Ecoregions

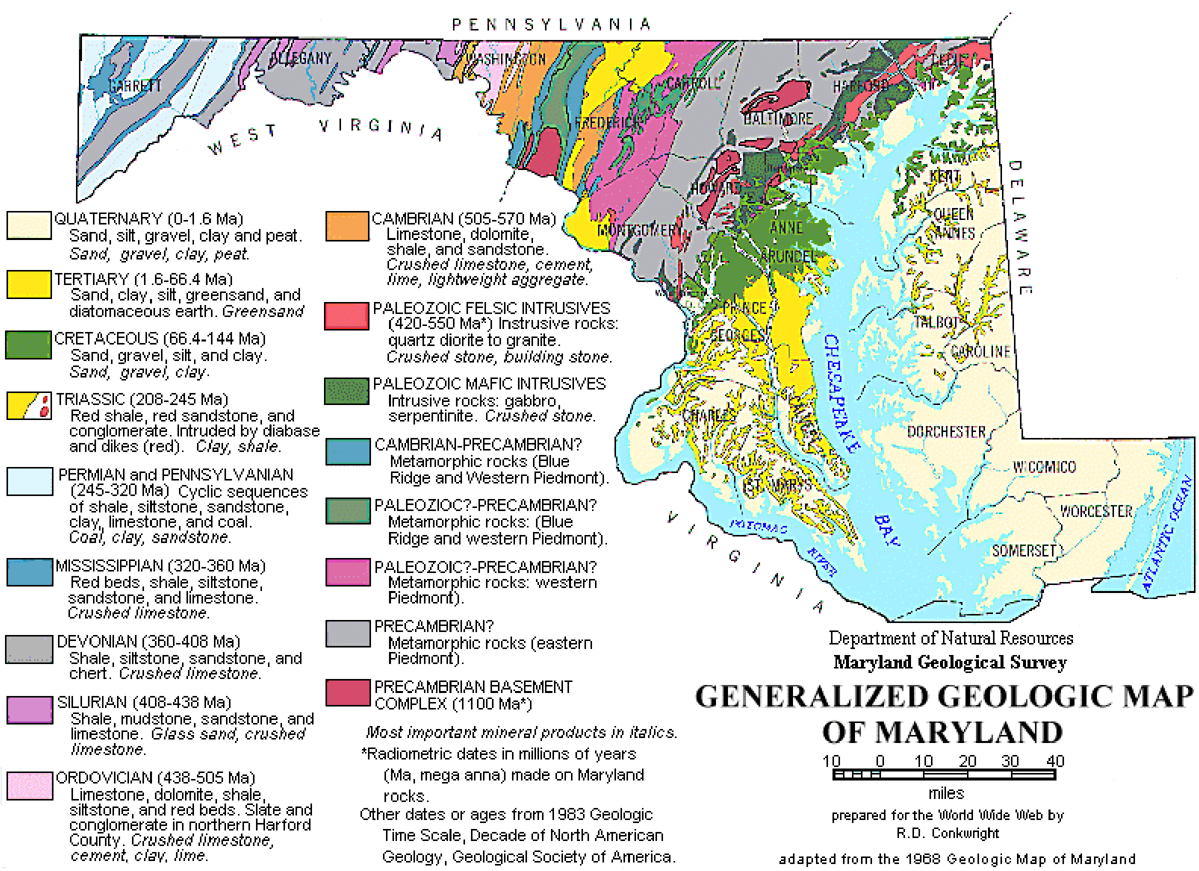
Geology

The Coastal Plain is underlain by unconsolidated sediments, the Piedmont Province by a variety of hard igneous and metamorphic rocks, and the Ridge and Valley Province and Allegheny Plateau by folded and faulted sedimentary rocks (Figure 2.2). The Frederick Valley, in central Frederick County, consists of limestone and dolomite (Edwards 1981). The folded rocks of the Ridge and Valley Province can easily be seen in the largest roadcut east of the Mississippi River, located along Highway 68 at Sideling Hill in Washington County; nearly 810 feet of rock layers are exposed where the highway cuts through the mountain (Brezinski 1994).

Maryland's geology is more diverse than its bedrock, however. The Appalachian Mountains that make up the Allegheny Plateau and Ridge and Valley Physiographic Provinces were formed 250 to 450 million years ago and have been eroding ever since – forming the soils, rivers and streams of most of the state in the intervening millennia (Grumet 2000). The formation of Chesapeake Bay was precipitated by a meteor strike that is believed to have occurred 35 million years ago, which created a depression that defined the region's drainage basins. The crater, centered near Cape Charles, Virginia, is believed to have been the size of Rhode Island and created a depression as deep as the Grand Canyon. The region's tectonic activity is not limited to the past, though, with at least 61 minor earthquakes striking the Maryland Piedmont and western Coastal Plain since 1758 (Reger 2003).

The state's geology is an important factor in defining the abundance, distribution and health of several wildlife habitats. Not only does it influence the topography of the mountains and the estuaries, but several valuable habitats occur only on certain geologic features. There are over 50 caves in the Allegheny Plateau and Ridge and Valley provinces, which provide habitat for numerous specialized, subterranean species (MGS 2004a). The distribution of limestone rocks creates karst (e.g., caves, springs, seeps) and limestone cliff habitats for other specialized species. Shale barrens and other bare rock habitats are determined by the occurrence of those particular rock types in western Maryland. The Pilot Serpentine Barren in Cecil County and Soldier's Delight Serpentine Barren in Baltimore County have unique groups of plants and animals that favor the serpentine rock outcrops in those locations (Grumet 2000).

Figure 2.2 Maryland's Geology (Source: MD Geological Survey 1968)



Soils

Maryland's soils are a reflection of their underlying geology. The most abundant soil type in Maryland is a loam that is deep, permeable and well drained (MDP 1973). These soils are found throughout the state and are excellent for farming. But Maryland also has bare rock areas without soil, very rocky soils that are less than two feet deep, fertile floodplain soils, loose sand soils, and mucky marsh and swamp soils that are wet most of or all of the time. Maryland does not have a state-wide soil map available in digital format, however some county soil maps are available on the internet through the NRCS at http://www.md.nrcs.usda.gov/technical/soils.html.

Soils in the Allegheny Plateau and Ridge and Valley provinces are often thin, with loose rocks or bare bedrock exposed on the surface. The dramatic relief of the mountains creates steep slopes where soils may be easily eroded, especially if the land has been cleared. The mountain soils frequently contain gravel or rock fragments as the underlying rock is weathered to produce the soil; some of the gravel concentrations are high enough to be economically valuable for roadfill and other uses. In some areas of central and western Maryland, bedrock is within 20 inches of the ground's surface. Soils may be strongly acidic depending on the area's rock type (e.g., acid shale, sandstone). Ridges and hillsides composed of limey shales, limestones and clays have created clayey soils interspersed with rock outcrops. River floodplains have deeper, well-drained soils of loamy alluvium deposited by their rivers or streams during floods, creating fertile soils excellent for farming. Floodplain soils located farther from the river or stream tend to have higher concentrations of finer sediments and are poorly to very poorly drained (MDP 1973).

The soils of the Piedmont tend to have a high amount of clay. A band of red clay extends through northern Prince George's County, northwestern Anne Arundel County and eastern Washington D.C., covered by a few inches to several feet of surface soil. In other areas, the bedrock of the Piedmont creates an acidic, thin soil that contains a high percentage of shale or other rock fragments. Broad ridges or upland depressions often have moderately well drained, thin (less than 2 feet) silty or loamy soils that are perched on top of an underlying clay or hardpan layer, which also seasonally traps a shallow water table and creates a strongly acidic wetland. Floodplain and rocky soils are similar to those found in the mountains (MDP 1973).

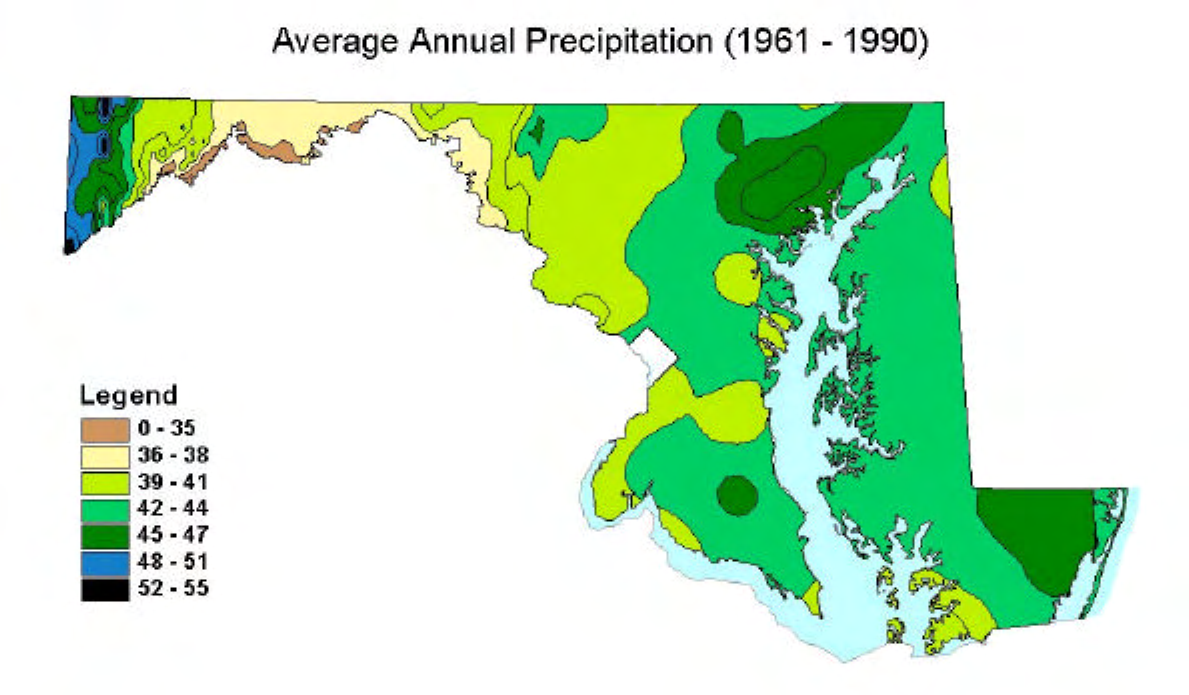
The Coastal Plain is characterized by soils of sand, silt or clay that reflect the province's coastal heritage. In some areas of the Lower Coastal Plain, soils may be so sand-rich that they are economically valuable as sources of sand. These deep sand soils are very permeable and do not retain moisture well; in fact, when they are exposed at the surface without vegetation, they are easily eroded by wind. Along shorelines, these loose sand soils can easily be seen in dunes and beaches. Where organic material is available, the Coastal Plain's sandy soils become loams, may be highly acidic, and retain more moisture. In some shallow or exposed areas, soils may have silts or clays that further enhance their ability to retain moisture, host more diverse plant life, and support agriculture. Wetlands are found where silt, clay and/or very fine sand create wet, acidic soils, especially on the Eastern Shore; these soils have been ditched and drained in many areas for farm fields. Tidal marsh and swamp soils are found along shorelines in the Coastal Plain and can be rich in organic material, including peat, or be sandy; these wetland soils may be highly toxic to crops due to sulfur that oxidizes when drained (MDP 1973).

Climate

Statewide, an average of 40 to 50 inches of precipitation fall on Maryland each year (Roth et al. 1999). Precipitation varies throughout the state, however, with southern Garrett County the wettest and the Ridge and Valley region the driest (Figure 2.3). The statewide average annual temperature is 53.7 degrees Fahrenheit, with July being the warmest month (highs in the mid to upper 80s) and January the coldest (highs in the low to mid 20s) (National Climate Data Center 2005).

Maryland's temperate climate is moderated by coastal influences in the eastern part of the state and by the Appalachian Mountains in the western part. The climate is mild, humid and relatively stable, which is a major factor in determining the plant and animal assemblages of the state. The winter months of December to March tend to be the state's wettest and the late summer to fall is the driest time of year. Maryland summers vary from mild to hot and the winters from very cold to moderate, depending on the location.

Figure 2.3 Annual Precipitation in Maryland (Source: NRCS Water and Climate Center 1998)



The Allegheny Plateau is significantly cooler than eastern Maryland, averaging 150 days with temperatures below freezing as opposed to less than half that in the southern Coastal Plain (MDP 1973). The growing season is accordingly much shorter (130 days) in the Allegheny Plateau region than on the Lower Coastal Plain, where it can exceed 200 days.

The mountains of the Allegheny Plateau create a "rain shadow" that encourages precipitation on their western slopes.

The climate in the Ridge and Valley Province is characterized by rain shadows as well (MDP 1973). The Allegheny Mountain range blocks most of the precipitation from the west, while the Blue Ridge Mountains block precipitation moving in from the east. The Ridge and Valley Province averages 36 to 40 inches of precipitation and 160 to 170 growing days a year.

The Piedmont averages 170 to 190 growing days a year, with the southern Piedmont warmer than the northern Piedmont (MDP 1973). Precipitation averages 40 to 44 inches a year. The Coastal Plain typically is wetter than the Piedmont, with an average of 44 to 48 inches of precipitation annually. The growing season is the longest in the Coastal Plain and can reach 230 days along the shores of the Chesapeake in the southern part of the state; the northern Coastal Plain's growing season averages 190 days.

Long-term trends indicate that Maryland is getting warmer and slightly wetter each year (MD State Climatologist's Office 2005). Baltimore, which has had high rates of urbanization during the last century, has warmed by about 4 degrees Fahrenheit from 1893 to 1999. Areas without such urbanization trends, meanwhile, have warmed less than a degree during the same time period. From 1948 to 1999, the average annual precipitation in several areas of the state has increased only slightly, less than a tenth of an inch per year.

Land Use and Vegetative Cover

Maryland's land use has been monitored by the state for a number of years. The most recent land use/land cover analysis was performed for the year 2002, and the resulting county and statewide maps are available through the MD Department of Planning (MDP) and to the public on several websites (e.g., http://www.mdp.state.md.us/compmaps.htm). Maryland is losing forest and agricultural lands, but there is an increase in submerged lands and an even more rapid increase in residential and urban development. Forestland is concentrated in the western and southeastern parts of the state and agricultural lands tend to be found in the fertile valleys of the Piedmont and Coastal Plain (Figure 2.4).

In Maryland, the Coastal Plain is a region of relatively flat, low-lying landscape that extends eastward from the Fall Line to the Atlantic Ocean. This region is divided into upper (western) and lower (eastern) provinces separated by the Chesapeake Bay. Prior to English settlement, the forests that covered the Coastal Plain consisted primarily of hardwoods, though they increasingly mixed with pine towards the south. These forests were likely combinations of oak-hickory, oak-gum, or oak-pine, and today exist in second growth form as a result of repeated cutting or agricultural abandonment. In addition, much of the contemporary forest consists of successional or silvicultural stands of loblolly pine. Wetland diversity in this region is exceptionally high and ranges from expansive freshwater to saline estuarine marshes, tidal and palustrine swamps (e.g., bald cypress swamps and Atlantic white cedar swamps), seasonally flooded depressions (e.g., Carolina bays and interdunal swales), and seepage swamps. The Coastal Plain is one of the most heavily utilized areas in Maryland because of agriculture and silviculture in the lower regions and development and urbanization in the upper regions throughout the Baltimore-Washington corridor and beyond.

The Piedmont is a region of gently rolling topography that extends across much of central Virginia, Maryland, southeastern Pennsylvania, and northern New Jersey. Habitat diversity in the Piedmont is high, but very localized due to the numerous bedrock formations (i.e., calcareous, mafic, felsic) and high gradient rivers along the Fall Line. Historically, the forests of the Piedmont could have been characterized as oak-chestnut, but since the near eradication of the American chestnut by chestnut blight (*Cryphonectria parasitica)*, it has now been replaced by oak-hickory and oak-pine forests with scattered pockets of mixed mesophytic forests. In addition, the thousands of acres of grasslands that once existed in northern Maryland (Mayre 1920) have been reduced to small pockets where soils are poorly developed and bedrock is exposed. Undeveloped areas are becoming fragmented due to the conversion of forest and agricultural lands to residential use (and the associated roads, power lines, and other infrastructure) as the urban centers of Baltimore and the District of Columbia continue to expand westward (Kearney 2003).

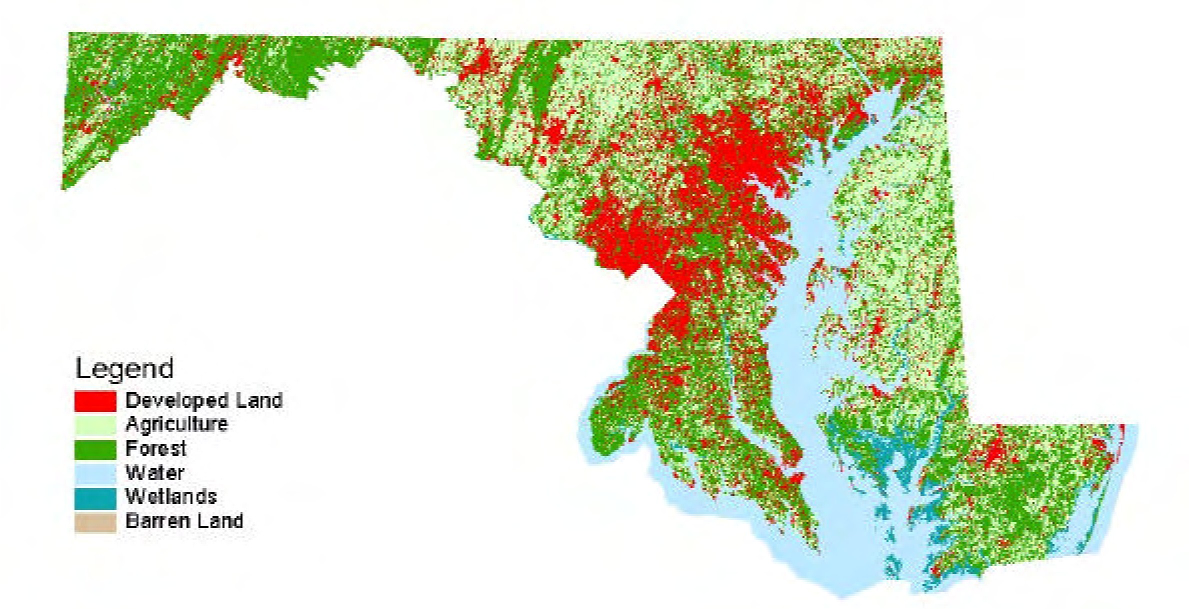
The Ridge and Valley and Allegheny Plateau regions include western Maryland and the mountains of Virginia and eastern West Virginia. Most of these physiographic regions consist of long mountain ridges and valleys. The headwaters of many rivers that feed the Chesapeake Bay and mid-Atlantic Coastal Plain are found in these provinces, including the Potomac River Basin in western Maryland. Predominant vegetation in the provinces consists of oak and oak-hickory forests on the mountain ridges and northern hardwood forest in the Allegheny Mountains. Large portions of the lower valleys are devoted to agricultural production or urban development (Rosenberg 2003).

Human populations are relatively sparse throughout the montane provinces and are mostly confined to the larger valleys. Suburban and second-home development from large urban centers to the east (e.g., Baltimore, Washington D.C.) is rapidly encroaching on the mountain areas. Timber extraction has been historically important and continues to be important on both public and private forestlands. Coal, oil and gas extraction are also important land uses throughout the Ridge and Valley and Allegheny Plateau provinces. One of the most significant disturbance factors currently affecting forest habitats in this region is the abundance and spread of native and exotic insect pests and disease (Rosenberg 2003).

As the undeveloped areas of Maryland are impacted by urban and suburban development, the state population continues to increase. The Maryland population is increasing at a slow but positive statewide growth rate of just less than 1%, which is forecast to continue through 2030 (MDP 2004). Localized areas have growth rates much higher than the state average, with the highest human population growth rates in the last decade (1990-2000) occurring in Montgomery County (16.5%), Prince George's County (15.1%), Baltimore County (14.2%), Baltimore City (12.3%) and Anne Arundel County (9.2%) (MDP 2004). Over 17,300 acres of land are converted to housing annually in Maryland. With an average of 0.74 acres of land used for each new housing unit, housing construction consumed 207,754 acres between 1990 and 2001.

The 1997 National Resources Inventory (USDA 2000), the most recent available, determined that 20.4% of Maryland's landscape is developed – the sixth highest percentage in the country. Non-federal land was developed at an annual rate of 35,500 acres a year between 1992 and 1997, more than doubling the development rate from 1982 to 1992. Just less than one-third of the land developed annually (10,400 acres/yr) between 1992 and 1997 was prime farmland.

Figure 2.4 Maryland's Land Use / Land Cover (Source: MD Department of Planning 2002)



Maryland's forests decreased by 3.0% between 1986 and 1999 to cover only 41% of the state's landscape (USFS 2004). The Environmental Law Institute (ELI) summarizes the status and trends of the forests of the Chesapeake Bay area (ELI 2000). Almost a quarter of a million acres of forest has been lost between 1973 and 2002, for a long-term loss of roughly 9% (MDP 2004). Eighty-two percent of the state's forestland is privately owned, and oak/hickory forest is by far the most abundant forest type (USFS 2004). From 1997 to 2002 agricultural land decreased by 5.3% (USDA 2004), but the longer term trend is a 16% loss in agricultural land from 1973 to 2002 (MDP 2004). The area covered by wetlands rose by nearly 1,000 acres in the last three decades while the amount of land covered by water grew by over 4,500 acres. Meanwhile, low-density residential land use has increased by 190% and industrial land use by 254% from 1973 to 2002. The amount of land that is barren, without vegetation, rose by 37% during the same time period.

The USGS produced a National Land Cover Data (NLCD) map for every state and an image of Maryland's map is available online at **http://landcover.usgs.gov/select_state.asp?rec=md**.

The USDA Forest Service classifies Maryland's forests into eight groups; oak/hickory, loblolly/shortleaf pine, northern hardwoods, oak/pine, oak/gum/cypress, elm/ash/red maple, white/red pine, and spruce/fir. Each of these groups represents a broad association of multiple forest types covering the northeastern United States. For example, embedded within the oak/hickory group are forest types characterized by chestnut oak, white oak, and northern red oak. Approximately 60% of Maryland's forests are classified as oak/hickory covering 1.5 million acres (USDA 2000). Although relatively abundant and widely distributed throughout the state, the Piedmont province of central Maryland contains the majority of oak/hickory forests with its diverse geology and undulating landscape.

The second largest forest group in Maryland is the loblolly/shortleaf pine group covering an estimated 12% or 295,000 acres (USDA 2000). Much like the oak/hickory forest group, the loblolly/shortleaf pine group is a broad one that includes forest types dominated by loblolly pine, shortleaf pine, Virginia pine, table mountain pine, pond pine, or pitch pine. Throughout the state it is found on moist and poorly drained soils. At higher elevations on the Coastal Plain, it is found on drier soils and often on abandoned farmland. Combined the Upper and Lower Coastal Plain physiographic provinces account for 275,000 acres of the loblolly/shortleaf pine group in Maryland. Outside of the Coastal Plain, forest types embedded within the loblolly/shortleaf pine group (i.e., Virginia pine, table mountain pine) occupy an estimated 5,800 acres in the Piedmont and 14,400 acres in the Ridge and Valley physiographic provinces (USDA 2000).

An estimated 9% or 230,000 acres in Maryland are classified as oak/pine forests (USDA 2000). These forests differ in composition from the loblolly/shortleaf pine forests by having a higher percentage of oaks and other hardwoods mixed with or codominated by pines. Examples within the oak/pine group would include Coastal Plain forests of loblolly pine mixed with hardwoods of black gum, sweet gum, and red maple. Forests classified as northern hardwoods (beech, birch, and maple) also account for approximately 9% or 224,000 acres in Maryland (USDA 2000, ELI 2000). The majority of northern hardwood forests are found on the Appalachian Plateau and Ridge and Valley physiographic provinces where elevation and a cooler climate provide favorable growing conditions for northern tree species.

Forests classified as oak/gum/cypress and elm/ash/red maple are exclusive to swamps, bottomlands, and alluvial floodplains of major rivers and tributaries. The oak/gum/cypress forest accounts for approximately 5% or 132,000 acres (USDA 2000) and is most abundant along the Chesapeake Bay and the lower western and eastern shore areas of the Coastal Plain. These forests are characterized by hydric soils that are often flooded during most of the growing season. The elm/ash/red maple group also accounts for 5% of Maryland's forests but is much more widespread than the oak/gum/cypress group. The majority of forest types within the elm/ash/red maple group are found in the Piedmont and mountain regions in bottomland swamps, alluvial floodplains of major rivers, and along stream banks of small order streams.

The two remaining forest groups classified by the USDA each account for less than 1% of Maryland's forests. In Maryland, the white/red pine forest group includes those forests dominated by white pine and a mixture of northern hardwoods as well as forests dominated by eastern hemlock. Although these forests are predominately found throughout the mountain regions of Maryland, small stands of eastern hemlock can be found on cooler, north-facing slopes in the Piedmont and Coastal Plain. Approximately 25,000 acres of Maryland's forests are classified as the white/red pine group (USDA 2000, ELI 2000). About 4,400 acres are classified as the spruce/fir forest group. In Maryland, this group includes forests of red spruce and spruce-hardwood mixtures that are restricted to higher elevations and cooler microclimates found on the Appalachian Plateau physiographic province. Due to their restricted geographic and elevation ranges, forest types within the spruce/fir group are considered rare in Maryland.

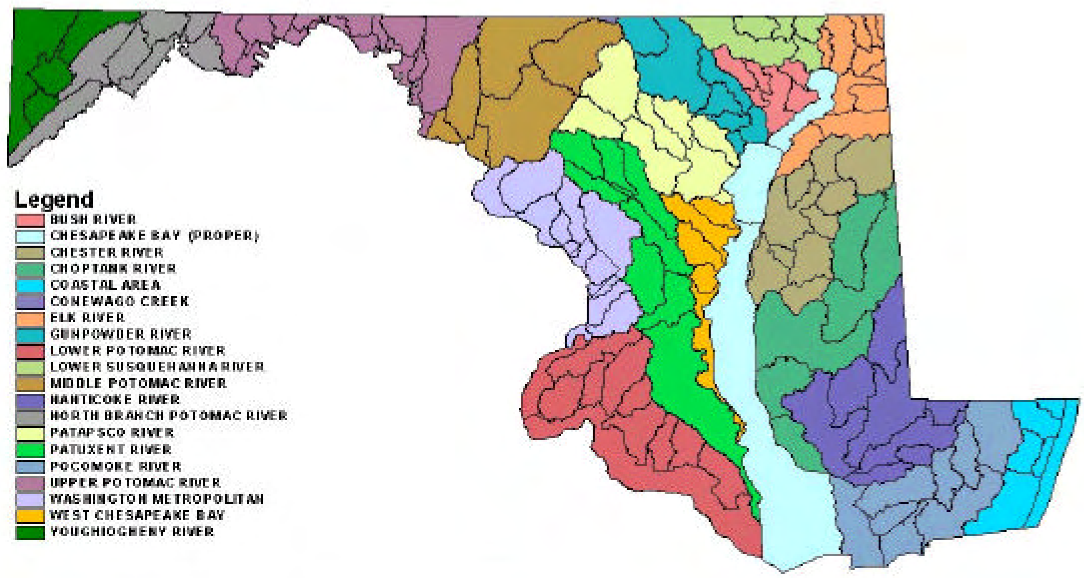
Tens of thousands of acres of grassland dotted with Blackjack and Post Oaks once stretched across northern Maryland and nearby Pennsylvania. Prior to European settlement, much of Baltimore, Harford and Carroll Counties and adjacent counties in Pennsylvania were covered by this prairie-like grassland intermingled among wooded valleys (Mayre 1920, 1955). English settlers seeing this virtually treeless expanse referred to it as "The Barrens." For thousands of years, Native American fire-hunting kept the grasslands relatively free of woody vegetation. When European settlement eliminated large-scale frequent fires, woodlands replaced ungrazed grassland areas. Prairie-like vegetation persisted on outcrops of serpentine, a dry and nutrient-poor soil. Only about 2,000 acres of this globally-rare serpentine grassland still exist in Maryland. However, other types of grasslands have been created and are usually maintained for cultural uses, including pastures and hayfields, infrequently mowed edges of large airports, and reclaimed strip-mines. Maryland currently contains about 240,000 acres of grasslands, primarily as pastures and hayfields.

Maryland's Waterscape and Wetlands

Maryland has a diverse waterscape that includes the Chesapeake Bay, the Atlantic Ocean and 3,800 miles of rivers and 8,800 miles of streams. However, Maryland has no natural lakes. Approximately 10% of Maryland's landscape is wetlands, totaling 598,172 acres (LaBranche et al. 2003). Wetland loss has been 45 to 73 percent in Maryland between pre-Columbian settlement and the 1980's (Dahl 1990, Whitney 1994, LaBranche et al. 2003).

Maryland facilitates the management of the state's watersheds through a series of Watershed Planning Units (Figure 2.5). Using a Tributary Strategy Watershed framework, Maryland is developing Watershed Restoration Action Strategies for individual watersheds. An assessment process led to the designation of 58 subwatersheds throughout the state as those that showed the highest need for restoration and resource protection (MD DNR 2000b). In an approach similar to this WDCP, the individual Watershed Restoration Action Strategies identify the most significant sources of point and non-point source pollution in the watershed, determine what actions are needed to address these threats, and outline an implementation strategy with milestones to measure success.

Figure 2.5 Maryland's Watersheds (Source: MD DNR)



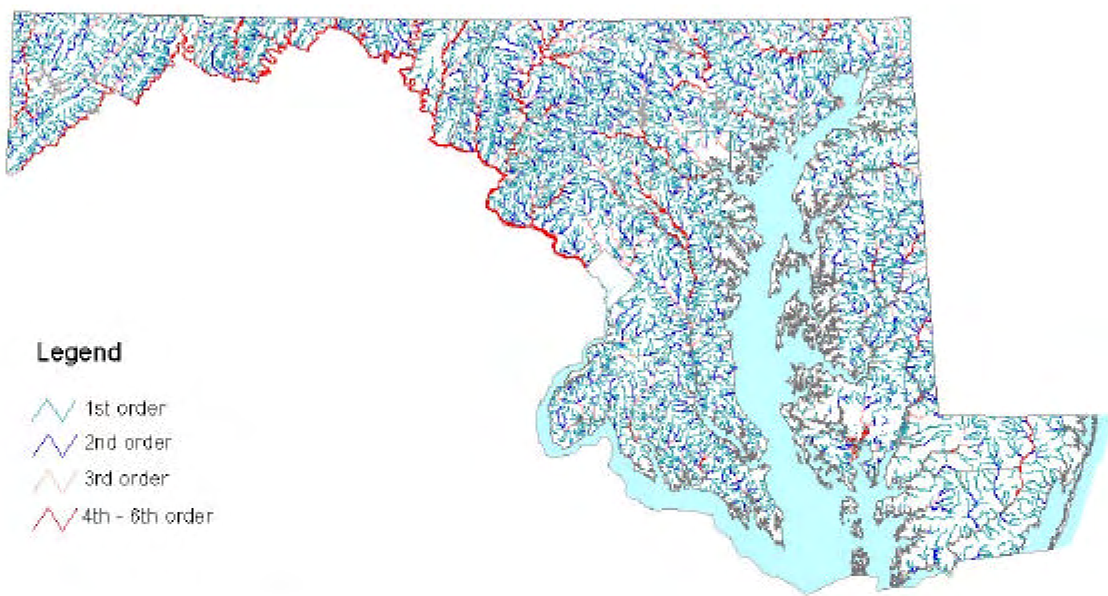
Rivers and Streams

Maryland harbors a tremendous variety of rivers and streams, including tidal, nontidal, fresh, brackish, cold water, and warm water. The abundant freshwater streams in Maryland are a valuable resource and significant component of the state's diverse landscapes. Ninety-five percent of these streams flow into the Chesapeake Bay (Boward et al. 1999). The USGS classifies rivers and streams according to the hydrologic unit code (HUC). First order streams have no tributaries and are thus the smallest in size. A second order stream occurs where two or more first order streams merge into a larger stream. When second order streams merge, a third order river results, and so on. About two-thirds of Maryland's stream miles are of the first order with an average width of less than 8 feet (Boward et al. 1999). Less than one-tenth are of the fourth order or larger. The Patapsco River is a fifth order river. The Susquehanna and Potomac Rivers are larger order rivers with large drainage basins and many, many tributaries. For the purpose of this document, streams have been classified by ecological community distinctions as Coldwater, Limestone, Highland, Piedmont, Coastal Plain, and Blackwater Streams, and rivers have been categorized as Highland, Piedmont, and Coastal Plain Rivers.

There are 18 major river basins in Maryland, most of which share their drainage basins with adjacent states (Figure 2.5). The Youghiogheny River in far western Maryland is on the western side of the continental divide and drains into the Ohio River. This drainage contributes unique aquatic diversity to the state because of the barrier to dispersal imposed by the continental divide. The Ocean Coastal basin drains into the Atlantic Ocean via the Coastal Bays. All of the other river basins empty into the Chesapeake Bay. The majority of the Susquehanna River basin is outside of Maryland (its headwaters are in New York), but its mouth forms the headwaters of Chesapeake Bay. The Potomac River forms the southwestern boundary of the state, from its headwaters in the Allegheny Plateau Province to its mouth in the Upper Coastal Plain. The Middle Potomac river basin is the state's largest at 925 square miles and 1,102 miles of stream. The smallest river basin is the Bush, which covers 195 square miles and 186 stream miles that drain into the northern Chesapeake (Boward et al. 1999).

Maryland's rivers and streams have a variety of physical characteristics. Streams and rivers in the Coastal Plain tend to have sand and gravel substrates, while bedrock commonly forms the substrate of mountain and Piedmont streams. The steeper gradient, or topography, of the mountains and Piedmont creates swifter moving water; the Youghiogheny is known for its whitewater, a result of steep mountain gradients and large rock boulders and bedrock exposed in the river. Some streams are characterized by riffles and pools, where water flows alternatively through shallow gravelly areas and slow, deep pools. Where the rivers of the Ridge and Valley or Allegheny Plateau pass through valleys, they meander on wide floodplains. The streams of the Coastal Plain, on the other hand, are nearly flat and flow slowly; the streams of the Upper Coastal Plain have higher gradients than those on the Lower Coastal Plain (Roth et al. 1999). The temperatures of mountain and Piedmont streams are cooler than those of the Coastal Plain and tend to have higher levels of dissolved oxygen, incorporated from water tumbling over rocks. The fall line that divides the Piedmont from the Coastal Plain is defined as the area where rivers tend to have falls as they pass from the steeper Piedmont to the flatter Coastal Plain. Coastal Plain rivers typically have more woody debris (e.g., logs, fallen trees) than the rivers in the Piedmont or mountains, and some are blackwater rivers with high tannin concentrations created by decomposing leaves (Boward et al. 1999).

Figure 2.6 Maryland's Stream and Rivers (Source: Versar, Inc. 2003; MD DNR)



The habitat adjacent to streams is critical for maintaining healthy streams. Statewide about 59% of all stream miles have forested riparian buffers, whereas 27% are unbuffered, and

14% are buffered by vegetation other than forest, such as abandoned farmland or lawns (Boward et al. 1999). The most extreme habitat changes come from stream channelization, and about 17% of all stream miles statewide are channelized. However, more than one-half of those stream miles are channelized in two heavily farmed river basins, Pocomoke and Nanticoke/Wicomico, on the Eastern Shore.

Statewide, nitrate concentrations are less than 1 mg/L in about 45% of Maryland's stream miles (Boward et al. 1999). Concentrations greater than 1 mg/L are considered unnaturally high. Acid rain is the most widespread source of acidity in Maryland streams, impacting about one in five stream miles. Only about 3% of Maryland's stream miles are naturally acidic, and most of those occur in five river basins of the Coastal Plain. About 4% of Maryland's stream miles are acidic due to fertilizers, and most of those streams are in river basins of the Coastal Plain. Statewide, 6% of all stream miles have dissolved oxygen levels less than 5 mg/L and on the Coastal Plain 3 river basins have low dissolved oxygen levels in more than 25% of the stream miles. Low dissolved oxygen levels less than 5 mg/L are considered to be biologically stressful.

Reservoirs

Maryland has almost 78,000 acres of lakes and ponds, but none of the lakes are natural features (MD DNR 2000b). More than 1,000 barriers block the state's rivers and streams, most of which form lakes or reservoirs of all sizes and shapes (Boward et al. 1999). Of the 947 lakes and reservoirs, only 15 exceed 500 acres in size. Over half of the state's lakes and reservoirs are less than 10 acres in size (MD DNR 2000b). The largest lakes are reservoirs that were created primarily for water supply, flood control and/or hydroelectric power (Reger 2004). Some of these include the Conowingo Reservoir, Deep Creek Lake, Liberty Reservoir, Loch Raven Reservoir, and Prettyboy Reservoir.

Fifty-nine of the state's lakes are classified as "significant, public lakes" and have been assessed for water quality by MD DNR (2000b). Although this is a low percentage of the total number of lakes, they account for over 21,000 acres. Twenty-nine of these lakes have been "monitored" for the state's Section 305(b) report (prepared for the EPA) and the other thirty have been "evaluated" using older water quality data. Of the ~21,000 acres assessed, 57.5% were impaired for one or more uses (i.e., aquatic life support, fish consumption, swimming, drinking water, Natural Trout Waters, and Recreational Trout Waters) in 1997-1999. The principal cause of water quality impairment was found to be low oxygen conditions resulting from excess nutrients. Pesticide contamination of fish, low pH, invasive aquatic vegetation and excessive siltation were also found to be causing impairment. Since the cancellation of the federal Clean Lakes Program in 1995, no formalized lake restoration program has been available to address these water quality problems (MD DNR 2000b).

Wetlands

Maryland is a state with an abundance of wetlands, most of which are in the Coastal Plain surrounding Chesapeake Bay. The historic extent of wetlands is difficult to estimate, but the best available estimates are that Maryland once had over 1.4 million acres of wetlands (Tiner and Burke 1995, LaBranche et al. 2003). Roughly 10% of the state is currently classified as wetland, ranging from 16% of the Eastern Shore to 0.04% of Baltimore City (LaBranche et al. 2003). Dorchester (44.6%) and Somerset Counties (37.7%) have the highest proportions of wetlands, while Allegany (0.2%) and Washington Counties (0.7%) in western Maryland have the least. The Blackwater-Transquaking-Chicamacomico (118,537 acres), Pocomoke (99,458 acres) and Choptank (65,655 acres) watersheds have the most wetlands (Tiner and Burke 1995, LaBranche et al. 2003). In fact, 66.4% of the state's tidal (coastal) wetlands are located in the Pocomoke, Nanticoke and Choptank river basins (LaBranche et al. 2003).

The Lower Eastern Shore has the state's highest extent of wetlands due to its low topography, predominantly clay rich soils and high groundwater tables (LaBranche et al. 2003). The Upper Eastern Shore has steeper gradients to its topography and more well-drained soils, so its wetlands are less extensive than the Lower Eastern Shore. Carolina bays, bald cypress and Atlantic white cedar wetlands are a few of the unique, non-tidal wetland types found on the Eastern Shore. Freshwater marshes dominate the wetlands of the Upper Western Shore, while the Lower Western Shore has predominantly brackish high marsh and submerged aquatic wetlands.

Wetland communities occur throughout the Piedmont, though not to the extent seen in the neighboring Coastal Plain (LaBranche et al. 2003). The Piedmont's wetlands tend to be less diverse than those of the Coastal Plain, consisting mostly of isolated palustrine and riverine wetlands (e.g. floodplains and upland depressional swamps). Wetlands are uncommon in the Ridge and Valley Province, with the wetlands that are present located in topographic slopes and depressions. The wetlands of the Allegheny Plateau are diverse, however, and include wet thickets, shrub bogs, seasonally-flooded wet meadows and marshes (LaBranche et al. 2003).

In 1981-82, most of the state's wetlands were palustrine wetlands (342,649 acres) and estuarine wetlands (251,549 acres) with a much smaller number of riverine, lacustrine or marine wetlands (4,227 acres) (LaBranche et al. 2003). Forested wetlands are the most widely distributed and abundant palustrine wetland type and are found on riparian floodplains, in upland depressions and in flat, broad areas between drainages. The estuarine wetlands are extensive on Maryland's tidal rivers, extending far upstream to freshwater areas. Brackish marsh is the most common estuarine wetland type, and estuarine shrub swamps are common in the coastal zone.

How many of the state's wetlands have been lost is difficult to determine, with some sources estimating 58% (LaBranche et al. 2003) and others 73% (Dahl 1990, Whitney 1994). The Maryland Wetland Conservation Plan (LaBranche et al. 2003) estimates that 821,339 acres of wetland may have been lost historically. The loss of wetlands has been partially offset by wetland gains in recent years, with 6,966 acres of wetlands gained between 1998 and 2001. Somerset, Worcester and Dorchester Counties have added the highest numbers of wetlands, with over 1,000 acres apiece in that four year period. Part of Maryland's approach to wetland conservation includes the designation by the Maryland Department of the Environment of hundreds of wetland sites as Nontidal Wetlands of Special State Concern (COMAR 26.23.06), many of which support rare plant and animal communities or are unique wetland types (e.g., Carolina bays, Atlantic white cedar swamps, and bogs).

Estuaries and Bays

Chesapeake Bay

The Chesapeake Bay is the nation's largest estuary; its watershed covers 64,000 square miles (Figure 2.7, Pyzik et al. 2004). The Bay is nearly 200 miles long and is fed by 48 major rivers, 100 smaller rivers, and thousands of tiny streams and creeks. The Bay's diverse and complex watershed provides habitat for 2,700 species of plants and animals. The upper, or northern, portion of the Bay is within Maryland and the lower, or southern, portion is in Virginia. Maryland's portion of the Bay has 1,726 square miles of waters (MGS 2001a). The Chesapeake's shoreline is not uniform, with the eastern shore being relatively low and flat-lying while the western shoreline has more relief and occasional cliffs (e.g., Calvert Cliffs) (Ward et al. 1989). The shoreline may be fringed with salt or brackish marsh, sandy pocket beaches, low sandy banks, bluffs and cliffs of various materials, or manmade riprap, bulkheads, seawalls and groins. The lower Eastern Shore is characterized by extensive marshes with some low sandy banks and estuarine beaches.

Chesapeake Bay is a relatively shallow estuary, averaging 20 to 25 feet deep (Ward et al. 1989). The center of the Bay is deeper than its edges, where the original river channels (now drowned) lie and where navigation channels (35 to 50 feet deep) have been dredged along most of the upper Bay's length to service the port at Baltimore. The deepest point in the upper Bay is Bloody Point Hole at 174 feet deep (MGS 2004b).

The Bay's substrate consists of varying amounts of clay, silt and sand with sandier sediments along the edges and finer sediments in the middle of the Bay (Kerhin et al. 1988). Occasional oyster reefs (now uncommon) and beds of submerged aquatic vegetation (SAV) are also found on the Bay's bottom.

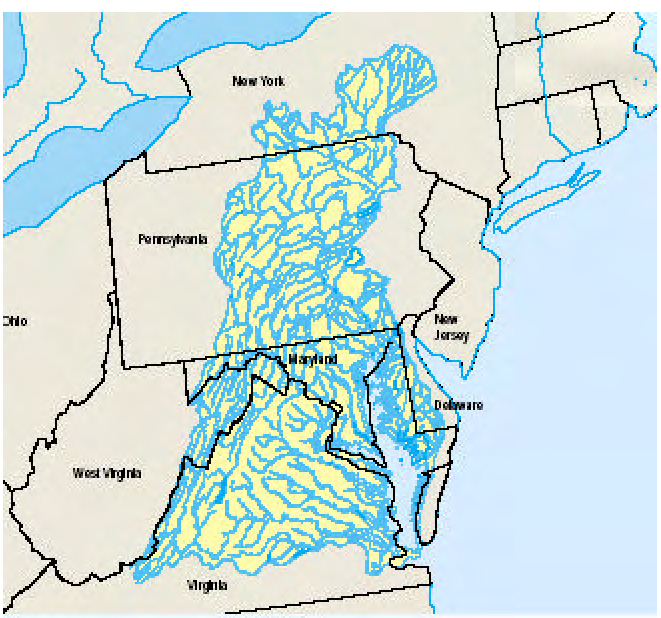


Figure 2.7 The Chesapeake Bay Watershed (from Mac et al. 1998)

The Bay is affected by daily tides, with tidal range increasing from the headwaters of the Bay towards its mouth. The tidal range is 1.4 to 2.8 feet on the Potomac River, 1.4 to 2.4 on the Choptank River and 0.8 to 1.0 feet at Baltimore (Ward et al. 1989). The Bay's water level changes not only with the tides, but with wind and precipitation patterns as well. Hurricanes may also affect the Bay, creating storm surges of 8 to 10 feet along Maryland's shores. In fair weather waves are typically less than one foot high in the Bay, but during storms they may reach three or four feet high. Water temperature in the Bay fluctuates throughout the year from 34 to 84 degrees Fahrenheit (Pyzik et al. 2004).

Numerous islands dot the interior of the Bay, some of which are composed almost entirely of marsh (e.g., Bloodsworth, South Marsh), are frequently flooded and have high erosion rates (Ward et al. 1989). Shoreline erosion rates tend to be higher along shorelines facing the open Bay, and lower along the shorelines of tributary estuaries where they are more sheltered from waves. High erosion rates and rising sea levels have led to the rapid shrinking or even disappearance of some Bay islands. Sharps Island, originally a 438 acre island at the mouth of the Choptank River, disappeared entirely by 1965 in just over a century's time. Tilghman Island was 2,015 acres in 1848 but was only 1,686 acres big in 1901; its southern end is eroding at 20 feet per year. Smith and Poplar Islands are the subject of federal restoration projects due to their severe land loss rates.

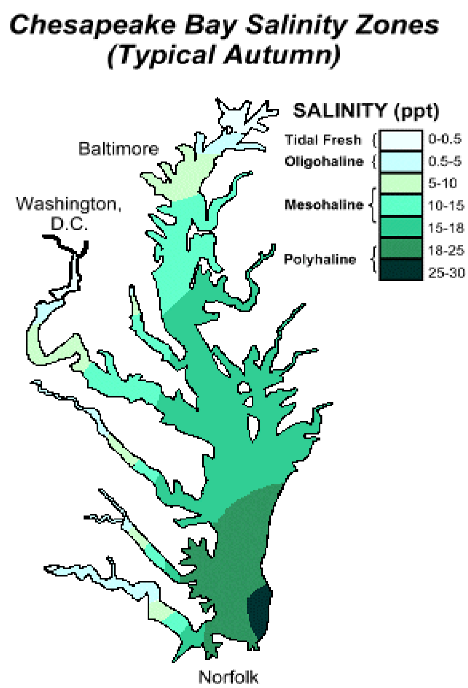


Figure 2.8 Salinity of the Chesapeake Bay (Source: Pyzik et al. 2004)

Rising sea levels, subsidence and coastal erosion have enlarged the Bay since the arrival of European colonists, with many sections of shoreline now 200 to 2,000 feet landward of their 17th century positions (Ward et al. 1989). Maryland loses an estimated 260 acres a year to shoreline erosion (MD DNR 2004b). This retreat of the shoreline increases sediment loads in nearshore waters and shifts habitats in position as new areas flood with estuarine waters. Sea level rise has inundated 16,721 acres of estuarine-forested wetlands in Maryland, or 6.7% of the state's total acreage of estuarine wetlands (LaBranche et al. 2003).

The salinity of Chesapeake Bay varies over numerous times scales and is dependent upon a number of factors, including season, tidal stage, and weather patterns (Pyzik et al. 2004, Figure 2.8). As oceanic tides rise, higher salinity waters move up the estuaries and the Bay. Salinities shift by season according to precipitation patterns, with spring rains creating large areas of lower salinity and the drier autumn months increasing salinity in most of the Bay. During a typical autumn, the majority of the Bay is considered mesohaline (5-18 ppt). Oligohaline, or low-salinity, waters are concentrated in the upper reaches of contributing estuaries and the upper Bay near Baltimore. Polyhaline waters are generally found in the southernmost of Maryland's portion of the Bay (MD DNR 2000b). During times of drought and along the Bay's bottom, salinities increase farther northward, and during times of high precipitation (and thus freshwater input into the Bay) lower salinities prevail in the upper estuaries. The proximity of an estuary to the open Atlantic Ocean also influences salinity, with higher salinities found in the lower Bay and near the mouth of the Chesapeake and Delaware Canal, which connects Delaware Bay with the Elk River in northeastern Maryland.

The CBP has the best available comprehensive information and maps regarding the salinity of the Bay at: http://www.chesapeakebay.net/status/wquality/interpolator/do/gallery.htm.

The Chesapeake Bay watershed is a major population center where 15 million people live, work, and recreate. Population in the watershed is expected to increase to 18 million by the year 2020 (Pyzik et al. 2004). Population projections for Maryland's coastal communities indicate a 15.4% increase from the 1999 level of 3,419,000 to 3,944,000 inhabitants by 2015 (NPA Data Services 1999).

By the 1980's, the Bay's waters were enriched with nutrients from agriculture and loaded with pollutants from urban and suburban areas (Flemer et al. 1983). The Bay's submerged grasses were disappearing, fisheries two centuries old were in serious decline, and wetlands and other natural habitats were under continuing threats of development.

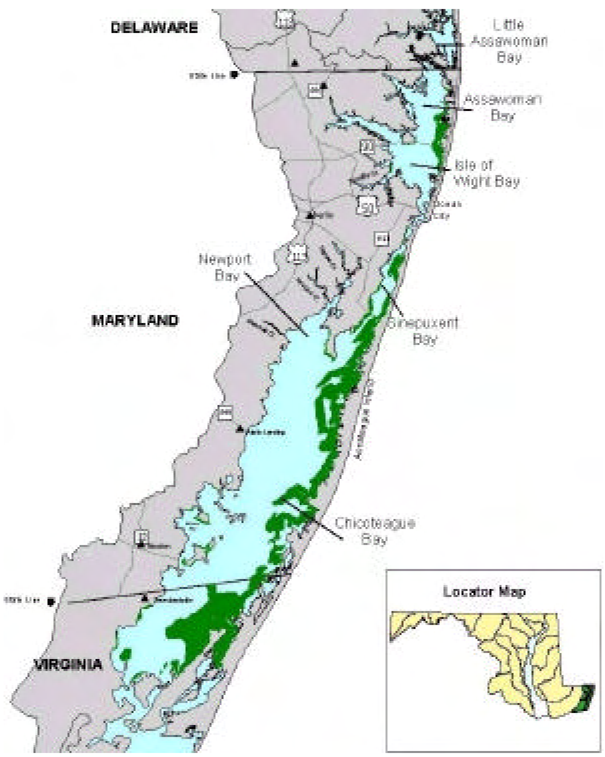
In 1983 the federal government, Virginia, Maryland, Pennsylvania, the District of Columbia, and the Chesapeake Bay Commission formally declared their intent to work cooperatively to restore the natural resources of the Bay. Their partnership, known as the CBP, attacked water-quality problems by adopting measures to reduce inputs of nitrogen and phosphorus from urban, industrial, and agricultural sources and to increase levels of dissolved oxygen in Bay waters. Simultaneously, scientists and managers determined the status of Bay species and natural habitats and began to track historical and ongoing trends (Pendleton 1995). The Bay Agreement was revised in 1987 and updated in 2000. The current Chesapeake 2000 Agreement resulted from a 3 year, stakeholder-driven process that defined almost 100 conservation actions, organized into five focus areas: (1) protecting and restoring living resources, (2) protecting and restoring vital habitats, (3) improving water quality, (4) managing lands soundly, and (5) engaging individuals and local communities (CBP 2000). The CBP's "The State of the Chesapeake Bay and Its Watershed" report (CBP 2004a) summarizes the current status of the Bay's living resources and habitats.

Coastal Bays

The Coastal Bays are complex, lagoon-like estuaries that provide habitat for a wide range of aquatic life. The Bays are contained by the barrier islands on Maryland's east coast and a small, 175 square mile watershed on the mainland with its 23 creeks and tributaries. They include Chincoteague, Newport, Sinepuxent, Isle of Wight, and Assawoman Bays. The Bays are shallow water bodies with an average depth of four feet. Since salinity in the Bays and their tributaries comes from the ocean, the areas closer to the ocean have higher salinities. This leaves the midbay as being polyhaline, the creek mouths as mesohaline, and the upstream creeks as oligohaline to fresh. Together, the Coastal Bays are one of the most diverse estuaries in the eastern seaboard, supporting numerous rare and threatened plant (89) and animal species (19). They also provide forest and wetland habitats vital to migratory songbirds and waterfowl. Over 140 species of finfish and 120 species of epibenthic and benthic invertebrates have been identified in the Bays (MD DNR 2004d). Over 300 species of birds utilize the Bays or the surrounding watershed for breeding, roosting, or foraging (http://www.dnr.state.md.us/bay/czm/coastal_facts.html).

In 2004, the Coastal Bays were ranked from best to worst in terms of estuarine health as Sinepuxent Bay, Chincoteague Bay, Assawoman Bay, Isle of Wight Bay, Newport Bay and St. Martin River (MD DNR 2004d). The Bays are threatened by non-point source pollution, nutrient enrichment, hypoxia, contaminants, exotic species, and growth in the human population of the watershed. Seagrass distribution is concentrated on the ocean side of the Bays, with Sinepuxent and Chincoteague Bays having the highest abundances of seagrass (Figure 2.9). In 2003, the abundance of seagrass increased 5% to roughly 11,069 acres in the Coastal Bays (http://dnr.maryland.gov/coastalbays/index.html). Oysters remain in small remnant populations only, while bay scallops have recently returned to the Bays but in low abundance. Hard clams are below historical levels but appear stable over the last decade. The population trend of blue crabs varies but does not appear to be in decline. Forage fish populations, however, are in steady decline.

Figure 2.9 Seagrass Distribution in the Coastal Bays (Source: MD DNR http://www.dnr.state.md.us/coastalbays/living_resources/coast_bay_grasses_map.html)



The NPS owns and operates the Assateague Island National Seashore, which includes the seaward portion of estuarine habitats in Chincoteague and Sinepuxent Bays. Assateague State Park and the Sinepuxent Bay Wildlife Management Area also have conserved land and waters in the Coastal Bays ecosystem. The recently established Coastal Bays Program, a part of the EPA's National Estuary Program, formalized a partnership amongst MD DNR, EPA, federal and state agencies, local governments, NGOs and others to protect the Bay ecosystem. A Coastal Bays Comprehensive Conservation and Management Plan was completed in 1999 and identifies steps to monitor the status and trends of the ecosystem and manage its conservation and threats (MD DNR 1999). In addition, the Maryland Coastal and Estuarine Land Conservation Plan (CELCP) identifies threats and priority conservation needs throughout the state's coastal and estuarine areas, including the Coastal Bays.

Atlantic Ocean

Maryland's Eastern Shore has 32 miles of marine shoreline along the Atlantic Ocean. Ocean City, a highly populated urban area, forms the northern portion of the state's Atlantic coastline, while the undeveloped and preserved Assateague Island forms the southern portion. Maryland has state jurisdiction of the waters and seafloor from these shorelines seaward for three miles. Ocean City and Chincoteague Inlets allow the exchange of water and marine species between the Atlantic Ocean and the Coastal Bays. Anadromous fish such as menhaden and herring, as well as spawning horseshoe crabs, utilize these habitat corridors to travel between freshwater and estuarine spawning and juvenile habitats and adult marine habitats. Ocean City Inlet is stabilized with jetties and actively managed by the U.S. Army Corps of Engineers, while Chincoteague Inlet is unstabilized and managed by the USFWS National Wildlife Refuge System as a part of Chincoteague NWR in Virginia. The Assateague Island National Seashore has management responsibilities over the nearshore region of Assateague Island extending one-half mile seaward.

The seafloor within the state's jurisdictional waters consists of sandy and muddy substrates that support a diversity of epibenthic and benthic species (MGS 2004c). Several linear sand shoals run obliquely parallel to the shoreline but are threatened by mining for beach nourishment projects; over 8 million cubic meters of sand have been removed from the shoals and placed on nearby beaches since 1988. Numerous artificial reefs and shipwrecks provide localized vertical relief to the seafloor, creating hard substrates for epibenthic fauna and attracting reef species.

None of the state's ocean waters are impaired in terms of water quality (MD DNR 2000b). The nearshore region is impacted by beach nourishment projects in Ocean City and northern Assateague Island, as well as the dual jetty system at Ocean City Inlet. These large scale water resources development projects modify the hydrology, sediment loads, and substrates of the nearshore ecosystem. The ocean ecosystem in Maryland is managed by MD DNR's Coastal Zone Management Program. Its fisheries resources are managed by the MD DNR Fisheries Service, with some species also managed by the NMFS, ASMFC and the Mid-Atlantic Fishery Management Council (MAFMC).

This chapter has summarized the landscape of Maryland and its regional context, and has laid the groundwork for describing the key wildlife habitats found in the state (addressing **Element #2**). Chapter 4 lists these key wildlife habitats. The next chapter will provide information on the full array of wildlife found in Maryland and will identify those species in greatest conservation need (addressing **Element #1**).

Chapter 3: Maryland's Wildlife Resources and Species of Greatest Conservation Need (GCN)

This chapter addresses **Element #1** and summarizes the best available information regarding the status, distribution, and abundance of all major taxonomic groups according to the best available scientific data. Sources of information (e.g. literature, data bases, agencies, individuals) on Maryland's wildlife abundance and distribution consulted during the planning process are detailed in Appendix 1a. More detailed information regarding the status and relative abundance of Maryland's full array of wildlife can be found in Appendix 3a. Appendix 3b identifies the status, rank, and distribution of those species identified as in greatest conservation need in Maryland. This chapter identifies low and declining populations according to best available scientific data and expert opinion. This chapter also summarizes the process used to select the species in greatest need of conservation. Maryland supports a wide variety of wildlife, despite its small size, because of the many kinds of habitats that are found from the Atlantic Ocean in the east to the Allegheny Mountains in the west. The diversity of Maryland's native animals that are known or potentially occurring within its borders includes 97 species of mammals, 410 species of birds, 90 species of reptiles and amphibians, several hundred species of freshwater and marine fishes, and over 20,000 species of invertebrates (Whitaker and Hamilton 1998, Boward et al. 1999, Roth et al. 1999, MD DNR http://www.dnr.state.md.us/wildlife/mdwllists.asp). A portion of these species are rare, uncommon, or in serious decline (Table 3.1).

Distribution and Abundance of Maryland's Wildlife

The state's physiographic gradient and associated regional climatic differences provide the distribution framework for its wildlife species. Some common wildlife species are distributed throughout the state as part of Maryland's typical fauna. Others, however, are limited to specific areas of the state. For example, Appalachian Mountain species, such as the Alleghany woodrat, are limited to the western part of the state. Estuarine species like oysters and blue crab are found only in the Chesapeake Bay or the Coastal Bays. Whales and bluefin tuna are limited to the marine waters of the Atlantic Ocean and piping plovers nest on the beaches of Assateague Island. The pearl dace and checkered sculpin are examples of fish species found in Maryland's Great Valley, with most of the world's population of the checkered sculpin found in Maryland.

Table 3.1 summarizes the state, federal, and global listings and abundance ranks for Maryland's species by taxa. For additional regional, national, and international ranks see Appendix 3a and 3b. Each taxa group is discussed further in the next sections. The species ranks assigned and maintained by the WHS NHP are the most complete list and accounting of wildlife species abundance status in Maryland (Appendix 3a). Data maintained by NHP represents the best available summary of information on the abundance, distribution and status of wildlife species for the state, and these data were reviewed as one of the initial steps to determine which species are in the greatest need of conservation.

Table 3.1 Wildlife Diversity of Maryland

Taxa	Total[1]	State-listed[2]	Federally-listed	S1 - S3 Ranked	G1 – G3 Ranked[3]	GCN
Mammals	97	24	10	18	11	34
Birds	410	33	6	127	8	141
Reptiles and Amphibians	90	20	6	23	8	42
Fishes	635	26	2	28	3	40
Invertebrates	20,000+	58	5	205	62	245
Total		161	29	401	92	502

[1]Includes accidentals and species ranked by NHP as SP (Potentially occurs in the state); does not include subspecies or species with State Rank of SRF (Reported falsely: Erroneously reported in the state and the error has persisted in the literature), or SE (Exotic: An exotic established in the state; may be native in nearby regions).
[2]Number of state-l,isted species includes some, but not all that are listed in COMAR 08.02.12 due to taxonomic group listing (e.g., sharks).
[3]Global ranks are maintained by NatureServe; 2003 data were used for this document.

Key: S1 = Critically imperiled in the state
S2 = Imperiled in the state
S3 = Rare to uncommon and potentially vulnerable to extirpation within in the state
G1 = Critically imperiled across its entire range (i.e., globally)
G2 = Imperiled across its entire range (i.e., globally)
G3 = Rare across its entire range (i.e., globally) or distributed locally in a restricted range
GCN = Species of Greatest Conservation Need

Identification of Species of Greatest Conservation Need (GCN)

This WDCP development process provided MD DNR the opportunity to identify species of wildlife in greatest need of conservation, as well as the key habitats that support them. Rather than focusing on a certain group or category of wildlife, this effort evaluated the status of over 2,000 known animal species and considered the countless thousands more of additional invertebrate species yet unnamed and unstudied in Maryland. By considering all species in this assessment, the broader interrelationships of wildlife conservation could be addressed. While it is clear that the rarest (threatened and endangered species) are in need of conservation, it is also clear that other declining or vulnerable species need attention. By considering these additional factors, as well as the national guidance criteria (described below), over 500 species, like the least brook lamprey, cerulean warbler, southern pygmy shrew, and the rapids clubtail, were determined to be in greatest need of conservation (Appendix 3b). These are species at risk of disappearing from Maryland in the foreseeable future if appropriate conservation actions are not implemented.

The MD WDCP process for identification of species of greatest conservation need within each of the wildlife taxa groups involved collection and compilation of the best available quantitative and qualitative input from agency staff and stakeholders, including: Wildlife and Heritage Service, Fisheries Service, Maryland Biological Stream Survey, university and non-profit organization partners, and scientific experts (Appendix 1a). Using national guidance and the best scientific information available, each species status was assessed to determine those in greatest need of conservation. The criteria that were used during the assessment process and to ultimately identify these species were adopted from national guidelines developed by the International Association of Fish and Wildlife Agencies (IAFWA) and the U.S. Fish and Wildlife Service (USFWS) (Table 3.2). Numerous existing state, regional, and national ranking systems that prioritized or ranked species for each wildlife taxa group were used as a foundation for this process, including: NHP and NatureServe's State and Global Ranks, TNC ecoregional target species, USFWS and NMFS, indicator species from the MBSS, regional species of concern from the Northeast Technical Committee of the Association of Fish and Wildlife Agencies, USFWS Birds of Conservation Concern, Partners in Flight (PIF) Bird Conservation Plan priority species, MD DNR Fisheries Service, and American Fisheries Society's species of concern (Table 3.3). The overlap of priorities among groups, stakeholders, experts and agencies indicated significant agreement.

Table 3.2 IAFWA National Guidance Committee Criteria for GCN Species Assessment

- Endangered, threatened and candidate species (federal or state)
- Imperiled species (globally rare)
- Declining species
- Endemic species
- Disjunct species
- Vulnerable species
- Species with small, localized "at-risk" populations
- Species with limited dispersal
- Species with fragmented or isolated populations
- Species of special, or conservation, concern
- Focal species
  (keystone species, wide-ranging species, species with specific needs)
- Indicator species
- "Responsibility" species
  (i.e. species that have their center of range within a state)
- Species that aggregate in concentration areas
  (e.g. migratory stopover sites, bat roosts / maternity sites)

Some species groups, especially among invertebrates, have received little scientific study compared to others. Thus the list of rare and declining invertebrates is fairly well established for some groups, such as butterflies, dragonflies and damselflies, and freshwater mussels; however, it is known to be inadequate for many others, including most insects. This Plan is using the Key Wildlife Habitats and natural communities as a coarse-filter or umbrella to accommodate this lack of knowledge and to provide some level of conservation for these little-known species. This more holistic approach of focusing on habitats and natural communities will proactively provide conservation to these GCN species, as well as the entire spectrum of wildlife from rare to abundant.

MD DNR WHS, MBSS, and Fisheries Service staff provided information on species' status, abundance, distribution, and habitat associations. Individuals who are recognized in their field and represent many of the major universities and conservation organizations active in conserving these species in Maryland added their input to MD DNR. Staff and stakeholder input from surveys and workshops helped refine the resulting list of these species of GCN.

Table 3.3 Categories used for inclusion on Maryland's list of Wildlife Species of Greatest Conservation Need (GCN)

- Federally-listed threatened and endangered animals
- State-listed threatened and endangered animals
- Wildlife species listed as In Need of Conservation
- Natural Heritage Program tracked and watchlist animal species
- Northeast wildlife species of regional conservation concern
- Endemic species
- Responsibility species (those for which MD supports the core populations)
- Partners in Flight and All Bird Conservation priority species
- US Fish & Wildlife Service's migratory birds of management concern
- Colonial waterbirds
- Forest interior breeding birds
- Shrubland successional breeding birds at risk
- Grassland breeding birds at risk
- Shorebirds with significant migratory concentrations
- Marshland breeding birds (e.g., rails, bitterns, sedge wren) at risk
- Reptiles and amphibians at risk
- Bats at risk
- Small mammals at risk
- Terrestrial and aquatic invertebrates at risk
- Freshwater fish at risk
- American Fisheries Society's species of concern
- Depleted anadromous fish (e.g., shad spp., sturgeon)
- Depleted marine invertebrates (e.g., horseshoe crab)
- Sensitive aquatic species

Mammals of Maryland

Whitaker and Hamilton (1998) list 121 species of mammals native to, or currently established, in the eastern United States. Specifically to Maryland, Paradiso (1969) lists 64 land mammals, including introduced species, and 10 marine mammals, plus six species that have been extirpated since 1600. The Smithsonian Book of North American Mammals (Wilson and Ruff 1999) records 89 species of native mammals, including 26 species of marine mammals, as occurring in Maryland. These sources of information on mammals in Maryland present differing or incomplete views on numbers of mammal species found in the state. Although there may never be a final authority or consensus regarding the exact number of species, this WDCP is a tool and an ongoing mechanism to track the current abundance and distribution of species in greatest need of conservation in Maryland.

The NHP database includes 97 native mammals as residents, migrants, accidental visitors, or species that are very likely to occur in the state, including 28 marine mammals and 7 historical or extirpated species. All together, NHP database lists 75 land mammals in Maryland including native and introduced species. These 75 include 12 shrews and moles, 11 bats, 3 rabbits and hares, 26 rodents, 17 carnivores, 2 deer, and the Assateague pony. Much of the mammal diversity of the state can be attributed to the four western counties, with 21 species found exclusively in or near these counties. By contrast, only the Delmarva fox squirrel, sika deer, and Assateague pony are restricted to the Coastal Plain; the latter two being introduced species. Thus, most of Maryland's mammals have statewide distributions.

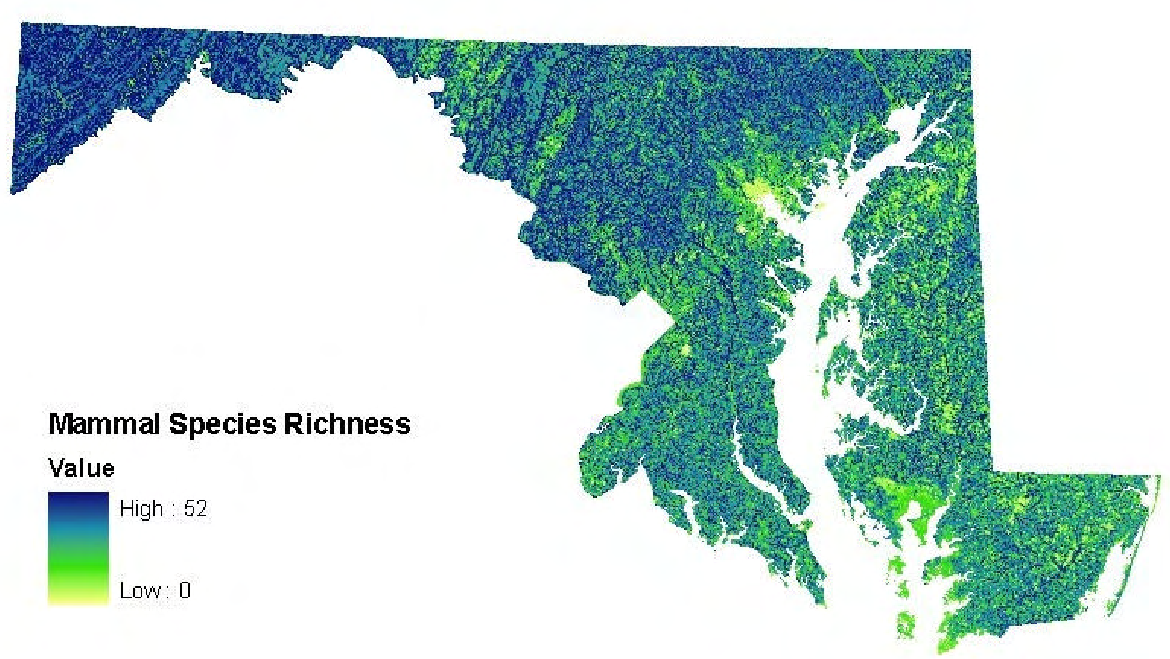
Exotic species of mammals have become established in Maryland either through intentional or unintentional introductions. Three rodents arrived in Maryland with the earliest waves of Europeans to the Americas: house mouse, Norway rat and black rat. Sika deer, released in Maryland on James Island in 1916 and on Assateague Island about 1930, have increased greatly and now occupy four counties on Maryland's Eastern Shore (Whitaker and Hamilton 1998). Nutria, a 15-20 lb rodent of South American origins, have displaced the native muskrat in many marshes of the Eastern Shore. Able to breed throughout the year and sometimes "eating out" marsh vegetation, nutria greatly alter the marsh ecosystem and are currently a nuisance. An aggressive nutria eradication program is currently underway on the Eastern Shore.

Several species of mammals in Maryland are game animals with legal hunting or trapping seasons. MD DNR WHS has several programs that monitor the current status of game species, including deer, bears, small game, and furbearers. The deer management program monitors abundance and distribution in the state and regulates deer-hunting seasons to maintain healthy deer populations within biological and cultural carrying capacities. A deer management plan (MD DNR 1998) was developed by MD DNR. During the past 15 years, deer populations have doubled or more in most counties, even increased 5-7 times in some counties. The four western counties have high population densities (and the lowest rates of increase in the past 15 years), the highest deer yields, and the lowest ratios of fawns per adult doe, perhaps indicating population densities near carrying capacity. By contrast, eastern counties have more greatly expanding populations and much higher ratios of fawns per adult does. Even with the increased taking of antlerless deer, the state's deer population continues to expand.

Black bear populations have increased in western Maryland over the past 20 years. A black bear management plan (MD DNR 2004a) was developed recently by MD DNR. Black bear populations have been monitored since the 1980s using a variety of techniques. Most of Maryland's estimated 400-500 bears are in the four western counties. In an effort to curb the expanding population and with public support, a limited hunt was initiated in 2004 and 20 bears were harvested on the first day.

The furbearer management program involves research to monitor population levels of 14 species and to obtain biological information for mammal species currently or historically harvested for fur, including foxes, muskrats, beavers, and raccoons. Otters and fishers have become established within their historical ranges and coyotes are now present throughout Maryland. Trappers have taken an average of 240 otters annually for the past 8 years; the first fishers were taken in 1977-1978, and trappers have taken an average of 14 fishers a year for the past 6 years. Associated management and outreach activities include resolving conflicts when population numbers increase in public areas and sometimes result in human-wildlife conflicts.

Figure 3.1 Distribution of Maryland's Mammals (Source: McCorkle, Gorham and Rasberry 2005)



GCN Mammals of Maryland

Thirty-four species of mammals have been identified during the WDCP development process as species of greatest conservation need (Table 3.4). Of these, 21 are state-listed species, 11 of which are listed as threatened or endangered, 21 are of national or international concern, 11 are of conservation concern in the Northeastern U.S. region, and 6 are otherwise declining, at risk, or of uncertain status in the state. The following are designated as federally-endangered: Indiana bat, Delmarva fox squirrel, and 6 species of whales. For additional regional, national, and international ranks see Appendix 3a and 3b.

Mammals of greatest conservation need include species that require an extensive, connected landscape of habitat patches, as well as species limited to specialized habitats such as boulder and rock outcrops, caves and mines, remnant spruce-hemlock forests, and marine environments. It is noteworthy that 12 GCN species are found mostly or exclusively in the four western counties, emphasizing again the importance of this region for the wildlife diversity of the state.

Threats to GCN mammals are related to their unique life histories. Species such as bobcat, North American porcupine, and Allegheny woodrat range over large areas through time and require connected habitat patches. Boulder and rock outcrops, threatened by human disturbance such as recent wind power development on ridgetops, provide habitat for a suite of species including long-tailed shrew, eastern small-footed myotis, and southern rock vole. The loss of spruce and hemlock habitats has particularly affected relict populations of more northern species, such as snowshoe hare. Bats face particular threats to their food source through pesticide use and reduction of aquatic prey due to pollution, and are sensitive to disturbance during hibernation and while in maternity colonies located in human structures or rock outcrops (eastern small-footed myotis). The removal of large tree snags and forest cover affects species such as Indiana bat and red bat. Urbanization has increased the level of competition and disease transmission between some GCN species and species such as raccoons that adapt well to human-altered landscapes.

Conservation Actions and Information Needs for GCN Mammals

Some of the conservation actions needed to address threats to specific GCN species are presented in recovery plans for federally-endangered species (Indiana bat, Delmarva fox squirrel, whale species). Protection of forest, wetland, and rock outcrop habitats is needed for these and other GCN species. Landscape habitat models can help to identify areas for conservation action, especially for species with large home ranges or that need connected habitat patches. The restoration of spruce and hemlock habitats, and protection through the control of hemlock wooly adelgid, would provide needed habitat for relict species and opportunities for reintroductions. Education of the public and working with industry could help to minimize bat disturbance and mortality and deter the presence of urbanized species near wildlife areas.

To determine additional conservation measures, specific information or research is needed for some GCN species. The fossorial and nocturnal habits of many GCN mammal species make inventory, monitoring, and research on basic biology and habitat needs a particular challenge for this group. For wide-ranging species, understanding the landscape configuration needed to maintain metapopulations is of primary importance. Documenting the migratory flyways of bats and how to deter collisions with wind turbines are becoming more pressing issues as wind power development increases in the eastern U.S. Best management practices need to be developed to minimize the impacts of agricultural and timber harvesting activities on forest and wetland mammals.

Table 3.4 GCN Mammals of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S - Rank	G - Rank
Allegheny woodrat	*Neotoma magister*	E		S1	G3G4
American marten	*Martes americana*	X		SX	G5
Blue whale	*Balaenoptera musculus*	E	E	SZN	G3G4

Common Name	Scientific Name	State-listed	Federally-listed	S - Rank	G - Rank
Bobcat	*Lynx rufus*	I		S3	G5
Delmarva fox squirrel	*Sciurus niger cinereus*	E	E	S1	G5T3
Eastern harvest mouse	*Reithrodontomys humulis*	X		SH	G5
Eastern red bat	*Lasiurus borealis*			S5B,S5N	G5
Eastern small-footed myotis	*Myotis leibii*	I		S1B,S2N	G3
Eastern spotted skunk	*Spilogale putorius*			S1	G5
Fin whale	*Balaenoptera physalus*	E	E	SZN	G3G4
Harbor porpoise	*Phocoena phocoena*			SZN	G4G5
Hoary bat	*Lasiurus cinereus*			SPB,S5N	G5
Humpback whale	*Megaptera novaeangliae*	E	E	SZN	G3
Indiana bat	*Myotis sodalis*	E	E	S1	G2
Least shrew	*Cryptotis parva*			S3S5	G5
Least weasel	*Mustela nivalis*	I		S2S3	G5
Long-tailed shrew	*Sorex dispar*	I		S2	G4
New England cottontail	*Sylvilagus transitionalis*	I		S1	G4
North American Porcupine	*Erethizon dorsatum*	I		S1S2	G5
Northern flying squirrel	*Glaucomys sabrinus*			SP	G5
Northern right whale	*Eubalaena glacialis*	E	E	SZN	G1
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*			SP	G3G4
Sei whale	*Balaenoptera borealis*	E	E	SZN	G3
Silver-haired bat	*Lasionycteris noctivagans*			SPB,S5N	G5
Smoky shrew	*Sorex fumeus*	I		S2S3	G5
Snowshoe hare	*Lepus americanus*	X		SH	G5
Southeastern myotis	*Myotis austroiparius*			SP	G3G4
Southeastern shrew	*Sorex longirostris*			S3S4	G5
Southeastern star-nosed mole	*Condylura cristata parva*			SU	G5T4
Southern bog lemming	*Synaptomys cooperi*			S3	G5
Southern pygmy shrew	*Sorex hoyi winnemana*			S2	G5T4
Southern rock vole	*Microtus chrotorrhinus carolinensis*	E		S1	G4T3

Common Name	Scientific Name	State-listed	Federally-listed	S - Rank	G - Rank
Southern water shrew	*Sorex palustris punctulatus*	E		S1	G5T3
Sperm whale	*Physeter catodon*	E	E	SZN	G3G4

Birds of Maryland

Birds are the most familiar and widely enjoyed wildlife in North America. 423 species of birds have been accepted on the "Official List of the Birds of Maryland" (Maryland Ornithological Society 2005). This list includes two extirpated species (trumpeter swan and greater prairie chicken) and two extinct species (passenger pigeon and Carolina parakeet), as well as a large number of accidental species that have been observed only one or a few times in Maryland since records were first kept in1804.

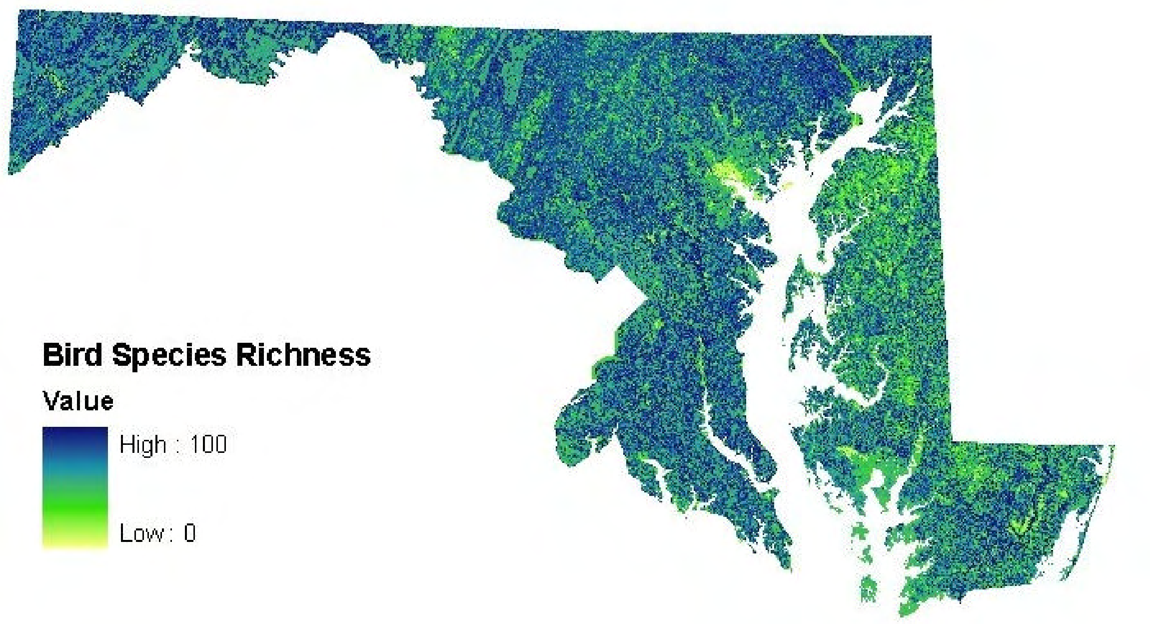
Most Maryland birds are migratory, but some, such as northern cardinal and mourning dove, are permanent residents. Many migratory species breed in the state. Other species migrate south to Maryland and spend the winter here, while other migrants simply pass through the state during spring and fall migrations. 201 species were recorded during the Breeding Bird Atlas from 1983 to 1987 (Robbins and Blom 1996).

Maryland's importance to birds has been recognized by several organizations that have designated specific areas as particularly valuable to seabirds, wading birds, waterfowl, shorebirds and others. The Atlantic Coast Joint Venture (ACJV) has designated the Upper Western Shore, Delmarva Peninsula and Lower Western Shore as Waterfowl Focus Areas. An ACJV map is publicly available online and can be viewed at http://www.fws.gov/northeast/migratorybirds/acjv_planning.htm. The Mid-Atlantic/New England Maritime Regional Working Group for Waterbirds (MANEM) is a regional partnership working to conserve waterbirds in the Northeast, and they have identified (draft) Important Waterbird Areas for breeding seabirds, wading birds, and marshbirds for 11 states and 4 provinces in the Northeast. MANEM maps for each of the mentioned groups of waterbirds are available for each state, including Maryland, and can be viewed online at http://www.fws.gov/birds/waterbirds/MANEM/Habitat%20Profiles.htm. The National Audubon Society and American Bird Conservancy (Chipley et al. 2003) have designated a number of sites, including Fishing Bay Wildlife Management Area (Elliott Island), Blackwater National Wildlife Refuge (NWR), Jug Bay, Eastern Neck NWR, and Assateague Island National Seashore, as globally Important Bird Areas. Additional IBA's are currently being identified and designated by the National Audubon Society.

Maryland's landscape encompasses five physiographic regions, as described in Chapter 2: Lower Coastal Plain, Upper Coastal Plain, Piedmont, Ridge and Valley, and Allegheny Plateau. The diversity of habitats within these regions accounts for the diversity of birds found in the state. Because of this physiographic diversity, three Bird Conservation Regions (BCRs) occur in Maryland – New England/Mid-Atlantic Coast, Piedmont, and Appalachian Mountains (see Table 2.1). Each BCR addresses different suites of species and issues.

Additionally, numerous plans address the unique guilds or groups of bird species that occur within these regions (Appendix 1a).

Figure 3.2 Distribution of Maryland's Breeding Birds (Source: McCorkle, Gorham and Rasberry 2005)



Birds of the Coastal Plain

The avifauna of the Upper and Lower Coastal Plain is transitional and contains a mix of species mostly centered in southeastern North America, with some additional species spilling over from more inland regions. Of the Coastal Plain breeders, many species are associated with water and wetland habitats, as well as species of upland forests, shrublands, and grasslands. As would be expected, waterfowl, marsh birds, shorebirds, and colonial nesting species, aggregately known as waterbirds, are an important component of this region's avifauna (Kushlan et al. 2002). Of the perching birds, Coastal Plain specialists include brown-headed nuthatch, marsh wren, Swainson's warbler, saltmarsh sharp-tailed sparrow, seaside sparrow, and boat-tailed grackle.

The Chesapeake Bay is a major wintering area for waterfowl in the Atlantic Flyway. Most waterfowl species are game birds with established management programs administered by the USFWS with the cooperation of the MD DNR. Conservation actions are coordinated through the North American Waterfowl Management Plan (USFWS 1999) and the ACJV (ACJV 2004).

Efforts to assess Maryland's marsh bird populations began in the early 1990s (Brinker et al. 2001). Many aspects of the biology of marsh birds remain relatively poorly known as compared with other groups of birds. Even fairly basic information such as distribution during the breeding and winter seasons, timing and status of migrants, and specific habitat preferences throughout the year are poorly documented in the literature in many geographic areas (Ribic et al. 1999).

Since the mid-1980's, MD DNR has had an active colonial waterbird management program to assess and monitor populations. Regional coordination through MANEM (2004) and the Colonial Waterbird and Shorebird Working Groups provide regional assessments of waterbird population status and trends.

Shorebirds are also monitored in Maryland by MD DNR and the NPS Assateague Island National Seashore, and regionally by several Atlantic coast coordinated efforts (Clark and Niles 2000, Hunter 2003). Conservation actions in North America are provided in the U.S. Shorebird Conservation Plan (Brown et al. 2001). The piping plover, a federally threatened and state endangered shorebird, is a tiny dune-nesting species that nests on Maryland's Assateague Island and on other Atlantic coastal beaches (USFWS 1996b). The species is slowly recovering due to education of beach users, aided by signs and light fencing, the latter sometimes also being predator-resistant.

Birds of the Piedmont

Roughly 140 bird species breed within the entire mid-Atlantic Piedmont region (Carter et al. 2000). Six bird species have a disproportionately large share of their global populations breeding within this area, which extends from southern Virginia to northern New Jersey (Kearney 2003). These include five deciduous forest species (wood thrush, acadian flycatcher, scarlet tanager, Louisiana waterthrush, and eastern wood-pewee) and one species associated with early successional habitats (prairie warbler). The Piedmont is in the heart of these species' geographic ranges and, therefore, forest conservation in this region could especially benefit and sustain their populations over the long term.

Populations of three forest-nesting species exhibit significant declining trends in the Piedmont (Kearney 2003). These are the yellow-billed cuckoo, northern flicker, and great crested flycatcher. Two wetland species, black-crowned night heron and green heron, are also in decline. In contrast, a total of 40 bird species exhibit increasing trends, but those species displaying the greatest increases are habitat generalists and are either nonmigratory or short distance migrants. A number of species associated with mature forest habitats have increased locally, such as wild turkey, Cooper's hawk, red-shouldered hawk, worm-eating warbler, pileated woodpecker, northern parula.

In addition to forest-dependent species, Maryland's Piedmont habitats traditionally supported grassland species such as the horned lark, vesper sparrow, grasshopper sparrow, and eastern meadowlark, which have decreased by an average of 10% per year and are among the most steeply declining birds in the mid-Atlantic Piedmont (Kearney 2003). Dickcissel, bobolink, and upland sandpiper were once more common in the grassland habitats of this region of Maryland, and still occur occasionally. Birds of shrublands and early successional habitats, such as the field sparrow, northern bobwhite, and brown thrasher, have also seen large population declines as farming practices have changed and urbanization has increased.

Montane Birds

Habitat types of the Ridge and Valley and Allegheny Plateau include early successional forests, mesic deciduous forests, bog and fen wetland complexes, cliff and rock outcrops, and northern conifer-hardwood forests. Because this region includes some habitats that are unique within the state, it supports a number of bird species that essentially breed nowhere else in Maryland, such as northern saw-whet owl, alder flycatcher, least flycatcher, black-capped chickadee, winter wren, hermit thrush, and golden-winged, Nashville, chestnut-sided, magnolia, black-throated blue, blackburnian, and mourning warblers. Because farming practices and land-use patterns are not changing as rapidly in this region as in the remainder of the state, some species which formerly bred in other regions, such as Henslow's sparrow and upland sandpiper, now only breed in this region.

GCN Birds of Maryland

One hundred forty-one species of birds have been declared by the WDCP process as species of greatest conservation need in Maryland (Table 3.5). Of these, 29 are state-listed, 18 of which are listed as threatened or endangered, 22 are of national or international concern, and 27 are of conservation concern in the Northeastern U.S. region. An additional 86 were listed because the best available current scientific information indicates their populations are in decline or they require more specialized habitat types that are likely to be degraded. Federally-endangered birds that formerly bred in Maryland include roseate terns and red-cockaded woodpeckers. The bald eagle is listed as federally-threatened, as is the Atlantic coast breeding population of piping plovers. Support for the recovery plans for federally listed endangered and threatened species is included in the implementation of the WDCP. Fourteen species are considered by the MD DNR to be endangered in the state: Wilson's plover, piping plover, upland sandpiper, gull-billed tern, royal tern, black skimmer, short-eared owl, olive-sided flycatcher, Bewick's wren, sedge wren, loggerhead shrike, Swainson's warbler, mourning warbler, and northern goshawk (in western Maryland). State-threatened species include the bald eagle, least tern, blackburnian warbler, and Henslow's sparrow. For additional regional, national, and international ranks see Appendix 3a and 3b.

GCN bird species are negatively affected by certain factors more so than other taxa groups. For example, 49 GCN bird species are very sensitive to habitat fragmentation. Forest species, such as worm-eating warbler and red-shouldered hawk, and grassland species, such as Henslow's sparrow and short-eared owl, will not nest or are likely to have greatly reduced nest success in areas below a certain size. Fragmentation also opens up habitats to increased nest parasitism by brown-headed cowbirds. Conversion of native forest communities to commercial pine plantations alters the suitability of the habitat for most GCN forest species, and overbrowsing by deer removes critical habitat structure for some forest nesters. Grassland birds such as dickcissel and bobolink are further threatened by changes in agricultural practices such as earlier mowing. Beach-nesting shorebirds and colonial waterbirds face special challenges as they are concentrated in areas with increased recreational use, expanding gull populations, and shoreline development. Disturbance of colonial waterbird colonies is of special concern given the potential to negatively affect the breeding success of a large group of birds by impacting just one or a few areas.

The vast saltmarsh habitats of Maryland support the regional stronghold of rails and saltmarsh sparrows, such as black rail and coastal plain swamp sparrow. Contamination and drainage of these and other marsh habitats through development and mosquito control efforts can be a serious problem for marsh-nesting species. As in mammal GCN species, some bird species, such as northern saw-whet owl and golden-crowned kinglet, are dependent on relict northern spruce-hemlock habitats that have been greatly reduced in size.

Twenty-one species of greatest conservation need do not breed in Maryland, but overwinter or stop in Maryland during migration. Migratory stopover or wintering habitat is critical for these species, most of which are shorebirds or waterfowl. Disturbance of beach habitats and the absence of horseshoe crab eggs for shorebirds (especially red knot), entanglement in fishing nets for seabirds, and degradation of aquatic habitats for waterfowl threaten these groups of GCN species. Several general threats to birds also affect GCN species to differing degrees. Collisions with towers, windows, cars, and other human structures kill many thousands of birds each year. GCN species face competition for nest sites with introduced bird species, and free-ranging domestic cats kill millions of birds annually in the U.S.

Conservation Actions and Information Needs for GCN Birds

To address the special needs of GCN bird species, more information is particularly needed on migratory stopover and overwintering requirements; area sensitivity (forest, grassland, and marsh species); and inventory of nocturnal species. Information needs and conservation actions for breeding federally-listed species (piping plover, bald eagle) can be found in their respective recovery plans. Partners in Flight has produced conservation plans that include Maryland GCN species, and plans are under development that will include species of concern in the Mid-Atlantic and Appalachian BCR designated by the North American Bird Conservation Initiative. Recommendations for GCN waterbirds, seabirds, and waterfowl are included in other regional plans. Landscape-level habitat information can be used to identify priority areas for conservation and restoration of habitat for area sensitive and northern habitat species, which should include control of hemlock wooly adelgid. The recent designation of Important Bird Areas (IBA) by Audubon Maryland/DC will assist with this effort. There is considerable overlap between the components of the IBA program and this plan, thus collaboration between the two will enhance bird conservation efforts in Maryland. Fragmentation and habitat destruction for forest-interior species can be limited by conserving the remaining large blocks of unfragmented forests, controlling urban sprawl through implementation of the state's smart growth initiatives, and limiting forest conversion to monotypic pine plantations. Work with the public can encourage the protection of GCN species at migratory stopover sites, beach-nesting sites, waterbird nesting colonies, and through control of predation by free-ranging cats. Control of introduced and invasive bird species, predators, and deer populations continues to be needed to conserve some nesting bird species. Food resources of GCN birds can be protected by limiting the use of pesticides and overharvest of horseshoe crabs. Encouraging farming practices that favor grassland and shrub-scrub nesting species, such as late mowing, hedgerow establishment, and reduced pesticide use can benefit a number of GCN species. Retention and improvement of aquatic habitats for GCN birds can be achieved by controlling common reed, restoring marshes, the enforcement of wetland protection laws, and the reduction of by-catch by commercial fisheries. Working with a variety of partners will be critical to minimize mortality due to collisions.

Table 3.5 GCN Birds of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Acadian flycatcher	*Empidonax virescens*			S5B	G5
Alder flycatcher	*Empidonax alnorum*	I		S2B	G5
American bittern	*Botaurus lentiginosus*	I		S1S2B,S1N	G4
American black duck	*Anas rubripes*			S4B,S5N	G5
American oystercatcher	*Haematopus palliatus*			S3B,SAN	G5
American peregrine falcon	*Falco peregrinus anatum*	I		S2	G4T3
American redstart	*Setophaga ruticilla*			S4B	G5
American woodcock	*Scolopax minor*			S4B,S4N	G5
Bachman's sparrow	*Aimophila aestivalis*	X		SHB	G3
Bald eagle	*Haliaeetus leucocephalus*	T	T	S2S3B,S3N	G4
Bank swallow	*Riparia riparia*			S3S4B	G5
Barn owl	*Tyto alba*			S3	G5
Barred owl	*Strix varia*			S5	G5
Bewick's wren	*Thryomanes bewickii altus*	E		S1B	G5T2Q
Bicknell's thrush	*Catharus bicknellii*			SZN	G4
Black rail	*Laterallus jamaicensis*	I		S2S3B	G4
Black skimmer	*Rynchops niger*	E		S1B	G5
Black tern	*Chlidonias niger*			SZN	G4
Black-and-white warbler	*Mniotilta varia*			S4B	G5
Black-bellied plover	*Pluvialis squatarola*			S3N	G5
Black-billed cuckoo	*Coccyzus erythropthalmus*			S4B	G5
Blackburnian warbler	*Dendroica fusca*	T		S1S2B	G5
Black-crowned night-heron	*Nycticorax nycticorax*			S3B,S2N	G5
Black-throated blue warbler	*Dendroica caerulescens*			S3S4B	G5
Black-throated green warbler	*Dendroica virens*			S4B	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Blue-headed vireo	*Vireo solitarius*			S3S4B	G5
Blue-winged warbler	*Vermivora pinus*			S4B	G5
Boat-tailed grackle	*Quiscalus major*			S3S4	G5
Bobolink	*Dolichonyx oryzivorus*			S3S4B	G5
Brant	*Branta bernicla*			S3N	G5
Broad-winged hawk	*Buteo platypterus*			S4B	G5
Brown creeper	*Certhia americana*			S4	G5
Brown pelican	*Pelecanus occidentalis*			S1B	G4
Brown thrasher	*Toxostoma rufum*			S5B,S2N	G5
Brown-headed nuthatch	*Sitta pusilla*			S3S4	G5
Canada warbler	*Wilsonia canadensis*			S3B	G5
Canvasback	*Aythya valisineria*			S3S4N	G5
Cerulean warbler	*Dendroica cerulea*			S3S4B	G4
Chestnut-sided warbler	*Dendroica pensylvanica*			S4B	G5
Chuck-will's-widow	*Caprimulgus carolinensis*			S4B	G5
Coastal plain swamp sparrow	*Melospiza georgiana nigrescens*	I		S2B,SZN	G5T3
Common loon	*Gavia immer*			S4N	G5
Common moorhen	*Gallinula chloropus*	I		S2B,SAN	G5
Common nighthawk	*Chordeiles minor*			S3S4B	G5
Common raven	*Corvus corax*			S2	G5
Common tern	*Sterna hirundo*			S4B	G5
Dark-eyed junco	*Junco hyemalis*			S2B,S5N	G5
Dickcissel	*Spiza americana*			S2B	G5
Dunlin	*Calidris alpina*			S3N	G5
Eastern meadowlark	*Sturnella magna*			S5B,S3N	G5
Eastern towhee	*Pipilo erythrophthalmus*			S5B,S4N	G5
Field sparrow	*Spizella pusilla*			S5	G5
Forster's tern	*Sterna forsteri*			S4B	G5
Glossy ibis	*Plegadis falcinellus*			S4B	G5
Golden eagle	*Aquila chrysaetos*			S1N	G5
Golden-crowned kinglet	*Regulus satrapa*			S2B,S4N	G5
Golden-winged warbler	*Vermivora chrysoptera*			S3B	G4

Common Name	**Scientific Name**	**State-listed**	**Federally-listed**	**S – Rank**	**G - Rank**
Grasshopper sparrow	*Ammodramus savannarum*			S4B	G5
Great blue heron	*Ardea herodias*			S4B,S3S4N	G5
Great egret	*Ardea alba*			S4B	G5
Greater yellowlegs	*Tringa melanoleuca*			S1N	G5
Gull-billed tern	*Sterna nilotica*	E		S1B	G5
Hairy woodpecker	*Picoides villosus*			S5	G5
Harlequin duck	*Histrionicus histrionicus*			S1N	G4
Henslow's sparrow	*Ammodramus henslowii*	T		S1S2B	G4
Hermit thrush	*Catharus guttatus*			S3S4B,S4N	G5
Hooded warbler	*Wilsonia citrina*			S4S5B	G5
Horned grebe	*Podiceps auritus*			S4N	G5
Kentucky warbler	*Oporornis formosus*			S4B	G5
King rail	*Rallus elegans*			S3S4B,S2N	G4G5
Laughing gull	*Larus atricilla*			S1B,S4N	G5
Least bittern	*Ixobrychus exilis*	I		S2S3B	G5
Least flycatcher	*Empidonax minimus*			S3S4B	G5
Least tern	*Sterna antillarum*	T		S2B	G4
Little blue heron	*Egretta caerulea*			S3B	G5
Loggerhead shrike	*Lanius ludovicianus*	E		S1B,S1N	G4
Long-eared owl	*Asio otus*			SHB,S1N	G5
Louisiana waterthrush	*Seiurus motacilla*			S5B	G5
Magnolia warbler	*Dendroica magnolia*			S3S4B	G5
Marsh wren	*Cistothorus palustris*			S4B,S2N	G5
Mourning warbler	*Oporornis philadelphia*	E		S1B	G5
Nashville warbler	*Vermivora ruficapilla*	I		S1S2B	G5
Northern bobwhite	*Colinus virginianus*			S5	G5
Northern gannet	*Morus bassanus*			SZN	G5
Northern goshawk	*Accipiter gentilis*	E*		S1B,SZN	G5
Northern harrier	*Circus cyaneus*			S2B,S4N	G5
Northern parula	*Parula americana*			S4S5B	G5
Northern saw-whet owl	*Aegolius acadicus*			S1B,S1N	G5
Northern waterthrush	*Seiurus noveboracensis*			S2S3B	G5
Olive-sided flycatcher	*Contopus cooperi*	E		SHB,SZN	G4
Ovenbird	*Seiurus aurocapillus*			S5B	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Pied-billed grebe	*Podilymbus podiceps*			S2B,S3N	G5
Pileated woodpecker	*Dryocopus pileatus*			S5	G5
Piping plover	*Charadrius melodus*	E	T	S1B,SAN	G3
Prairie warbler	*Dendroica discolor*			S4B	G5
Prothonotary warbler	*Protonotaria citrea*			S4B	G5
Purple sandpiper	*Calidris maritima*			S2N	G5
Red knot	*Calidris canutus*			SZN	G5
Red-breasted nuthatch	*Sitta canadensis*			S1B,S3N	G5
Red-cockaded woodpecker	*Picoides borealis*	X	E	SHB,SAN	G3
Red-eyed vireo	*Vireo olivaceus*			S5B	G5
Red-headed woodpecker	*Melanerpes erythrocephalus*			S4	G5
Red-shouldered hawk	*Buteo lineatus*			S4S5B,S4N	G5
Red-throated loon	*Gavia stellata*			S3S4N	G5
Roseate tern	*Sterna dougallii*	X	E	SHB,SAN	G4
Royal tern	*Sterna maxima*	E		S1B	G5
Ruddy duck	*Oxyura jamaicensis*			S3N	G5
Ruddy turnstone	*Arenaria interpres*			S1N	G5
Saltmarsh sharp-tailed sparrow	*Ammodramus caudacutus*			S3B,S1N	G4
Sanderling	*Calidris alba*			S3N	G5
Sandwich tern	*Sterna sandvicensis*			S1B	G5
Savannah sparrow	*Passerculus sandwichensis*			S3S4B,S4N	G5
Scarlet tanager	*Piranga olivacea*			S5B	G5
Seaside sparrow	*Ammodramus maritimus*			S4B,S2N	G4
Sedge wren	*Cistothorus platensis*	E		S1B	G5
Semipalmated sandpiper	*Calidris pusilla*			SZN	G5
Sharp-shinned hawk	*Accipiter striatus*			S1S2B,S4N	G5
Short-billed Dowitcher	*Limnodromus griseus*			SZN	G5
Short-eared owl	*Asio flammeus*	E		S1B,S2N	G5
Snowy egret	*Egretta thula*			S3S4B	G5
Solitary sandpiper	*Tringa solitaria*			SZN	G5
Summer tanager	*Piranga rubra*			S4B	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Swainson's thrush	*Catharus ustulatus*			SXB	G5
Swainson's warbler	*Limnothlypis swainsonii*	E		S1B	G4
Tricolored heron	*Egretta tricolor*			S3B	G5
Upland sandpiper	*Bartramia longicauda*	E		S1B	G5
Veery	*Catharus fuscescens*			S4B	G5
Vesper sparrow	*Pooecetes gramineus*			S3S4B,S2N	G5
Wayne's black-throated green warbler	*Dendroica virens waynei*			SU	G5TU
Whimbrel	*Numenius phaeopus*			SZN	G5
Whip-poor-will	*Caprimulgus vociferus*			S3S4B	G5
Willet	*Catoptrophorus semipalmatus*			S3S4B	G5
Willow flycatcher	*Empidonax traillii*			S4B	G5
Wilson's plover	*Charadrius wilsonia*	E		S1B	G5
Wilson's snipe	*Gallinago delicata*			S2N	G5
Winter wren	*Troglodytes troglodytes*			S2B,S3N	G5
Wood thrush	*Hylocichla mustelina*			S5B	G5
Worm-eating warbler	*Helmitheros vermivorus*			S4B	G5
Yellow-bellied sapsucker	*Sphyrapicus varius*			SHB,S3N	G5
Yellow-crowned night-heron	*Nyctanassa violacea*			S2B	G5
Yellow-throated vireo	*Vireo flavifrons*			S4S5B	G5

Reptiles and Amphibians of Maryland

The NHP database includes 41 amphibians and 49 reptiles as being native to or likely to be found in the state. The most recent published account of the Maryland herpetofauna (Harris 1975) is now out of date. The Maryland Herpetological Society (MDHS) publishes local and statewide information in its bulletin and updates of information can be found in their newsletter and their website (www.naturalhistory.org). This is the best available scientific information regarding all herpetofauna in Maryland. Detailed scientific information on a number of individual species is available in the literature and from other sources.

Although members of the two groups often are found together, moist-skinned amphibians are most abundant either in the cool damp forests such as of the western counties or in or near aquatic or wetland habitats throughout the state. By contrast, most reptiles (snakes, lizards, and some kinds of turtles) are more suited to warm and dry environments, where their dry and relatively impermeable skin conserves water. Amphibians generally are intolerant of even low concentrations of salt water, but the marine environment is not a barrier to many kinds of reptiles, in Maryland notably the seaturtles.

Amphibians

Maryland's list of amphibians includes 21 salamanders and 20 frogs and toads. Globally, widespread and largely unexplained declines in amphibians have been observed since 1980, and the need to identify the specific causes of these declines is urgent (Gibbons et al. 2000). Declines in some species may be due to over-exploitation, whereas habitat loss also contributes to declines in some species (Stuart et al. 2004). But the sharpest declines are "enigmatic" (no known or obvious cause), especially for stream-dwelling species in tropical locations, often in seemingly pristine conditions. For reasons that are unclear, the declines have been slow and fewest in North America, where the best information on populations exists. There is a recognized national and regional need for advocacy focused on conservation and the use of an ecosystem approach to incorporate protection of amphibian and reptilian species into existing management plans (PARC 1999, SE PARC 2004, NE PARC in press).

Many amphibians require vernal or other fish-free ponds, slow-moving streams, or non-tidal wetlands for breeding. The 21 species of salamanders found in Maryland are sensitive to human sprawl and the associated habitat fragmentation. According to a survey conducted by the EPA, even the slightest bit of urbanization, less than 3%, has contributed to the disappearance of three salamanders, namely mountain dusky, seal, and northern slimy salamanders (Boward et al. 1999). Many salamanders seek traditional breeding sites, shortly after emergence from hibernation in late winter or early spring. When habitats are fragmented, it often becomes difficult or impossible for these salamanders to reach breeding sites. If their breeding sites are altered or destroyed, then breeding truly becomes impossible, unless alternative sites can be found. Because water temperature is critical to successful reproduction in many species, delays in finding breeding sites can result in failed reproduction. Four of Maryland's amphibian species belong to the Ambystomatidae, the mole salamanders, a family in which the rate of population decline is greater than the average for all amphibians (Stuart et al. 2004).

Figure 3.3 Distribution of Maryland's Amphibians (Source: McCorkle, Gorham and Rasberry 2005)

Most of Maryland's frogs and toads belong to three families (Bufonidae, toads; Hylidae, treefrogs and their allies; and Ranidae, true frogs) that are experiencing the sharpest declines worldwide (Stuart et al. 2004). Although most species lay eggs in water, toads and some frogs are terrestrial as adults, the latter living in cool damp habitats where their moist skin does not readily desiccate. Each species of frog and toad has a distinctive mating call, usually made at night when most breeding activity occurs. After breeding, most frogs and toads go silent and then their presence is much harder to detect.

Reptiles

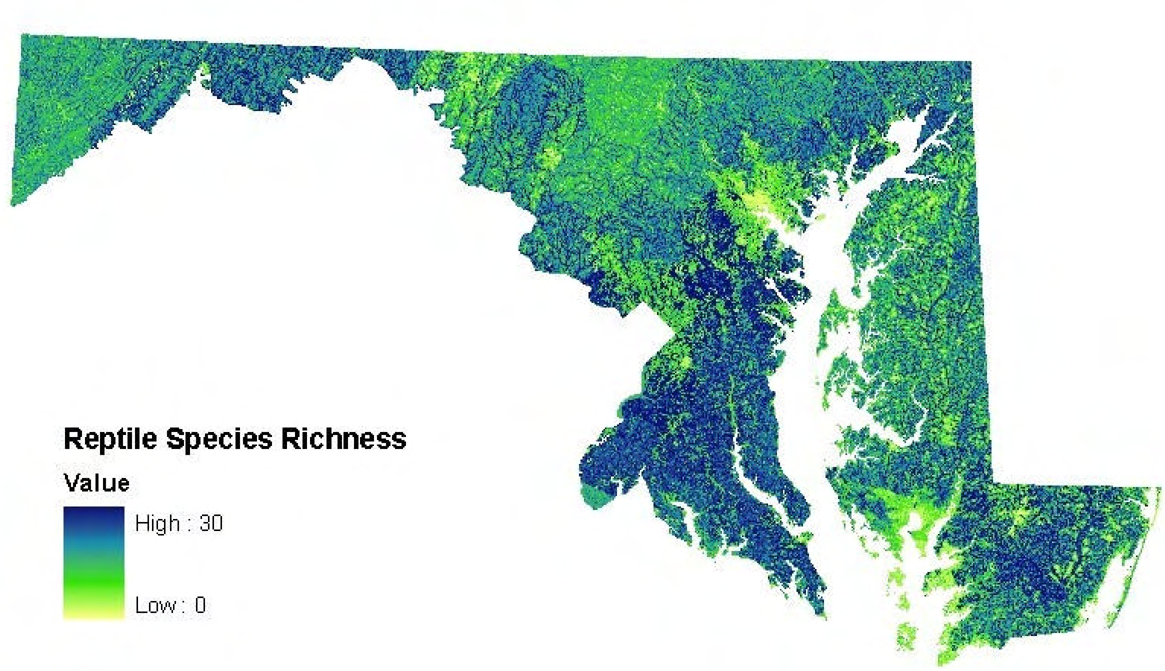
Native reptiles in Maryland include 18 turtles, 7 lizards, and 24 snakes. Maryland's 18 turtles range from the highly aquatic eastern spiny softshell to the terrestrial eastern box turtle to the 5 seaturtles that visit Maryland's ocean waters, the Chesapeake Bay and its estuaries during the warmer months. The marine turtles are large to massive, have their forefeet modified as flippers, and have specialized salt glands to maintain proper water balance while living in the marine environment. Seaturtle strandings are documented for Maryland's coastline and in the Chesapeake Bay. The MD DNR's Fisheries Service manages two turtle species commonly found in the Chesapeake Bay watershed – the northern diamond-backed terrapin and the snapping turtle – as commercial species with regulations controlling harvest methods and seasons. The northern diamond-backed terrapin is the only truly estuarine reptile in Maryland. Although most other turtles can tolerate some salt water, the eastern snapping turtle lives in brackish water more than the other turtles on Assateague Island

(Mitchell and Anderson 1994). The spotted turtle and especially the bog turtle inhabit freshwater wetlands; most of the other species are stream and pond inhabitants.

Maryland's seven lizards are small, four-legged, slender, and long-tailed. The common five-lined skink and the fence lizard are widespread and by inference tolerate a wide range of habitats. Others, such as the northern coal skink is found in montane western Maryland, whereas the broad-headed skink probably is restricted to the eastern half of the state. Only the fence lizard was found on Assateague Island (Mitchell and Anderson 1994).

The 24 snakes in Maryland range from the tiny, earthworm-like eastern wormsnake to the thick-bodied, heavy, and venomous timber rattlesnake. About half of Maryland snakes lay eggs and the rest are live-bearers, females retaining eggs during development. Maryland's snakes are carnivorous, eating a range of foods from invertebrates to small mammals. Most are terrestrial or even arboreal, and a few, such as the watersnakes are semiaquatic.

Figure 3.4 Distribution of Maryland's Reptiles (Source: McCorkle, Gorham and Rasberry 2005)



GCN Reptiles and Amphibians of Maryland

Forty-two species of amphibians and reptiles have been identified by the WDCP process as species of greatest conservation need in Maryland (Table 3.6). Of these, 17 are amphibians and 25 are reptiles. Of these, 9 amphibians and 11 reptiles are state-listed, including 6 amphibians and 10 reptiles listed as threatened or endangered; 1 amphibian and 10 reptiles are of national or international concern; and 9 amphibians and 13 reptiles are of conservation concern in the Northeastern U.S. region. An additional 4 amphibians and 3 reptiles are included due to concerns of declining populations or for other reasons. For additional regional, national, and international ranks see Appendix 3a and 3b.

Six reptiles are listed as federally-endangered or threatened species. The loggerhead and green seaturtles are listed as threatened, and Kemp's Ridley, hawksbill, and leatherback seaturtles are listed as endangered. To improve the population status regionally, the USFWS, NMFS, and other partners coordinate the actions identified by the Federal Recovery Plans for these species (NMFS and USFWS 1991a, 1991b, 1992a, 1992b; 1993). There is also a state-specific plan to conserve these seaturtles along with other marine animals in Maryland (Litwiler 2001). The bog turtle is also federally listed and its recovery plan (USFWS 2001) is being implemented in Maryland. These plans contain detailed status and distribution information as well as prioritized conservation actions, based on surveys and other research results.

Almost all of the GCN amphibians include species that rely on freshwater streams, vernal pools, or ponds for all or some of their life stages. Threats such as pollution, acid mine drainage, and sedimentation due to erosion and run-off from impervious surfaces can seriously impact populations of these species by making water conditions unsuitable. Watershed deforestation impacts include changes in water temperature, sedimentation, and a decrease in organic inputs that maintain a food base. These threats are especially of concern in western Maryland, where 8 of the 10 extant GCN salamander species are found. In addition, Wehrle's and green salamanders rely on moist rock crevices and are especially vulnerable to the destruction of rock outcrops and the removal of forest canopy that alters substrate moisture. Forest reptiles, including mountain earth snake, broad-headed skink, and eastern box turtle are also threatened by deforestation and fragmentation due to timber harvests, habitat conversion and road building. In some areas of the state, hydrological changes and groundwater withdrawal threaten the continued presence of critical water bodies for aquatic species. The loss of beaver impoundments, overgrazing, and ditching and draining of marshes and wetlands have further impacted populations of some amphibians and reptiles through the loss of habitat, including the federally-listed bog turtle. Aquatic snakes, such queen, rainbow, and red-bellied water snake, turtles that rely on riverine and pool habitats such as wood, eastern spiny softshell, and map face threats similar to GCN amphibians. In the marine environment, seaturtles are subject to boat collisions and ingestion of trash. Northern diamond-backed terrapin is also threatened as a non-target capture in commercial and recreational crab traps. In addition, shoreline development and structural stabilization threatens nesting areas for the terrapin.

The use of different habitats at different times of year for breeding, overwintering, and developing into adult stages further increases the vulnerability of GCN amphibians and reptiles to landscape-level fragmentation and the loss of travel corridors. Movements between these habitats also result in road mortalities for frogs, toads, turtles, snakes, and skinks. Unlike most other GCN species, some reptiles and amphibians are increasingly threatened by illegal collection. Snakes in general and venomous snakes in particular are harassed and often killed when perceived to be a threat. The hibernacula of timber rattlesnakes are particularly vulnerable to harassment, destruction, and illegal collecting activities.

Conservation Actions and Information Needs for GCN Reptiles and Amphibians

In order to better conserve GCN reptiles and amphibians, seasonal movements and needs of different life stages should be investigated for a number of species. Understanding the impacts of roads, development, and forest harvest practices on GCN species would also assist in their conservation. Direct inputs of contaminants to aquatic environments can be reduced through improved stormwater management practices, minimizing and mitigating acid mine drainage, controlling illegal dumping and wastewater inputs, minimizing the use of pesticides, and establishing adequate buffers of upland habitat. State and local wetland laws should be appended as needed to protect critical habitats for GCN amphibians, turtles, and snakes. Compatible management of the landscape in order to conserve aquatic habitats needs to include reduction of impervious surfaces, groundwater withdrawal, stream bank erosion, and watershed deforestation through better design and placement of developments, and improved timber harvest and agricultural practices. Restoration of key wetland habitats, such as beaver impoundments, and plugging ditches can help to address wetland losses. Road mortality may be minimized or mitigated through road design and placement. For marine and estuarine turtles, collision injuries and impacts related to commercial harvest activities may be reduced by working with the fishing industry, recreational boaters, and crab harvesters. Enforcement of existing state regulations on possession and trade of amphibians and reptiles, and revision of those regulations for further protection, are critical. In addition, education and outreach are needed to reduce illegal collecting and killing of reptiles and amphibians. Other inventory and research needs, and actions for conservation are included in seaturtle recovery plans, the bog turtle recovery plan, and the regional plan for northern diamond-backed terrapin.

Table 3.6 GCN Amphibians and Reptiles of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Amphibians					
Allegheny Mountain dusky salamander	*Desmognathus ochrophaeus*			S5	G5
Barking treefrog	*Hyla gratiosa*	E		S1	G5
Carpenter frog	*Rana virgatipes*	I		S2	G5
Eastern narrow-mouthed toad	*Gastrophryne carolinensis*	E		S1S2	G5
Eastern spadefoot	*Scaphiopus holbrookii*			S4	G5
Eastern tiger salamander	*Ambystoma tigrinum*	E		S2	G5
Green salamander	*Aneides aeneus*	E		S2	G3G4
Hellbender	*Cryptobranchus alleganiensis*	E		S1	G3G4
Jefferson salamander	*Ambystoma jeffersonianum*			S3	G4

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Long-tailed salamander	*Eurycea longicauda*			S5	G5
Mountain chorus frog	*Pseudacris brachyphona*	T		S2	G5
Mud salamander	*Pseudotriton montanus*			S2?	G5
Mudpuppy	*Necturus maculosus*	X		S1	G5
New jersey chorus frog	*Pseudacris triseriata kalmi*			S4	G5T4
Red salamander	*Pseudotriton ruber*			S5	G5
Seal salamander	*Desmognathus monticola*			S5	G5
Wehrle's salamander	*Plethodon wehrlei*	I		S2	G5
Reptiles					
Atlantic hawksbill seaturtle	*Eretmochelys imbricata*	E	E	SRN	G3
Bog turtle	*Clemmys muhlenbergii*	T	T	S2	G3
Broad-headed skink	*Eumeces laticeps*			S4	G5
Cornsnake	*Elaphe guttata*			S4	G5
Eastern box turtle	*Terrapene carolina*			S5	G5
Eastern hog-nosed snake	*Heterodon platirhinos*			S5	G5
Eastern ribbonsnake	*Thamnophis sauritus*			S5	G5
Eastern spiny softshell	*Apalone spinifera*	I		S1	G5
Green seaturtle	*Chelonia mydas*	T	T	S1N	G3
Kemp's ridley seaturtle	*Lepidochelys kempii*	E	E	S1N	G1
Leatherback seaturtle	*Dermochelys coriacea*	E	E	S1	G2
Loggerhead seaturtle	*Caretta caretta*	T	T	S1B,S1N	G3
Mountain earthsnake	*Virginia valeriae pulchra*	E		S2	G5T3T4
Northern coal skink	*Eumeces anthracinus*	E		SU	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Northern diamond-backed terrapin	*Malaclemys terrapin terrapin*			S4	G4T4
Northern map turtle	*Graptemys geographica*	E*		S1	G5
Northern pinesnake	*Pituophis melanoleucus*			SH	G4
Northern red-bellied cooter	*Pseudemys rubriventris*			S5	G5
Northern scarletsnake	*Cemophora coccinea*			S3	G5
Queen snake	*Regina septemvittata*			S5	G5
Rainbow snake	*Farancia erytrogramma*	E		S1	G5
Red-bellied watersnake	*Nerodia erythrogaster erythrogaster*			S2S3	G5T5
Spotted turtle	*Clemmys guttata*			S5	G5
Timber rattlesnake	*Crotalus horridus*			S3	G4
Wood turtle	*Glyptemys insculpta*			S4	G4

Fishes of Maryland

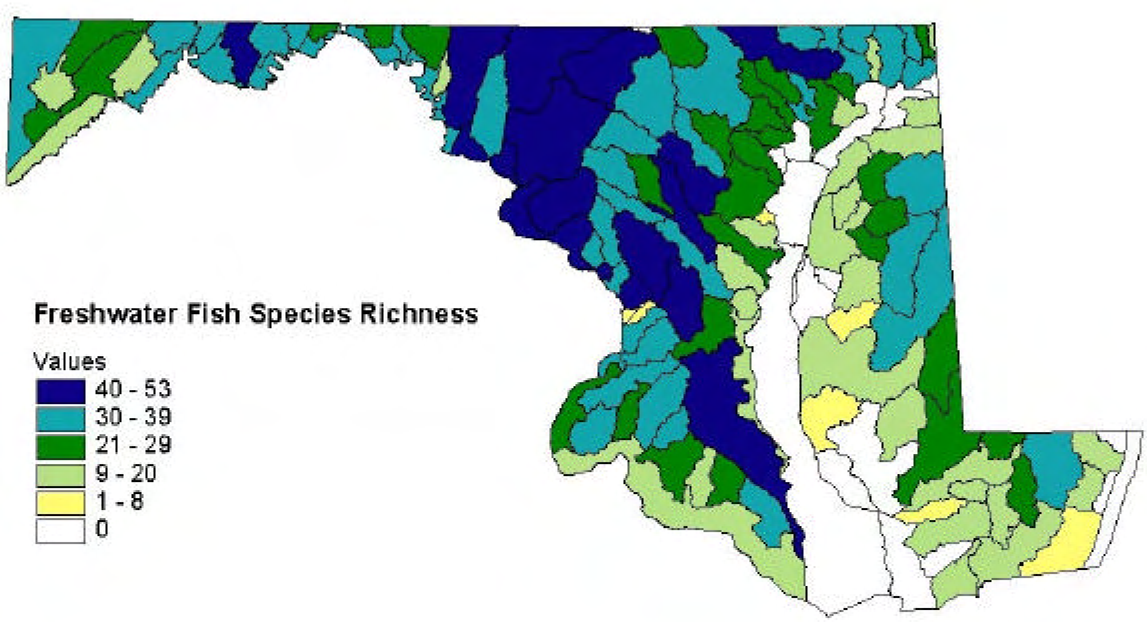
The Chesapeake Bay, Coastal Bays, Atlantic Ocean, and Maryland's rivers, streams, lakes, and ponds are home to many types of freshwater and saltwater fish. Some of the state's fish species are freshwater residents, such as brook trout and mud sunfish. Some fish are residents of the estuaries, including hogchoker and northern pipefish. Scup and bluefin tuna are among the fish species that live in marine waters, and several species of shark are highly migratory, traveling long distances. Anadromous fish species that utilize Maryland's freshwater rivers for spawning include striped bass, shad, and herring. Some species (e.g. red drum, tautog, Atlantic croaker) spawn in marine waters but rely upon estuaries for juvenile development, while still other marine species spawn in estuaries (e.g. weakfish) or use them as foraging habitat (e.g. black drum).

Maryland has a number of game fish. For example, trout are found in the streams of the mountains to the Piedmont, striped bass occur in the Chesapeake Bay, and marlin and tuna inhabit the open waters of the Atlantic. Numerous species have been stocked in Maryland's streams over the past 125 years, including largemouth bass, trout and carp (Boward et al. 1999). MD DNR Fisheries Service currently stocks a number of ponds, lakes and streams with warm-water and cold-water species every year; in the spring of 2005, a total of 426,650 trout were released. The Fishery Management Plan (FMP) Workgroup of the CBP has developed fish management plans guiding conservation of the major fish species in the Chesapeake Bay, including Atlantic croaker and spot (CBP 1991a), king mackerel and Spanish mackerel (CBP 1994a), red drum (CBP 1993a), black drum (CBP 1993b), shad and herring (CBP 1989a), striped bass (CBP 1989b), summer flounder (CBP 1991b) and tautog (CBP 1998a). The CBP is also working on four ecosystem based FMPs. The ecosystem plans will consider multi-species interactions and habitat considerations The Atlantic States Marine Fisheries Council (ASMFC), Mid-Atlantic Fishery Management Council (MAFMC) and NMFS have also developed FMPs for numerous fish species that are found in the state's Atlantic waters. Both organizations are promoting habitat management and protection in their plans (Appendix 1a)

Freshwater Fishes

MD DNR MBSS collected 85 fish species representing 72% of the total number of freshwater fish species occurring in the state of Maryland from 1995-1997 (Boward et al. 1999, Roth et al. 1999). The survey sampled 17 different basins, and only three species of freshwater fish were found to occur in all basins, namely the bluegill, largemouth bass, and pumpkinseed. The most common fish in Maryland's streams include the blacknose dace, eastern mudminnow, creek chub, blue ridge sculpin, mottled sculpin, and tessellated darter. The MBSS maintains the best available scientific information regarding population status, abundance, and distribution of freshwater fishes in the state.

Figure 3.5 Distribution of Maryland's Freshwater Fishes by watershed (Source: MD DNR MBSS)



In order to maintain recreational fisheries, many non-native fish were introduced to Maryland dating as far back as 1870 (Boward et al. 1999). At least 20-25 introduced fish inhabit Maryland's waters, and some have acclimated very well, like the popular largemouth bass and the not-so-popular common carp. MD DNR has recently expended much effort to irradicate several populations of the northern snakehead, an illegally introduced predatory fish from Asia, before it becomes established.

Marine and Estuarine Fishes

Maryland's marine and estuarine waters host a diverse array of fish, with the Chesapeake Bay hosting 350 fish species, the Coastal Bays more than 140 fish species of finfish, and the Atlantic Ocean being home to hundreds more (MD DNR 2004c, Pyzik et al. 2004). The 2001 commercial landings of finfish and shellfish from Chesapeake Bay were worth $175 million (Pyzik et al. 2004). More than one million anglers are estimated to travel to Chesapeake Bay each year for sportfishing. The Maryland Sportfishing Tournament, sponsored by MD DNR, was recently established to recognize anglers and promote recreational fishing opportunities in the state. A number of Maryland's marine and estuarine fish species have been overfished or show serious population declines, leading to the adoption of fishery management plans to conserve many individual species.

The marine species are all commercially valuable species and although many have existing Fishery Management Plans to guide their conservation (e.g., striped bass, spiny dogfish, monkfish, scup), harvest pressure coupled with impaired habitat has resulted in population declines and many questions on the status of forage species, trophic interactions and the loss of critical spawning and nursery habitat remain unanswered. Sharks, marlin and tuna are highly migratory species that move over large areas of the ocean and are not permanent residents of the state's marine waters. As a result, their management requires regional, national and sometimes international partnerships. The NMFS monitors the status of highly migratory species and has developed a fishery management plan (NMFS 2003) outlining conservation efforts for sharks, tuna and swordfish.

GCN Fishes of Maryland

Forty species of fish have been identified by the WDCP process as in greatest conservation need in Maryland (Table 3.7). Of these, 21 species are state-listed, 13 of which are listed as threatened or endangered, 3 are of national or international concern, 6 are of conservation concern in the Northeastern U.S. region, and an additional 17 species are included due to concerns about declining populations or for other reasons. For additional regional, national, and international ranks see Appendix 3a and 3b.

Two fish federally-listed as endangered occur in the state of Maryland, one freshwater and one estuarine species. The endangered freshwater fish is the Maryland darter. This fish is Maryland's only endemic vertebrate. Because recent biological surveys have not recorded a specimen of this species, it may already be extinct (Boward et al. 1999). The Maryland darter is subject to the same stressors as other freshwater fish, however due to its restricted distribution, its chances of survival are much reduced. The existing management plan presents detailed status and distribution information, as well as information on the threats and the actions to abate these threats (USFWS 1985). The endangered shortnose sturgeon is an anadromous species and ranges along the Atlantic coast. One of this species' 19 population segments in North America occurs in the Chesapeake Bay. Human impacts, such as bridge construction and demolition, can have adverse effects on swimbladder fish such as the shortnose sturgeon (Litwiler 2001). Other human impacts and biological factors that cause population decline in shortnose sturgeons and conservation actions to protect the species are presented in MD DNR's conservation plan.

Brook trout and American eel are two freshwater species that have suffered drastic population declines in the state of Maryland. Once found in the millions, the population of brook trout has decreased to 300,000. The most important limiting factor to these fish is water temperature. Brook trout thrive in cool water, and their population decline is attributed to hot water runoff from roofs and roadsides, loss of trees along streams, and global warming. A brook trout management plan is being developed by MD DNR's Fisheries Service. The population of American eel has declined nearly 90%. Dams and other man-made barriers and dams have limited the eel's access to their historical spawning and nursery habitat and have caused an alarming decline in Maryland's eel population (Boward et al. 1999).

The dependence of GCN fish species on aquatic environments makes them vulnerable to negative inputs to streams, rivers, and estuaries. For example, run-off from roads, impervious surfaces, and agricultural and suburban areas can directly contaminate habitats for GCN species through inputs of road salt, oil, pesticides, herbicides, nutrients, and excessive sediments. In addition to direct impacts and those from immediately adjacent areas, the alteration of the landscape of the watershed is another important source of negative impacts. All moving water bodies are influenced by upstream inputs, and accumulations of toxins, sediments, and nutrients can be particularly acute in large rivers and estuaries. Any changes in pH, temperature, and turbidity from sources such as acid mine drainage, livestock grazing, recreational use, and urbanization can make habitats unsuitable for GCN fishes. Some GCN species, such as pearl dace and checkered sculpin, are particularly sensitive to temperature changes that occur when forest cover is removed, while others, such as glassy darter and ironcolor shiner, are excluded from areas when development increases siltation. Removal of trees from the watershed in general and especially from riparian areas can impact stream temperature, increase sediment inputs, decrease instream woody debris and leaf litter, and alter tree root cover.

Groundwater withdrawals are an increasing threat to water levels in stream and river habitats in areas with high rates of development, and water withdrawal for irrigation is a threat in some areas of the state. Dams and other barriers to fish passage, such as road culverts, isolate populations and disrupt the connectivity that some species, such as American shad, require to remain a viable part of Maryland's fauna. Substrate and flow alterations, accompanied by the loss of prey and aquatic vegetation cover, through ditching and channelization threatens GCN species like mud sunfish. Pesticide applications, such as for mosquito control, can affect the aquatic prey species of many GCN fishes. Overharvest has particularly affected sturgeon and shad. Competition with species introduced for sport, mosquito control, or other means (e.g., bait bucket introductions, released pets) is an increasing concern.

Conservation Actions and Information Needs for GCN Fishes

For the effective conservation of GCN fishes, threats to aquatic habitats must be addressed at both local and landscape scales, from headwaters to large rivers and the Chesapeake Bay. Minimizing or eliminating stressors that affect key components of streams, rivers, and estuaries can come about through better stormwater management and reduction of impervious surfaces; reduction of acid mine drainage; upgrading wastewater treatment facilities; improved agricultural and forestry practices; reduction of pesticide use; and maintaining and improving riparian buffers. Careful planning to limit the location and extent of deforestation, urbanization, and nutrient inputs is needed to conserve functioning watersheds. Groundwater withdrawal should be limited and flows re-established through the restoration of natural processes. Maps of groundwater and hydrological systems could assist with determining potential impacts and planning restoration activities. Dams should continue to be removed wherever possible, stream blockages (including dams) should be improved, and work with highway departments should be increased to minimize the use of road culverts and encourage designs that reduce stream alterations and blockages.

More information on the seasonal movements and spatial requirements of GCN species, including anadromous fish, is needed to determine habitat requirements. Recreational management plans are important tools for conservation for some species, such as the brook trout management plan. Regulatory controls are needed to limit the establishment of non-natives and minimize their impact. Research on the impacts of competition between native and non-native species is also needed. Continued regulation is critical for the recovery of GCN shad and sturgeon populations. Reintroduction after habitat restoration has the potential to increase populations of some GCN species.

To restore Atlantic sturgeon, American shad, and hickory shad in the Chesapeake Bay, the MD DNR's Fisheries Service uses a combination of closed fishery, removal of barriers to spawning grounds, water quality improvements, and hatchery-produced fish. Information regarding threats and conservation actions for these fish can be found in the Fishery Management Plan for Atlantic Sturgeon by the Atlantic States Marine Fisheries Commission (ASMFC 1996), and the 1985 Interstate Fishery Management Plan for American Shad and River Herring (ASMFC 1985, 1999). In 1989, a Chesapeake Bay Alosid Fishery Management Plan (FMP) was developed for American shad, hickory shad, alewife and blueback herring (CBP 1989a). The FMP defined problems associated with declining abundance, habitat loss and degradation, the potential for overfishing, and research and monitoring efforts.

Table 3.7 GCN Fishes of Maryland

Common Name	**Scientific Name**	**State-listed**	**Federally-listed**	**S – Rank**	**G - Rank**
American brook lamprey	*Lampetra appendix*	T		S1S2	G4
American shad	*Alosa sapidissima*	I		S3	G5
Atlantic sturgeon	*Acipenser oxyrinchus*		C	S1	G3
Banded sunfish	*Enneacanthus obesus*			S2	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Blackbanded sunfish	*Enneacanthus chaetodon*	T		S1	G4
Bluespotted sunfish	*Enneacanthus gloriosus*			S3S4	G5
Bowfin	*Amia calva*			S1?	G5
Bridle shiner	*Notropis bifrenatus*	E		SH	G5
Brook trout	*Salvelinus fontinalis*			S3S4	G5
Cheat minnow	*Pararhinichthys bowersi*	X		SX	G1G2Q
Checkered sculpin	*Cottus sp 7*			S1S2	G4Q
Comely shiner	*Notropis amoenus*	T		S2	G5
Flier	*Centrarchus macropterus*	T		S1S2	G5
Glassy darter	*Etheostoma vitreum*	T		S1S2	G4G5
Greenside darter	*Etheostoma blennioides*			S5	G5
Hickory shad	*Alosa mediocris*	I		S3	G5
Ironcolor shiner	*Notropis chalybaeus*	E		S1	G4
Johnny darter	*Etheostoma nigrum*			S3	G5
Least brook lamprey	*Lampetra aepyptera*			S4	G5
Logperch	*Percina caprodes*	T		S1S2	G5
Longnose gar	*Lepisosteus osseus*			S2?	G5
Longnose sucker	*Catostomus catostomus*	X		SH	G5
Maryland darter	*Etheostoma sellare*	E	E	SH	GH
Mottled sculpin	*Cottus bairdi*			S3S4	G5
Mud sunfish	*Acantharchus pomotis*	I		S2	G5
Northern hogsucker	*Hypentelium nigricans*			S5	G5
Pearl dace	*Margariscus margarita*	T		S1S2	G5
Redside dace	*Clinostomus elongatus*			SX	G4
Rosyside dace	*Clinostomus funduloides*			S5	G5
Shield darter	*Percina peltata*			S3	G5
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	S1	G3
Silverjaw minnow	*Ericymba buccata*			S4	G5
Spotfin killifish	*Fundulus luciae*			S2?	G4
Stonecat	*Noturus flavus*	E		S1	G5
Stripeback darter	*Percina notogramma*	E		S1	G4

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Striped shiner	*Luxilus chrysocephalus*	I		S1S2	G5
Swamp darter	*Etheostoma fusiforme*	I		S2	G5
Trout-perch	*Percopsis omiscomaycus*	X		SX	G5
Warmouth	*Lepomis gulosus*			S3?	G5
White catfish	*Ameiurus catus*			SU	G5

Invertebrates of Maryland

As a taxa group, Maryland's invertebrates are not as well studied as are the vertebrates. This is true at the regional and national scales as well, due to the vast number of species and the complexities of the ecological communities of which they are an integral part. The status of some species, however, is known well enough for them to be recognized as in need of further study (the vast majority of them) or to be listed as endangered, threatened, or in need of conservation.

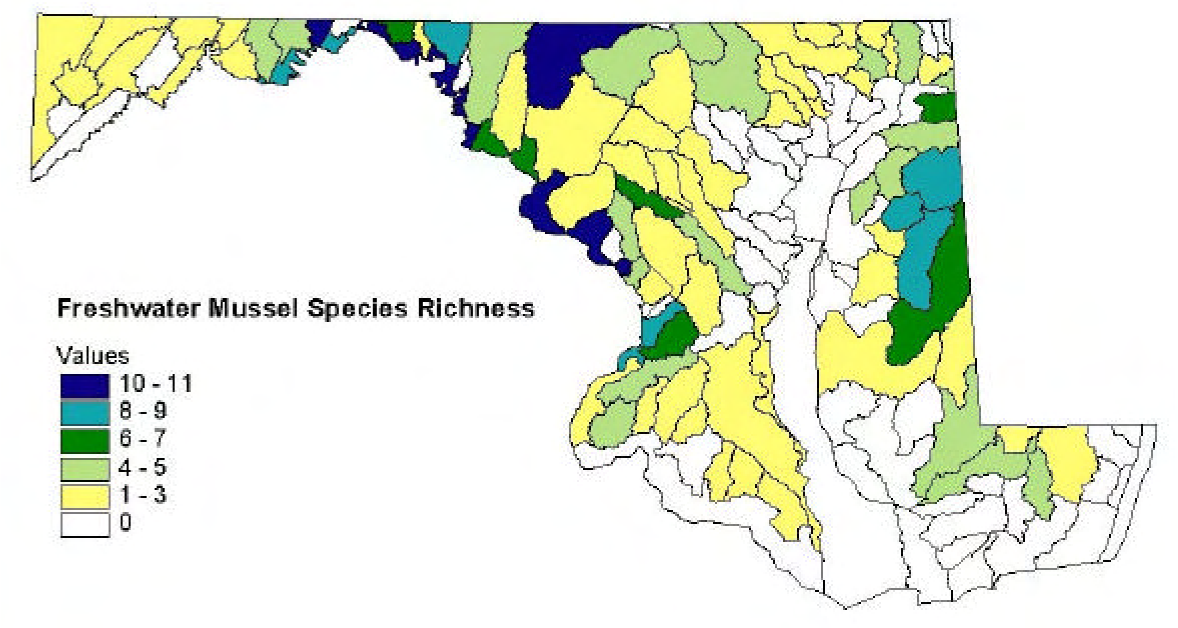
Because Maryland has marine, estuarine, freshwater and terrestrial environments, the invertebrate fauna of Maryland are diverse and include thousands of species ranging from dragonflies and damselflies, butterflies and moths, to freshwater mussels and benthic marine invertebrates.

Invertebrates in Maryland represent many taxonomic groups, including planarians, sponges, worms, mollusks, and arthropods (e.g., crustaceans, insects, arachnids). Several species are of high economic importance, either as commercially valuable species or as pest species. Commercially important species include the blue crab, several clam species and American oyster, which are collaboratively managed by MD DNR's Fisheries Service to strive for healthy, sustainable populations. The state's populations of horseshoe crab, blue crab and oysters have existing fishery management plans (CBP 1994c 1998b, 2004b). Oyster populations are only a small fraction of their historical abundance and the introduction of the Asian oyster is now being debated to restore an oyster population into the Chesapeake Bay. Blue crabs have the highest monetary value of any commercial fishery in the Chesapeake Bay, with average commercial landings of 86 million pounds a year and recreational landings of 22 million pounds in 1988 and 41 million pounds in 1983 (CBP 1998b). Horseshoe crabs are also commercially valuable, with Maryland catches making up 23-78% of the northeast region's landings along the Atlantic coast since 1980 (CBP 1994c).

Other invertebrate species serve as biological indicators for environmental health. More than 350 types of benthic macroinvertebrates are found in Maryland streams, allowing MD DNR to utilize an Index of Biotic Integrity for benthic macroinvertebrate species (plus another for fish) to assess the health of stream communities (Boward et al. 1999). The number of pollution-sensitive benthic macroinvertebrate taxa is another measure that MD DNR uses to assess stream health. Several mayflies, stoneflies and caddisflies, collectively called EPT for their taxonomic orders (Ephemeroptera, Plecoptera, and Trichoptera), are monitored to indicate water quality and/or physical habitat degradation of Maryland's streams (Boward et al. 1999). The benthic communities of the Coastal Bays and their associated tidal streams similarly have served as biological indicators for the health of those estuaries (MD DNR 2004d).

Some insects are considered pests. The Maryland Department of Agriculture has control programs in place to address agricultural and forest pest species. The gypsy moth, southern pine beetle, emerald ash borer, Asian longhorned beetle and pine shoot beetle are all insect pest species that the Department of Agriculture monitors and tries to suppress. The Department also controls mosquitoes to prevent the spread of mosquito-borne disease in humans, pets and livestock.

Figure 3.6 Distribution of Maryland's Freshwater Mussels by watershed (Source: MD DNR NHP)



The paucity of invertebrate information is an important statement to the limitations of our knowledge and ability to fully or fairly represent them in the MD WDCP. Although the population status for several invertebrate taxa and for some rare species is known, little is known for the vast majority of invertebrates in Maryland. For this reason, this plan takes a coarse-filter approach to invertebrate conservation, using available distribution and health of natural vegetative communities and habitats as surrogates for species lacking status information. For example, many butterflies require one or a few species of food plants in order to complete their life cycles. To take a well-known example, the Monarch butterfly lays its eggs on milkweeds in the genus *Asclepias.* Preserve habitats with milkweeds and this part of the butterfly's life cycle will be secure. For many odonates (dragonflies and damselflies), part of their life cycle is completed in the clean waters of flowing streams. Maintaining clean and free-flowing waters will enhance odonate populations.

Nationally and regionally, many freshwater mussel species are in danger of extinction (Williams et. al. 1993). Six of Maryland's 16 native freshwater mussel species are state-listed due to their rarity. Additional surveys and long-term monitoring are needed to fully determine the distribution and abundance of these freshwater mussels; however, surveys to date have revealed the distribution shown in Figure 3.6. Baseline population status and life history information is needed to establish effective conservation actions. The status and conservation of the federally-endangered dwarf wedge mussel is covered by an existing recovery plan (USFWS 1993a).

There is a need to assess abundance and distribution of non-harvested benthic estuarine and marine macroinvertebrates. As with other invertebrate species discussed above, a coarse-filter habitat approach will be necessary to manage for these species until population information is gathered.

GCN Invertebrates of Maryland

MD DNR lists 245 species of invertebrates as in greatest conservation need in the state. This list (Table 3.8) includes 5 species of flatworm, 14 freshwater mussels, 9 land snails, 27 freshwater crustaceans, 1 marine arthropod, 3 spiders, and 186 species within several orders of insects: Collembola (1 species), Coleoptera (23), Diptera (1), Ephemeroptera (1), Homoptera (2), Lepidoptera (58), and Odonata (100). Most of these species are so poorly known that they cannot be classified as endangered or threatened, only in need of further study, but about 10 percent of the insects are studied well-enough to know they merit conservation status.

The GCN invertebrate list includes 61 state-listed species, of which 42 are listed as threatened or endangered; 27 are of national or international concern; and 5 are of conservation concern in the Northeastern U.S. region. Five species are federally-listed, including the endangered dwarf wedge mussel, American burying beetle, Mitchell's satyr (butterfly) and two threatened tiger beetles. For additional regional, national, and international ranks see Appendix 3a and 3b.

Even nationally, endangered species of invertebrates are disproportionately underrepresented in species conservation efforts. As a result, many scientists call for an ecosystem-level approach to provide conservation for endangered invertebrates, while collecting needed information about the diversity, abundance and distribution of these species. Eventually population data would allow species-based actions to be incorporated into management plans to protect specific endangered invertebrate species (Hoffman Black et al. 2001).

Maryland's GCN invertebrates include species that are impacted by a wide range of threats to a variety of terrestrial and aquatic microhabitats. Freshwater mussels, crustaceans, odonates, aquatic macroinvertebrates, and spring amphipods are especially sensitive to contamination of water sources through acid mine drainage; sedimentation and water chemistry alteration from development, agriculture, and forest cover removal; and non-target effects of pesticide use for mosquito control. In addition, the dependence of some GCN mussels on specific fish hosts to complete their life cycles multiplies the effect of threats to aquatic environments. Terrestrial insects, including moths, butterflies, and forest beetles, may be impacted by the incompatible or excessive use of insecticides to control pest species such as gypsy moths and crop pests. GCN tiger beetles' dependence on open, sandy areas makes them vulnerable to a disruption of natural processes, such as shoreline cliff erosion, and to disturbance by recreational uses, development, and the use of heavy equipment and site preparation for logging.

The cave and aquifer habitats of a number of GCN isopods and amphipods are affected by groundwater pollution and hydrologic disturbances that are usually associated with development. These and other cave organisms (spiders, springtails, and planaria) are also affected by direct disturbance from spelunkers. GCN land snails are affected by air pollution, acid rain, and habitat drying from forest removal and fragmentation. Vernal pools, the only habitat for several GCN beetles including the recently-described Seth forest water scavenger beetle, may be drained or degraded through development, timber harvest activities, and gypsy moth control. Other wetlands are important for GCN dragonflies, and the loss of beaver impoundments, overgrazing, and ditching and draining of marshes and wetlands for agriculture, mosquito control, and development impact these species. The dependence of GCN butterfly and moth larvae on specific host plants makes them vulnerable to plant loss through extensive deer browsing, displacement of native species by exotic invasives, and control of plant species and incompatible mowing regimes along roadsides and powerlines. Overcollection is a particular concern for some butterfly species and also horseshoe crab.

Conservation Actions and Information Needs for GCN Invertebrates

Of all the taxonomic groups that comprise Maryland's wildlife, the invertebrate group includes the most species for which basic biological information is needed. Information on host plant preferences and impacts of invasive plants on butterflies and moths, fish hosts for mussels, microhabitat preferences and tolerances, and the impacts of pest control on non-target species are especially needed to determine effective conservation actions. Survey techniques for deepwater mussels and lesser known groups, and even identification of GCN organisms can be a challenge. Recovery plans for several federally-listed species, such as dwarf wedge mussel (USFWS 1993a) and northeastern beach and puritan tiger beetles (USFWS 1993b, 1994), and a regional conservation strategy for horseshoe crab can assist in determining conservation actions for these species in Maryland.

Aquatic habitats for GCN invertebrates require protection through a reduction or mitigation of acid mine drainage, impervious surfaces, deforestation, and inputs of nutrients, pesticides, and herbicides near water bodies. Pest control strategies that are incompatible with GCN species should be avoided. Human disturbance of open sand habitats, vernal pools, and cave environments, as well as overcollection, can be limited by education and exclusion from sensitive areas. Restoration of open and early successional habitats and of natural processes, such as fire frequency and cliff erosion, is needed to maintain and recover GCN invertebrates that are limited to such habitats. Degradation of forested habitats can be minimized by limiting forest fragmentation, buffering vernal pools, controlling deer populations and invasive plants, and maintaining critical microhabitats. State and local wetland laws should be appended as needed for greater protection, and the restoration of wetland habitats through beaver impoundments and plugging ditches can help to address wetland losses.

Table 3.8 GCN Invertebrates of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Planaria					
A planarian	*Phagocata virilis*			S1	G?
A planarian	*Planaria dactyligera*			S2	G?
A planarian	*Procotyla typhlops*	E		S1	G1G2
A planarian	*Sphalloplana sp 1*			S1S2	G?
Hoffmaster's cave planarian	*Sphalloplana hoffmasteri*	E		S1	G2G3
Molluscs					
Alewife floater	*Anodonta implicata*			S3	G5
Angular disc	*Discus catskillensis*			S1	G3G5
Appalachian spring snail	*Fontigens bottimeri*			S2	G2
Atlantic spike	*Elliptio producta*			S2S3	G4Q
Bear creek slitmouth	*Stenotrema simile*			SU	G?
Blue ridge spring snail	*Fontigens orolibas*	E		S1	G2G3
Brook floater	*Alasmidonta varicosa*	E		S1	G3
Cherrydrop snail	*Hendersonia occulta*	I		S2	G4
Creeper	*Strophitus undulatus*	I		S2	G5
Cylindrically-ornate wood snail	*Vertigo ventricosa*			SU	G3G4
Dwarf wedge mussel	*Alasmidonta heterodon*	E	E	S1	G1G2
Eastern lampmussel	*Lampsilis radiata*			SU	G5
Eastern pondmussel	*Ligumia nasuta*			SU	G4G5
Green floater	*Lasmigona subviridis*	E		S1	G3
Northern lance	*Elliptio fisheriana*			S3	G4
Paper pondshell	*Utterbackia imbecillis*			S3	G5
Rader's snail	*Glyphyalinia raderi*	X		SH	G2

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Spruce knob threetooth	*Triodopsis picea*			S1	G3
Striped whitelip	*Webbhelix multilineata*			S1	G?
Tidewater mucket	*Leptodea ochracea*			SU	G4
Triangle floater	*Alasmidonta undulata*	E		S1	G4
Yellow lampmussel	*Lampsilis cariosa*	X		S1	G3G4
Yellow lance	*Elliptio lanceolata*			SU	G2G3
Non-Insect Arthropods					
A crayfish	*Cambarus acuminatus*			S3	G4
A crayfish	*Orconectes obscurus*			S3	G5
A cyclopoid copepod	*Diacyclops palustris*			SU	G?
A harpacticoid copepod	*Attheyella spinipes*			SU	G?
Allegheny cave amphipod	*Stygobromus allegheniensis*	I		S2S3	G4
An amphipod	*Stygobromus sp 6*			S1	G?
An entocytherid ostracod	*Ankylocythere tridentata*			SU	G?
An entocytherid ostracod	*Dactylocythere scotos*			S1	G?
An isopod	*Caecidotea sp 1*			S1	G1
An isopod	*Caecidotea sp 2*			S1	G?
An isopod	*Caecidotea sp 3*			S1	G3
An isopod	*Caecidotea sp 4*			S1	G?
An isopod	*Caecidotea sp 5*			S1	G?
An isopod	*Caecidotea sp 6*			S2	G?
Appalachian cave spider	*Porhomma cavernicola*			S2	G4G5
Barrelville amphipod	*Stygobromus sp 5*			S1	G?
Biggers' cave amphipod	*Stygobromus biggersi*	E		S1	G2G4
Dearolf's cave amphipod	*Crangonyx dearolfi*	E		S1	G2G3
Franz's cave amphipod	*Stygobromus franzi*	I		S2S3	G2G3

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Franz's cave isopod	*Caecidotea franzi*	E		S1	G2G3
Greenbrier cave amphipod	*Stygobromus emarginatus*	E		S1	G3
Horseshoe crab	*Limulus polyphemus*			S?	G?
Pizzini's amphipod	*Stygobromus pizzinii*			S1	G2G4
Potomac amphipod	*Stygobromus tenuis potomacus*			S3	G4T3T4Q
Price's cave isopod	*Caecidotea pricei*			S3	G3G4
Red-legged purse-web spider	*Sphodros rufipes*			S1S2	G4
Roundtop amphipod	*Stygobromus sp 14*			S1	G?
Shenandoah cave amphipod	*Stygobromus gracilipes*	E		S1	G2G4
Snivelys cave spider	*Oreonetides sp 1*			SU	G?
Tenuis amphipod	*Stygobromus tenuis tenuis*			SU	G4G5T2T3Q
Tidewater amphipod	*Stygobromus indentatus*			S1	G3
Insects - Beetles					
A cave beetle	*Pseudanophthalmus sp 15*			S1	G1
A coccinellid beetle	*Nephus gordoni*			SU	G?
A dytiscid beetle	*Hoperius planatus*			S2	G?
A hydrophilid beetle	*Hydrochara occultus*			SU	G?
A hydrophilid beetle	*Sperchopsis tessellates*			S2	G?
A lampyrid firefly	*Photuris bethaniensis*			SP	G1?
A tiger beetle	*Cicindela abdominalis*	E		S1	G5
A tiger beetle	*Cicindela ancocisconensis*	E		S1	G3
A tiger beetle	*Cicindela purpurea*			S3	G5
A tiger beetle	*Cicindela scutellaris*			S3	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
A tiger beetle	*Cicindela splendida*			S3	G5
A tiger beetle	*Cicindela unipunctata*			S3	G4
American burying beetle	*Nicrophorus americanus*	X	E	SX	G2G3
Big sand tiger beetle	*Cicindela formosa*			SU	G5
Giant stag beetle	*Lucanus elephas*			S1	G3G5
Green-patterned tiger beetle	*Cicindela patruela*	E		S1	G3
Little white tiger beetle	*Cicindela lepida*	E		S1	G4
Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	E	T	S1	G4T2
Puritan tiger beetle	*Cicindela puritana*	E	T	S1	G1G2
Schwarz' diving beetle	*Laccophilus schwarzi*			SX	G?
Seth forest water scavenger beetle	*Hydrochus spangleri*	E		S1	G1
Six-banded longhorn beetle	*Dryobius sexnotatus*	E		S1	G?
White tiger beetle	*Cicindela dorsalis media*	E		S1	G4T4
Insects – Butterflies and Moths					
A geometrid moth	*Cyclophora nanaria*			S1?	G5
A noctuid moth	*Apamea mixta*			S1	GU
A noctuid moth	*Hadena ectypa*			SU	G3G4
A noctuid moth	*Meropleon titan*			SU	G2G4
A noctuid moth	*Zale curema*			S1?	G3G4
American chestnut nepticulid moth	*Ectoedemia castaneae*			SH	GH
Appalachian blue	*Celastrina neglectamajor*			S3S4	G4
Atlantis fritillary	*Speyeria atlantis*	T		S1	G5
Baltimore checkerspot	*Euphydryas phaeton*			S3	G4
Bog copper	*Lycaena epixanthe*	E		S1	G4G5
Carolina satyr	*Hermeuptychia sosybius*			S1S3	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Chermock's mulberry wing	*Poanes massasoit chermocki*	E		S1	G4T1
Chestnut clearwing moth	*Synanthedon castaneae*			SX	G3G5
Cobweb skipper	*Hesperia metea*			S3	G4G5
Compton tortoiseshell	*Nymphalis vaualbum*	E		S1B	G5
Cypress sphinx moth	*Isoparce cupressi*			SU	G4
Dion skipper	*Euphyes dion*			S3	G4
Dotted skipper	*Hesperia attalus slossonae*			SH	G3G4T3
Dusky azure	*Celastrina ebenina*	E		SH	G4
Early hairstreak	*Erora laeta*	E		S1	G3G4
Edwards' hairstreak	*Satyrium edwardsii*	E		S1	G4
Frosted elfin	*Incisalia irus*	E		S1	G3
Giant swallowtail	*Papilio cresphontes*	I		S2	G5
Golden-banded skipper	*Autochton cellus*	X		SH	G4
Gray comma	*Polygonia progne*			S1S3	G5
Great purple hairstreak	*Atlides halesus*	T		S1S2	G5
Harris's checkerspot	*Chlosyne harrisii*	T		S2	G4
Hessel's hairstreak	*Mitoura hesseli*	X		SH	G3G4
Hickory hairstreak	*Satyrium caryaevorum*	E		S1	G4
Hoary elfin	*Callophrys polios*			S1	G5
Indian skipper	*Hesperia sassacus*			S3	G5
King's hairstreak	*Satyrium kingi*	E		S1	G3G4
Long dash	*Polites mystic*			S3	G5
Marbled underwing	*Catocala marmorata*			SH	G3G4
Mitchell's satyr	*Neonympha mitchellii*		E	SR	G1G2
Mottled duskywing	*Erynnis martialis*	E		S1	G3G4
Northern crescent	*Phyciodes cocyta*			SP	G5
Northern hairstreak	*Fixsenia ontario*	E		S1S2	G4T4
Northern metalmark	*Calephelis borealis*	T		S2	G3G4

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Olympia marble	*Euchloe olympia*	I		S2	G4G5
Palamedes swallowtail	*Papilio palamedes*	E		S1	G5
Pepper and salt skipper	*Amblyscirtes hegon*	I		S2	G5
Persius duskywing	*Erynnis persius persius*			SH	G5T2T3
Phleophagan chestnut nepticulid moth	*Ectoedemia phleophaga*			SH	GH
Pine barrens zanclognatha	*Zanclognatha martha*			S1S3	G4
Pink-edged sulphur	*Colias interior*			S1	G5
Precious underwing	*Catocala pretiosa pretiosa*			SH	G4T2T3
Rare skipper	*Problema bulenta*	T		S1	G2G3
Regal fritillary	*Speyeria idalia*	X		SH	G3
Seaside goldenrod stem borer	*Papaipema duovata*			SU	G4
Silver-bordered fritillary	*Boloria selene*			S3	G5
Silvery blue	*Glaucopsyche lygdamus*	I		S2	G5
Southern grizzled skipper	*Pyrgus wyandot*	E		S1	G2
Tawny crescent	*Phyciodes batesii batesii*	X		SH	G4T1
The buckmoth	*Hemileuca maia maia*			SU	G5T5
Three-horned moth	*Pachypolia atricornis*			SH	G3G4
Two-spotted skipper	*Euphyes bimacula*	E		S1	G4
West virginia white	*Pieris virginiensis*			S3	G3G4
Insects – Dragonflies and Damselflies					
A snaketail	*Ophiogomphus sp 1*			S1	G?
Allegheny river cruiser	*Macromia alleghaniensis*			S2	G4
Allegheny snaketail	*Ophiogomphus incurvatus*			S2	G3
Amber-winged spreadwing	*Lestes eurinus*			S3	G4

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
American emerald	*Cordulia shurtleffi*			S3	G5
Arrowhead spiketail	*Cordulegaster obliqua*			S2	G4
Atlantic bluet	*Enallagma doubledayi*			SH	G5
Attenuated bluet	*Enallagma daeckii*			S3	G4
Aurora damsel	*Chromagrion conditum*			S3S4	G5
Azure bluet	*Enallagma aspersum*			S3S4	G5
Band-winged meadowhawk	*Sympetrum semicinctum*			S3	G5
Bar-winged skimmer	*Libellula axilena*			S3	G5
Beaverpond baskettail	*Epitheca canis*			S3	G5
Big bluet	*Enallagma durum*			S3	G5
Black-tipped darner	*Aeshna tuberculifera*			S2	G4
Blackwater bluet	*Enallagma weewa*			S1	G5
Blue-faced meadowhawk	*Sympetrum ambiguum*			S3S4	G5
Brown spiketail	*Cordulegaster bilineata*			S2	G5
Burgundy bluet	*Enallagma dubium*			S1	G5
Canada darner	*Aeshna canadensis*			S2	G5
Chalk-fronted skimmer	*Libellula julia*			S2	G5
Cherry-faced meadowhawk	*Sympetrum internum*			S2	G5
Cobra clubtail	*Gomphus vastus*			S3	G5
Comet darner	*Anax longipes*			S3	G5
Common sanddragon	*Progomphus obscurus*			S3	G5
Crimson-ringed whiteface	*Leucorrhinia glacialis*			S1	G5
Cyrano darner	*Nasiaeschna pentacantha*			S3	G5
Delta-spotted spiketail	*Cordulegaster diastatops*			S3	G5
Dot-tailed whiteface	*Leucorrhinia intacta*			S3	G5

Common Name	**Scientific Name**	**State-listed**	**Federally-listed**	**S – Rank**	**G - Rank**
Eastern red damsel	*Amphiagrion saucium*			S3	G5
Eastern ringtail	*Erpetogomphus designatus*			S2	G5
Elfin skimmer	*Nannothemis bella*			S1	G4
Elusive clubtail	*Stylurus notatus*			SU	G3
Emerald spreadwing	*Lestes dryas*			SH	G5
Faded pennant	*Celithemis ornata*			S1	G5
Fine-lined emerald	*Somatochlora filosa*			S2	G5
Four-spotted pennant	*Brachymesia gravida*			S3S4	G5
Golden-winged skimmer	*Libellula auripennis*			S3	G5
Gray petaltail	*Tachopteryx thoreyi*			S2	G4
Great spreadwing	*Archilestes grandis*			S3	G5
Green-faced clubtail	*Gomphus viridifrons*			S1	G3
Green-striped darner	*Aeshna verticalis*			S2	G5
Hagen's bluet	*Enallagma hageni*			S3S4	G5
Harlequin darner	*Gomphaeschna furcillata*			S3	G5
Harpoon clubtail	*Gomphus descriptus*			S1	G4
Hudsonian whiteface	*Leucorrhinia hudsonica*			S1	G5
Lance-tipped darner	*Aeshna constricta*			SH	G5
Laura's clubtail	*Stylurus laurae*			S2	G4
Least clubtail	*Stylogomphus albistylus*			S3S4	G5
Little blue dragonlet	*Erythrodiplax minuscula*			S1	G5
Lyre-tipped spreadwing	*Lestes unguiculatus*			SH	G5
Mantled baskettail	*Epitheca semiaquea*			SH	G4
Marsh bluet	*Enallagma ebrium*			SH	G5
Martha's pennant	*Celithemis martha*			S2	G4
Midland clubtail	*Gomphus fraternus*			S2	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Mocha emerald	*Somatochlora linearis*			S3S4	G5
Northern pygmy clubtail	*Lanthus parvulus*			S1	G4
Ocellated darner	*Boyeria grafiana*			S1	G5
Pale bluet	*Enallagma pallidum*			SH	G4
Petite emerald	*Dorocordulia lepida*			SH	G5
Piedmont clubtail	*Gomphus parvidens*			SH	G4
Rainbow bluet	*Enallagma antennatum*			S1	G5
Rapids clubtail	*Gomphus quadricolor*			S1	G3G4
River jewelwing	*Calopteryx aequabilis*			S1	G5
Riverine clubtail	*Stylurus amnicola*			SH	G4
Robust baskettail	*Epitheca spinosa*			S1S2	G4
Royal river cruiser	*Macromia taeniolata*			S3	G5
Russet-tipped clubtail	*Stylurus plagiatus*			S3	G5
Rusty snaketail	*Ophiogomphus rupinsulensis*			S2	G5
Sable clubtail	*Gomphus rogersi*	E		S1	G4
Sedge sprite	*Nehalennia irene*			S3	G5
Seepage dancer	*Argia bipunctulata*			S3	G4
Selys' sunfly	*Helocordulia selysii*			S2	G4
Skillet clubtail	*Gomphus ventricosus*			SH	G3
Ski-tailed emerald	*Somatochlora elongata*			S1	G5
Slender bluet	*Enallagma traviatum*			S3	G5
Smoky rubyspot	*Hetaerina titia*			SH	G5
Southern pygmy clubtail	*Lanthus vernalis*			S1	G4
Southern sprite	*Nehalennia integricollis*			S1S2	G5
Sparkling jewelwing	*Calopteryx dimidiata*			SH	G5
Sphagnum sprite	*Nehalennia gracilis*			S2	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Spine-crowned clubtail	*Gomphus abbreviatus*			SH	G3G4
Splendid clubtail	*Gomphus lineatifrons*			SH	G4
Spotted spreadwing	*Lestes congener*			S3	G5
Spring blue darner	*Aeshna mutata*	E		S1	G3G4
Stripe-winged baskettail	*Epitheca costalis*			S1	G4
Stygian shadowdragon	*Neurocordulia yamaskanensis*			S2	G5
Superb jewelwing	*Calopteryx amata*			S2	G4
Sweetflag spreadwing	*Lestes forcipatus*			S3	G5
Taper-tailed darner	*Gomphaeschna antilope*			S2	G4
Tiger spiketail	*Cordulegaster erronea*			S2	G4
Treetop emerald	*Somatochlora provocans*			S1	G4
Tule bluet	*Enallagma carunculatum*			SH	G5
Turquoise bluet	*Enallagma divagans*			S3S4	G5
Uhler's sundragon	*Helocordulia uhleri*			S3	G5
Vesper bluet	*Enallagma vesperum*			S3	G5
White corporal	*Libellula exusta*			S1	G4
White-faced meadowhawk	*Sympetrum obtrusum*			S3	G5
Yellow-sided skimmer	*Libellula flavida*			S2	G5
Zebra clubtail	*Stylurus scudderi*			S1	G4
Insects – Other Orders					
A cicadellid leafhopper	*Chlorotettix sp 1*			SU	G?
Crabtree cave springtail	*Arrhopalites sp 1*			SU	G?
Eastern sedge barrens planthopper	*Limotettix minuendus*			S1	G1
Pitcher-plant mosquito	*Wyeomyia smithii*			S2	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Walker's tusked sprawler	*Potamanthus walkeri*			SU	G5

Using the best available and current information, this chapter summarized the full array of wildlife found in Maryland and identified GCN species in each taxonomic group (addressing **Element #1**). The next chapter will provide detailed information about the distribution and condition of the identified key wildlife habitats, the threats to them, and the required conservation actions and inventory, monitoring, and research needs to address each habitat and the GCN species that are found there.

Chapter 4: Key Wildlife Habitats and their Conservation

This chapter is the "meat" of the document and addresses aspects of **Elements #1, #2, #3**, and **#4**. This chapter is focused on Maryland's key wildlife habitats. The best available current information regarding the description, condition and distribution of key wildlife habitats (directly addressing **Element #2**) is provided and then linked with the associated GCN species found in that habitat (addressing **Element #1**). Threats that affect each of these habitats are listed (addressing **Element #3**) following each habitat description. There are many conservation actions (CA) that have been identified for each habitat, and the highest priority conservation actions are highlighted (addressing **Element #4**). Appendix 4 lists the compiled actions from existing national, international, regional, state, and local plans that were originally compiled and ranked by staff and stakeholders, followed then by several additional ranking iterations. It is important to recognize that conservation actions will be implemented depending on funding, resources, manpower, and partnerships, and thus this chapter only highlights those that are considered overall as the highest in importance. Appendix 1b links provides details of the information on threats that was used to assist in the development of conservation actions. Conservation actions are listed in sufficient detail to guide the development and execution of specific projects and programs to implement those actions; potential performance measures are presented immediately after each action. If available information is insufficient to describe needed conservation actions, the WDCP lists the identified inventory, monitoring, and research (IMR) needs for obtaining information to develop specific conservation actions.

The distribution and abundance of Maryland's wildlife species are directly related to the condition and location of their habitats. While some species can be found in a variety of habitats, many are less adaptive and are restricted to one or relatively few habitats. This is especially true for the rarest and most vulnerable wildlife species, including the GCN wildlife species identified for Maryland (Chapter 3). These specific habitats, themselves, often exhibit a restricted distribution in Maryland. This distribution is influenced by the diversity of Maryland's five major east-west physiographic provinces: Lower Coastal Plain, Upper Coastal Plain, Piedmont, Ridge and Valley, and Allegheny Plateau. Maryland's latitude also supports the overlap of ranges for typically northern or southern species. Aquatic habitats also exhibit a wide range, from saline Atlantic Ocean and coastal bays, to brackish Chesapeake Bay estuary, to fresh water streams, rivers and ponds. This adds to Maryland's wildlife and habitat diversity, but also influences the somewhat limited distribution of certain wildlife species and their habitats (Lawrence 1984, Lawrence and Gross 1984, Fergus 2003).

Habitats that support GCN species are broadly referred to here as "Key Wildlife Habitats". These key wildlife habitats can be further divided into finer scale vegetative associations. The restricted or vulnerable associations that support unique assemblages of plant and animal species are referred to as "Rare Natural Communities". MD DNR's NHP tracks rare natural communities, as it does the individual rare plant and animal species throughout the state. A rare natural community can be rare for a number of reasons. It might represent a habitat on the northern or southern extent of its range, or be declining or vulnerable due to anthropogenic threats or natural causes.

These rare natural communities can also represent coarse-filter surrogates or umbrellas for little known wildlife species. This is particularly true for the thousands of invertebrate species that are poorly understood and studied. Identification and protection of these rare natural communities within key wildlife habitats can be an effective, more holistic approach to conservation by saving all the pieces, as part of "intelligent tinkering" espoused by Aldo Leopold in *A Sand County Almanac* (Leopold 1949). Since then, a large body of literature has developed, supporting this coarse-filter, community approach that evolved into "systems ecology".

Identification of Key Wildlife Habitats

As with the process for identification of wildlife GCN species discussed in Chapter 3, Maryland's key wildlife habitats were identified though input, analysis, and review by MD DNR staff, scientific experts, and various stakeholders. For coarse-filter planning, information from the existing standardized ecoregion and vegetative classification systems was used, including the *Classification of the Vegetation Communities of Maryland: First Iteration – a subset of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States* (Harrison 2004). Harrison's work was collapsed into fewer categories and augmented by comparison with other classification systems, such as those found in *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et. al. 1979), *A Land Use and Land Cover Classification System for use with Remote Sensor Data* (Anderson, et. al. 1976) and *Field List of the Birds of Maryland* (Robbins and Bystrak 1977). This resulted in an initial list of habitats important to wildlife in Maryland. This list was then cross-walked with NatureServe's Terrestrial Ecological Systems (Appendix 2) as suggested by the IAFWA committee to ensure regional and national consistency. MD DNR staff, with assistance from scientific experts, associated each GCN species with the list of wildlife habitats. The resulting habitat and associated species spreadsheet was refined and any missing data was supplied based on best available current information. Stakeholder feedback from review of the identified key wildlife habitats and associated GCN species was also incorporated into the final working spreadsheet.

This process resulted in a list of 35 key wildlife habitat types for conservation purposes (Table 4.1). Each terrestrial key wildlife habitat usually contains more than one natural vegetative community that is similar in vegetative structure and characteristics in terms of wildlife habitat. However, some terrestrial habitats are essentially either unvegetated or rely on factors other than their sparse vegetation to define them (e.g., substrate) (Appendix 2).

Table 4.1 Maryland's 35 Key Wildlife Habitats

		PROVINCE OF OCCURRENCE				
#	**KEY WILDLIFE HABITAT**	**AP**	**RV**	**PD**	**UCP**	**LCP**
	TERRESTRIAL & WETLAND HABITATS					
1	Old Growth Forests	X	X	X	X	X

		PROVINCE OF OCCURRENCE				
#	**KEY WILDLIFE HABITAT**	**AP**	**RV**	**PD**	**UCP**	**LCP**
2	Early Successional Forests	X	X	X	X	X
3	Maritime Forests and Shrublands					X
4	Loblolly Pine - Oak Forests				X	X
5	Mesic Deciduous Forests	X	X	X	X	X
6	Dry Oak - Pine Forests	X	X	X	X	X
7	Northern Conifer - Hardwood Forests	X	X	X	X	X
8	Floodplain Forests	X	X	X	X	X
9	Upland Depressional Swamps	X	X	X	X	X
10	Carolina Bays					X
11	Vernal Pools	X	X	X	X	X
12	Forested Seepage Wetlands	X	X	X	X	X
13	Bog and Fen Wetland Complexes	X		X	X	X
14	Nontidal Shrub Wetlands	X	X	X	X	X
15	Tidal Shrub Wetlands				X	X
16	Nontidal Emergent Wetlands	X	X	X	X	X
17	Tidal Marshes				X	X
18	Grasslands	X	X	X	X	X
19	Barrens and Dry Glades	X	X	X		
20	Cliffs and Rock Outcrops	X	X	X	X	X
21	Caves, Mines, and Springs	X	X	X	X	X
22	Coastal Beaches, Dunes, and Mudflats				X	X
	STREAM & RIVER HABITATS					
23	Coldwater Streams	X	X	X		
24	Limestone Streams		X			
25	Highland Streams	X	X			
26	Piedmont Streams			X		
27	Coastal Plain Streams				X	X
28	Blackwater Streams				X	X
29	Highland Rivers	X	X			
30	Piedmont Rivers			X		
31	Coastal Plain Rivers				X	X
	ESTUARINE & MARINE HABITATS					
32	Oligohaline Estuaries (low salinity)				X	X
33	Mesohaline Estuaries (medium salinity)				X	X
34	Polyhaline Estuaries (higher salinity)				X	X
35	Ocean					X

Key: AP=Alleghany Plateau; RV=Ridge and Valley; PD=Piedmont; UCP= Upper Coastal Plain and LCP= Lower Coastal Plain

Once the list of key wildlife habitats was compiled, the need for a more comprehensive wildlife information system and, more specifically, for geographic information system (GIS) mapping data addressing the distribution of the key wildlife habitats was determined. The current scientific inventory and geo-spatial databases were not sufficient to produce accurate distribution and status maps for all of the GCN species, their associated key wildlife habitats, or vegetative associations identified during the WDCP process. Since coarse-level habitat information is critical as a surrogate for some of the GCN species lacking adequate distribution and abundance data, the field inventories and analysis required to produce these resources remain a priority.

The first iteration of the distribution maps of Maryland's key wildlife habitats are included in this chapter, within each habitat section, for all but one of the 35 habitats. Insufficient data exists on the distribution of Forested Seepage Wetlands to create a meaningful first iteration map. GIS data layers have been developed for the purpose of generating a graphical representation of the general distribution of these habitats. These maps were compiled using existing data sources, such as USFWS National Wetlands Inventory data (NWI); USGS Mid-Atlantic Gap Analysis Program vegetation data (MDN-GAP), National Elevation Dataset (NED), National Hydrography Dataset (NHD), and Geographic Names Information System (GNIS); USDA Soil Conservation Service generalized soils data (STATSGO); FEMA Q3 Floodplain data; MD Department of Planning's Land Use/Land Cover data; UMD Appalachian Environmental Lab (AEL) deep mines dataset; MD DNR MBSS/Versar Inc streams data (MBSS100k); and other MD DNR data provided by various sources, including Maryland Geological Survey (MGS), Resource Assessment Service (RAS) and NHP. The accuracy of these key wildlife habitat GIS data layers varies greatly, ranging from field-verified locations to predictive models, and many will need additional ground-truthing and other quality control measures and refinements before they should be considered accurate enough to use for most other purposes, especially at a local level.

However, these maps can be used as a tool to help direct distribution and abundance surveys of GCN species within these habitats and associated vegetative communities. The maps may also support the development of statewide strategies for specific key wildlife habitats on state and private lands designed to benefit all wildlife. Although the Biotics GIS system maintained by NHP contains location data for the rarest wildlife species in the state, predictive models of terrestrial vertebrate distribution developed in conjunction with the Mid-Atlantic Gap Analysis Program/USFWS/UMES provide the best overall distribution information for the remaining terrestrial vertebrate GCN species at this time (McCorkle, Gorham and Rasberry 2005). These data were used to compile the maps depicting the distribution of each major taxa group within Chapter 3. Further mapping of "ecological landscapes" and natural communities will identify and delineate land areas with similar topography, bedrock type, soils, surface hydrology, vegetation, and land use. This will allow improved analyses and prediction of the distribution of species and habitats of greatest conservation need within their ecological context and provide an important tool to assist in the conservation of unique habitats within the framework of natural biological systems.

Threats and Conservation Actions

Maryland's wildlife and key wildlife habitats face formidable threats including habitat loss, degradation, fragmentation, disturbances (both natural and anthropogenic), pollution, etc. There is clear consensus that the loss and degradation of viable wildlife habitat across the state from Maryland's human population increase and related development pressures remains the primary overarching threat to GCN species. A general discussion of threats is included in Chapter 1 and a summary of the overarching statewide threats to our wildlife and habitats is provided in Table 1.3. Threats and associated conservation actions that are best categorized as specific to certain wildlife taxa groups are included in Chapter 3. Those threats that pertain to the key wildlife habitats are listed in this chapter within each applicable key wildlife habitat section.

How Conservation Actions were Developed

Potential conservation actions were initially identified from a wide variety of existing plans and resources, including those of MD DNR and other agency and non-profit conservation groups relevant to wildlife and habitat conservation in Maryland at the state, regional, and national scales (Appendix 4a). Additional conservation actions were identified by staff during a review process to ensure that each threat had at least one related conservation action, as well as by various stakeholders during the WDCP input process to capitalize on the most current data and knowledge available.

To facilitate implementation of identified strategies and tasks, conservation actions are included at three levels: habitat-focused (affecting all species GCN within one or more key wildlife habitats), species-focused (addressing GCN species by taxonomic groups and provided in Chapter 3), and "other" (including policy-based actions and education/outreach). Each conservation action has specific detail to facilitate implementation. Potential key partners at the local, state, regional and national levels are also identified for conservation actions (Appendix 4b). Both staff and stakeholders were asked to provide input to determine the highest priority conservation actions, according to their effectiveness in addressing specific threats for the species and their habitats, and were given opportunity to provide input through a series of meetings, workshops, and review over the internet.

Statewide or Overarching Conservation Actions

Conservation actions are organized in several ways to best address the needs of Maryland's wildlife and its conservation. It is clear that conservation occurs at multiple scales, from the most specific population and local level to the more broad, statewide and overarching habitat and landscape scales. This chapter presents conservation actions across the spectrum of scales in order to capture the breadth of conservation needed in Maryland. First it presents the broadest, overarching, statewide actions, and then presents more specific habitat-focused actions for each of the key wildlife habitats.

During the process of identifying conservation actions for GCN species and key wildlife habitats, recurring patterns and issues crossed taxa and ecological boundaries. These critical "overarching" conservation actions were recognized to have broader impacts across taxa and habitats (see Table 4.2). This set of broad conservation actions best address the primary "overarching" threats previously identified in Chapter 1. Some of the identified strategies, such as comprehensive natural resource inventories and species/taxon surveys and life-history information collection by MD DNR staff, experts and partners, directly address the lack of a scientific knowledge base regarding habitat and associated wildlife species distribution, abundance, and condition. This new information is critical in determining limiting factors and habitat requirements to improve management for all GCN species across habitats. This information will also provide data for the identified need of GIS mapping and database management capacity that is so critical for monitoring and adaptive review of strategies.

Table 4.2 Overarching Statewide Conservation Actions

Secure adequate funding at the state, federal, local, and private levels to implement this WDCP, including developing mechanisms for wildlife diversity users to help fund this Conservation Plan
Maintain and disseminate appropriate data and GIS data layers on wildlife diversity and key wildlife habitats
Collaborate with partners and appropriate industries to implement this Conservation Plan
Utilize public outreach to increase awareness by the public of the value of wildlife diversity conservation and to garner public support for such
Develop recreational opportunities related to wildlife diversity to enhance public appreciation for the conservation of wildlife diversity and the key wildlife habitats that support them
Complete the development of Maryland's natural community classification and map spatially explicit locations for all natural community types using GIS technology
Identify the most important sites throughout the State for wildlife diversity conservation
Develop a core network of protected wildlife diversity conservation lands to capture the full array of Maryland's wildlife species
Develop mechanisms to ensure adequate connectivity of important wildlife diversity conservation sites
Establish effective laws, regulations, and ordinances at the local, state, and federal levels to conserve wildlife diversity
Fully implement all existing recovery plans for threatened and endangered species and species of conservation concern
Adequately enforce existing laws, regulations, and ordinances to protect GCN species
Enlist the support of elected officials at the state, local, and federal levels
Incorporate wildlife diversity conservation at the local land use planning level
Collaborate with sportsmen's organizations to effectuate wildlife diversity conservation
Collaborate with Chesapeake Bay conservation initiates to incorporate wildlife diversity conservation into the efforts to "save the bay"
Develop and utilize incentives for private landowners to conserve key wildlife habitat on their lands
Utilize acquisition and easement programs to conserve high quality key wildlife habitat

Utilize existing environmental regulatory programs at the state, local, and federal levels to conserve key wildlife habitat
Develop and implement invasive species management programs to reduce or prevent impacts to GCN species and key wildlife habitats
Train staff, partners, private landowners, and elected officials on state-of-the-art wildlife diversity conservation science, techniques, and philosophy
Coordinate conservation actions at regional and national levels
Work with private landowners and public land manager to assist with appropriate management for key wildlife habitats and GCN species
Develop programs and strategies to monitor key wildlife habitats and the effectiveness of conservation actions

Many of these high priority overarching conservation actions are strategies and activities that are already being accomplished by MD DNR and its numerous partners. However, this WDCP will provide a new context or framework to understand the importance of those actions with regards to conserving the full array of Maryland's wildlife.

Maryland's Key Wildlife Habitats

Following is a description of each key wildlife habitat, its location and condition, the threats to each habitat type, and the conservation actions and research, inventory, and monitoring needs that should to be implemented in order to abate those threats and conserve each habitat type and the associated wildlife species. Lists of associated GCN species and associated rare and unique natural communities, as well as some of the other wildlife species that MD DNR is currently managing, are also presented for each of the key wildlife habitats.

The list of threats has not been presented in any priority order. The same is true for the list of research, inventory, and monitoring needs. However the list of conservations actions has been grouped such that the highest priority actions are included at the top in bold text. There is no intentional additional order to the list (i.e., the sixth one listed is not necessarily the sixth most important action). This list of priorities was developed by summarizing the input worksheets from the July 2005 stakeholder workshop and comments received from the website. The WDCP development team reviewed the stakeholder priority results and provided further refinements.

Terrestrial and Wetland Habitats

(1) Old Growth Forests

Description:

Old growth forest historically occurred throughout Maryland, dominating the landscape and representing a broad range of forest types. Today, only scattered remnants remain in the state and elsewhere in eastern temperate North America. Old growth has been generally defined as forests in existence since pre-settlement times and lacking any significant, direct Euro-American disturbance. It has also been referenced using such terms as primeval, climax, virgin, and ancient forest. An interesting account and description of the pre-settlement forest of Maryland can be found in Robbins and Blom (1996). In a recent, on-going effort by MD DNR to map and characterize extant old growth forest throughout the state, the following definition has been applied:

An old growth forest is a minimum of 2 ha (5 acres) in size with a preponderance of old trees, of which the oldest trees exceed at least half of the projected maximum attainable age for that species, and that exhibits most of the following characteristics:

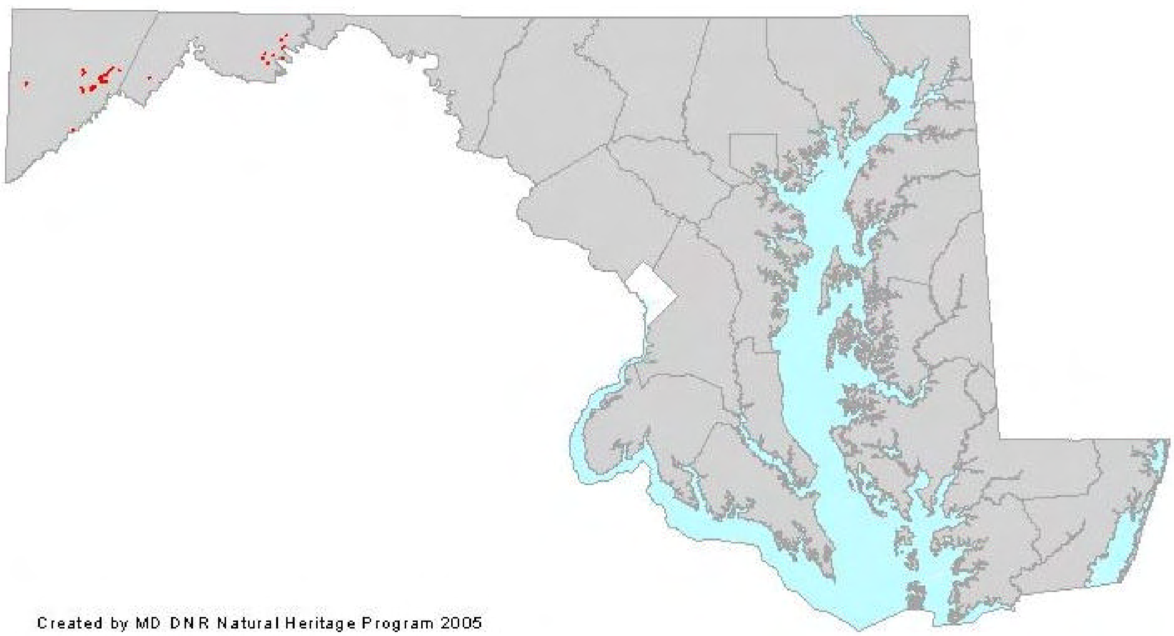
1. Shade tolerant species are present in all age/size classes.
2. There are randomly distributed canopy gaps.
3. There is a high degree of structural diversity characterized by multiple growth layers (canopy, understory trees, shrub, herbaceous, ground layers) that reflect a broad spectrum of ages.
4. There is an accumulation of dead wood of varying sizes and stages of decomposition, standing and down, accompanied by decadence in live dominant trees.
5. Pit and mound topography can be observed, if the soil conditions permit it.

Location and Condition:

Although old growth forest was once a dominant feature throughout most of the Maryland landscape, only about 40 small, scattered remnants remain (MD DNR, unpublished data). The ongoing inventory for old growth forests on state lands has documented 1,679 acres of this important key wildlife habitat in western Maryland. This habitat is fragmented into small patches ranging in size from about 3 to 390 acres. Only five areas exceed 100 acres each. Most are considerably smaller (3-50 acres) and confined to isolated steep slopes, sheltered ravines or otherwise difficult to access areas where they were spared from logging and deforestation. However, their isolation and limited acreage, along with increasing degradation of the surrounding landscape (e.g., via fragmentation) has compromised their ability to support old growth flora and fauna and function as intact ecosystems. Many areas are also threatened by logging, invasive plant species, introduced insect pests and pathogens, and disruption of natural disturbance processes.

Approximately 95% of all remaining old growth forest that has been documented during the ongoing inventory is located on state lands. The remainder is either on federal (0.4%) or private lands (4.7%). Some of the best remaining examples occur on Savage River State Forest and Potomac-Garrett State Forest in Garrett County.

Figure 4.1 Location of Old Growth Forests in Maryland documented to date (Source: MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Allegheny woodrat
American marten
Bobcat
Delmarva fox squirrel
Eastern red bat
Eastern small-footed myotis
Eastern spotted skunk
Hoary bat
Indiana bat
Least weasel
Long-tailed shrew
New England cottontail
North American Porcupine

Northern flying squirrel
Rafinesque's big-eared bat
Silver-haired bat
Smoky shrew
Southeastern myotis
Southeastern shrew
Southeastern star-nosed mole
Southern bog lemming
Southern pygmy shrew
Southern rock vole
Southern water shrew
Birds
Acadian flycatcher
American redstart

Bald eagle
Barred owl
Bicknell's thrush
Black-and-white warbler
Black-billed cuckoo
Blackburnian warbler
Black-throated blue warbler
Black-throated green warbler
Blue-headed vireo
Broad-winged hawk
Brown creeper
Brown-headed nuthatch
Canada warbler
Cerulean warbler

Chuck-will's-widow
Common raven
Dark-eyed junco
Eastern towhee
Golden-crowned kinglet
Hairy woodpecker
Hermit thrush
Hooded warbler
Kentucky warbler
Louisiana waterthrush
Magnolia warbler
Northern goshawk
Northern parula
Northern saw-whet owl
Northern waterthrush
Olive-sided flycatcher
Ovenbird
Pileated woodpecker
Prairie warbler
Prothonotary warbler
Red-breasted nuthatch
Red-cockaded woodpecker
Red-eyed vireo
Red-headed woodpecker
Red-shouldered hawk
Scarlet tanager
Summer tanager
Swainson's thrush
Swainson's warbler
Veery
Wayne's black-throated green warbler
Whip-poor-will
Winter wren
Wood thrush
Worm-eating warbler
Yellow-bellied sapsucker
Yellow-throated vireo
Reptiles
Broad-headed skink
Cornsnake
Eastern box turtle
Eastern hog-nosed snake
Northern pinesnake
Northern scarletsnake
Timber rattlesnake
Wood turtle
Amphibians
Allegheny Mountain dusky salamander
Barking treefrog
Eastern mud salamander
Eastern narrow-mouthed toad
Eastern spadefoot
Eastern tiger salamander
Green salamander
Jefferson salamander
Long-tailed salamander
New Jersey chorus frog
Northern red salamander
Seal salamander
Wehrle's salamander
Inverts: Dragonflies & Damselflies
Arrowhead spiketail
Brown spiketail
Delta-spotted spiketail
Gray petaltail
Harlequin darner
Northern pygmy clubtail
Southern pygmy clubtail
Taper-tailed darner
Tiger spiketail
Inverts: Butterflies & Moths
A noctuid moth
A noctuid moth
American chestnut nepticulid moth
Appalachian blue
Carolina satyr
Chermock's mulberry wing
Chestnut clearwing moth
Compton tortoiseshell
Cypress sphinx moth
Dusky azure
Early hairstreak
Giant swallowtail
Golden-banded skipper
Gray comma
Great purple hairstreak
Hessel's hairstreak
Hickory hairstreak
King's hairstreak
Marbled underwing
Northern crescent
Palamedes swallowtail
Pepper and salt skipper
Phleophagan chestnut nepticulid moth
Pine barrens zanclognatha
Precious underwing
The buckmoth
Three-horned moth
West virginia white
Inverts: Beetles
Giant stag beetle
Six-banded longhorn beetle
Inverts: Spiders
Red-legged purse-web spider
Inverts: Land Snails
Angular disc
Bear creek slitmouth
Cherrydrop snail
Cylindrically-ornate wood snail
Rader's snail
Spruce knob threetooth
Striped whitelip
Rare Natural Communities
This is considered the highest quality condition/stage of any forested community and is therefore rare from that standpoint

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, eastern fox squirrel, red squirrel, red fox, common gray fox, coyote, fisher, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink wild turkey, ruffed grouse, and American crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible management practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape-level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Selective timber harvest and hemlock wooly adelgid that causes loss of spruce and hemlock components in some old growth forests
j. Human disturbance, including ATV use, which results in degradation of habitat
k. Altered fire regime which result in loss conversion of old growth conditions

Conservation Actions:

a. Conserve large blocks of contiguous forest where appropriate ***[Measure: # of acres contiguous forests conserved]***
b. Protect all old growth forest habitat and adequate forested buffers ***[Measure: # of acres old growth forest and buffers protected]***
c. Increase old growth forest habitats where feasible ***[Measure: # of acres additional potential old growth forest protected]***
d. Establish and maintain landscape-scale protected habitat and movement corridors; ***[Measure: # of acres protected habitat established; # of acres new corridors established and protected]***
e. Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused forest habitat management actions]***
f. Minimize fragmentation of large, contiguous forest blocks ***[Measure: % of large, contiguous forest blocks remaining unfragmented]***
g. Identify areas that will become future old growth forests ***[Measure: # of sites identified as potential future old growth forests]***
h. Develop incentives for private land owners to conserve old growth on their properties *[Measure: # of incentives developed; # of new participants maintaining this habitat type]*
i. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
j. Limit access and educate the public about the value of old growth and its conservation to address human disturbance issues *[Measure: # of sites with limited access and educational signage; # of educational materials developed and distributed]*

k. Develop habitat management guidelines for use by foresters and land managers and work with them to implement such *[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]*
l. Restore spruce, hemlock and chestnut components where feasible *[Measure: # of acres forest with spruce/hemlock/chestnut components restored]*
m. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
n. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
o. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites with management implemented]*
p. Restore degraded habitats through appropriate techniques *[Measure: # of acres degraded habitat restored]*
q. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including forest interior birds and invertebrates *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters and life histories of GCN species, especially invertebrates *[Measure: # of research projects conducted conducted; # of research papers published]*
c. Conduct species surveys and determine distribution and abundance of GCN species, especially invertebrates *[Measure: # of surveys completed]*
d. Conduct research to determine habitat use and requirements, movement patterns and dispersal of GCN species, especially invertebrates *[Measure: # research projects; # of research papers published]*
e. Determine forest matrix requirements *[Measure: development of matrix model; # of conservation actions modified and re-prioritized based on model]*
f. Monitor forest health and pest impacts *[Measure: # of monitoring studies established]*
g. Continue inventory for old growth forests on public and private lands throughout the state *[Measure: # of sites or acres inventoried]*

(2) Early Successional Forests

Description:
Early successional forests are upland areas dominated by shrubs and small trees (< 8 m tall). This habitat occurs statewide in five broad settings:

Recently logged forests. Early successional habitat begins to develop within one year of a timber harvest and may persist for 10-20 years or more depending, in part, on pre-harvest forest conditions, soil type, the size and type of regeneration cut (e.g., clearcutting, single-tree selection, shelterwood), and post-harvest silvicultural treatments (e.g., seedling plantings vs. natural regeneration, thinnings). Habitat suitability for most early successional species of conservation concern tends to peak 2-10 years following harvest. Many such species are no longer present once tree canopy closure is attained.

Succeeding nonforested land. Examples include former cropland, pasture, old fields and reclaimed strip mines that are reverting to a forested state via natural succession or plantings. Early successional habitat may persist for 10-20 years or longer depending, in part, on the size of the opening, surrounding habitat conditions, prior land use, site conditions and the degree of woody plant browsing by deer and other mammals.

Temporary natural forest openings. Natural forest canopy openings result from a variety of natural disturbances including windthrow, ice storms, fire, beavers, tree senescence, insect outbreaks and pathogens. Canopy openings can range in size from small (< 0.4 ha), scattered light gaps to extensive (> 100 ha) blowdown areas. Large tracts (10-100 ha or larger) of early successional habitat may develop following severe ice storms, tornados and hurricanes. In riparian areas, beavers and floods may create sizeable openings. Although not native to North America, moderate to severe gypsy moth outbreaks can also result in large areas of early successional habitat. The duration of these temporary openings varies from a few years in scattered light gaps to several decades or more in large, catastrophic disturbances and extensive beaver-impounded areas. While some early successional species occur in small light gaps, habitat suitability for many early successional species tends to be greater in larger (> 2 ha) openings. Generally, the size and frequency of natural canopy openings increases with forest age although other factors (e.g., forest type, elevation, slope) are also important. Extensive tracts of mature to old growth forest can be an important source of early successional forest via temporary natural forest openings.

Shrub-dominated natural communities. Shrubs and small trees perpetually dominate a number of natural community types and ecotones. These conditions may occur within shale barrens, sandstone glades, dry oak-pine forests, maritime forests and shrublands and along extensive, ridgetop rock outcrops. Some early successional species of conservation concern also occur in nontidal and tidal shrub wetlands, and shrubby ecotones within Carolina bays, Allegheny Plateau "bogs" and upper tidal marsh fringes. These are described later within their respective key wildlife habitat sections.

Forest edges. Forest edges are usually abrupt, narrow (usually 1-10 m wide), linear ecotones between a forested and nonforested habitat (e.g., cropland, road, transmission line right-of-way, backyard) or between two dissimilar forest age classes (e.g., a mature forest and a recent clearcut). These conditions can provide early successional forest habitat for some of the more generalist wildlife species, especially if a "soft" edge or gradual transition between the two adjoining habitats is present.

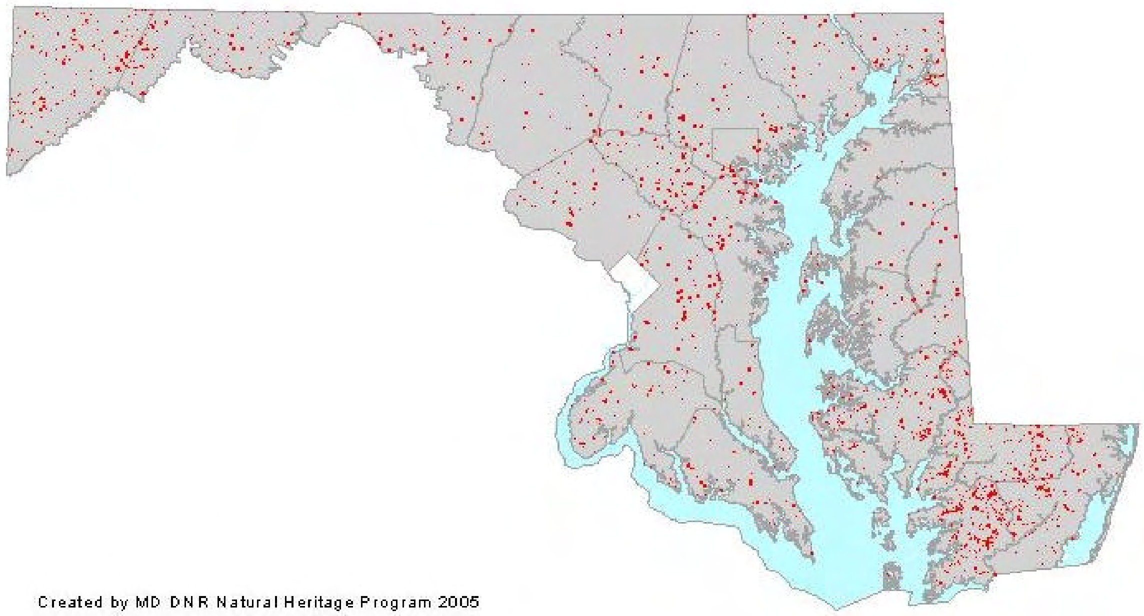
Location and Condition:

The historical extent of early successional forest in Maryland is uncertain. It may be comparable to today's acreage (~5% of the land area; Frieswyk 2001) but certainly the origin, distribution and characteristics of today's forms of this habitat are, in many cases, quite different. Prior to widespread European colonization, fires set by Native Americans and settlers and, to a lesser degree, lightning strikes, played a major role in creating and sometimes perpetuating forest conditions dominated by shrubs and small trees. Herbivores (e.g., beaver, bison, and elk), topography, edaphic conditions and storm-related events (e.g., floods, ice storms, and tropical storms) also played a significant role. Together, these agents of change maintained a shifting mosaic of early successional habitat embedded within a landscape that was likely dominated by old growth forest and a variety of grassland, shrubland and wetland habitats. The degree to which these factors affected the landscape varied by region and with local conditions (e.g., soil type, forest type, slope, and aspect).

Today, the majority of Maryland's early successional forest is in the form of forest edges and recently logged forests. The latter comprises approximately 291,000 acres or about 4.7% of the land area in Maryland (Frieswyk 2001). This habitat is particularly common on the lower Eastern Shore with an estimated 81,000 acres (16.4% of forest land), followed by Allegany and Garrett Counties with 56,000 acres (12.2% of forest land). Information is lacking on the extent of some shrub-dominated natural communities and temporary natural forest openings but the acreage and benefit to early successional species is probably significant.

As Maryland's landscape becomes increasingly fragmented and converted to residential and commercial development, the amount of forest edge will increase, benefiting some of the more generalist early successional forest wildlife species. However, opportunities for creating or restoring (e.g., via prescribed burns, logging, natural succession) other forms of early successional forest will dwindle due to habitat loss, fragmentation and the related effects of parcelization. Maintaining natural shrubland communities, old fields, and other forms of early successional habitat is critical since forest edges support relatively few early successional habitat specialists including those that are area-sensitive or dependant on naturally occurring shrublands. Increases in forest edge frequently also come at the expense of species requiring large, unfragmented forests.

Figure 4.2 Location of Early Successional Forests in Maryland (Sources: MD Dept of Planning; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Eastern red bat
Least shrew
North American Porcupine
Snowshoe hare
Southeastern shrew
Southern bog lemming
Birds
American woodcock
Bachman's sparrow
Bewick's wren

Blue-winged warbler
Brown thrasher
Chestnut-sided warbler
Common raven
Eastern towhee
Field sparrow
Golden-winged warbler
Least flycatcher
Mourning warbler
Nashville warbler
Northern bobwhite
Prairie warbler

Willow flycatcher
Reptiles
Eastern hog-nosed snake
Timber rattlesnake
Amphibians
Eastern spadefoot
New Jersey chorus frog
Inverts: Butterflies & Moths
Indian skipper
Rare Natural Communities
unknown

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, eastern cottontail, woodchuck, wild turkey, ruffed grouse, northern bobwhite, ring-neck pheasant, American woodcock, mourning dove, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible management practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Lack of disturbance and lack of recruitment allowing succession over time
j. Perceived lack of value by developers and the public
k. Removal of topsoil from agricultural fields that could revert to this habitat

Conservation Actions:

a. Develop habitat management guidelines for use by foresters and land managers and work with them to implement such ***[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]***
b. Utilize landowner incentive programs, including Farm Bill programs, to develop and maintain this habitat type ***[Measure: # of sites or acres with this habitat developed/maintained through landowner incentive programs; # of new participants maintaining this habitat type]***
c. Work with farmers to conserve and manage for this habitat on marginal croplands ***[Measure: # of sites with cooperative management projects; # of acres marginal cropland managed for this habitat type]***
d. Conserve appropriate corridors for movement and dispersal of GCN species; ***[Measure: # of acres forest corridors conserved]***
e. Conserve large blocks of contiguous forest where appropriate *[Measure: # of acres contiguous forests conserved]*
f. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
g. Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies *[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]*
h. Allow beaver maintained openings to persist *[Measure: # of sites maintained by beavers]*
i. Minimize fragmentation of large, contiguous forest blocks *[Measure: % of large forest blocks remaining unfragmented]*
j. Work with sportsmen organizations, such as Quail Unlimited, to promote and manage this habitat *[Measure: # of groups with cooperative management projects; # of acres managed for this habitat type]*
k. Mimic natural disturbance patterns *[Measure: # of sites or acres managed through mimicry of natural disturbance patterns]*
l. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*

m. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*
n. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
o. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
p. Protect and restore topsoil *[Measure: # of sites with topsoil protected or restored]*
q. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

Inventory, Monitoring and Research Needs:

a. Determine management needs and best management practices for populations, especially effects of various habitat management practices on species' productivity and on long-term habitat suitability *[Measure: # of BMPs developed; # of conservation actions with BMPs incorporated]*
b. Monitoring programs should accompany management activities to assess effects of techniques on GCN species and long-term habitat suitability *[Measure: # of monitoring programs designed to assess effects of management actions]*
c. Conduct a thorough inventory of existing shrub habitat to determine the most important sites for breeding populations *[Measure: # of inventories completed; # of acres inventoried]*
d. Determine precise habitat characterizations and needs of GCN species, including area sensitivity, habitat quality, and habitat availability *[Measure: # GCN species with habitat needs determined; # of studies designed to determine habitat needs; # of research papers published]*
e. Conduct studies on the factors limiting species abundance, such as predation rates, reproductive success, parasitism rates, and causes of mortality *[Measure: # of GCN species with studies of population-limiting factors; # of studies designed to determine population-limiting factors; # of research papers published]*
f. Determine the frequency of occurrence of natural disturbance regimes and where they occur in MD's landscape *[Measure: # of studies of natural disturbance regimes in MD; # of research papers published]*

(3) Maritime Forests and Shrublands

Description:

Maritime forests and shrublands are found within Coastal dune systems and flats along the Coastal regions and barrier islands in Maryland. The distribution and vegetation of these habitats is largely controlled by oceanic influences such as salt spray and deep sand deposits. Although oceanic influences are the primary contributing factors in vegetation structure and distribution, soil moisture and drainage also play a critical role in shaping these habitats. Shrublands or "scrub" vegetation develops on inland edges of back dunes and leeward dune slopes where they are moderately protected from ocean salt spray. The vegetation is best characterized as "scrubby" in appearance typically including stunted trees and low growing, dwarfed shrub species such as beach heather, bayberry, and high-tide bush. Herbaceous species are sparse however; frequent canopy gaps support many species that are recruited from adjacent maritime grassland communities. These shrublands often occur in a mosaic with woodlands and forests dominated by Loblolly pine. Both occur on sheltered back dunes away from the primary dune where the effects of salt spray are minimal however, soil moisture is the major difference with woodlands typically restricted to rapidly drained, xeric dunes. Because these habitats have a restricted geographic range (Delaware to North Carolina) and narrow habitat requirements, they are considered globally uncommon to rare. Rangewide, these habitats are threatened by coastal development and by natural and anthropogenic disturbances that destroy the protective primary dune system. However, in Maryland nearly all remaining habitat occurs on federal and state lands.

Location and Condition:

The best remaining example of maritime forests and shrubland habitats are in Worcester County on Assateague Island. Habitats on Assateague Island represent the largest contiguous blocks of maritime forests and shrublands stretching for approximately 22 miles into Virginia. Historically, portions of Fenwick Island were scattered with maritime forests and shrublands; however, the development of Ocean City and surrounding areas have virtually destroyed all remaining habitats on Fenwick Island. There are currently about 1,600 acres of maritime forests and shrublands in Maryland, of which 92.5% is owned by the federal government, 6.3% is owned by the state, and 1.2% is owned privately.

Figure 4.3 Location of Maritime Forests and Shrublands in Maryland (Sources: National Park Service, Assateague Island National Seashore; MD DNR NHP)

GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Least shrew
Birds
American woodcock
Bicknell's thrush
Boat-tailed grackle
Brown thrasher
Brown-headed nuthatch
Chuck-will's-widow
Common nighthawk

Eastern towhee
Field sparrow
Hairy woodpecker
Northern bobwhite
Prairie warbler
Red-cockaded woodpecker
Red-headed woodpecker
Summer tanager
Reptiles
Broad-headed skink

Eastern hog-nosed snake
Inverts: Beetles
American burying beetle
Rare Natural Communities
Maritime Dune Loblolly Pine Forests
Maritime Dune Scrub
Maritime Dune Woodlands

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white tailed deer, sika deer, eastern gray squirrel, red fox, common gray fox, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, eastern cottontail, nutria, northern bobwhite, American woodcock, mourning dove, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible management practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Sea-level rise
j. Non-native feral horses on Assateague Island
k. Increased human use that results in habitat degradation

Conservation Actions:

a. Conserve large blocks of contiguous forest where appropriate ***[Measure: # of acres contiguous forests conserved]***
b. Work with National Park Service and State Park managers to conserve this habitat on Assateague Island ***[Measure: # of acres conserved; # of cooperative projects implemented]***
c. Control non-native herbivore populations to reduce impacts to this habitat ***[Measure: # of control programs implemented and evaluated for effectiveness; # of acres with management implemented]***
d. Minimize fragmentation of large, contiguous forest blocks ***[Measure: % of large forest blocks remaining unfragmented]***
e. Maintain shrubland habitat, including all remaining on private lands ***[Measure: # of acres of shrubland habitat maintained; # of acres of privately-owned shrubland habitat maintained]***
f. Conserve appropriate corridors for movement and dispersal of GCN species *[Measure: # of acres forest corridors conserved]*
g. Develop habitat management guidelines for use by foresters and land managers *[Measure: guidelines developed]*
h. Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies *[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]*
i. Limit access and educate the public about the conservation of this habitat and its GCN species to address increasing human use *[Measure: # of sites with limited access and educational signage; # of educational materials developed and disseminated]*
j. Work with land managers to manage this habitat conducively for GCN species *[Measure: # of sites with cooperative management project; # of acres of this habitat managed for GCN species]*
k. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
l. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*
m. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*

n. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
o. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*

Inventory, Monitoring and Research Needs:

1. Initiate long-term monitoring studies of GCN species *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
2. Conduct research on basic ecology, breeding parameters, and life histories of GCN species *[Measure: # of research projects conducted; # of research papers published]*
3. Conduct research on habitat use and requirements of GCN species *[Measure: # of research projects conducted; # of research papers published]*
4. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of surveys completed]*
5. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
6. Determine the effects of management activities on GCN species *[Measure: # of monitoring programs designed to assess effects of management actions]*

(4) Loblolly Pine - Oak Forests

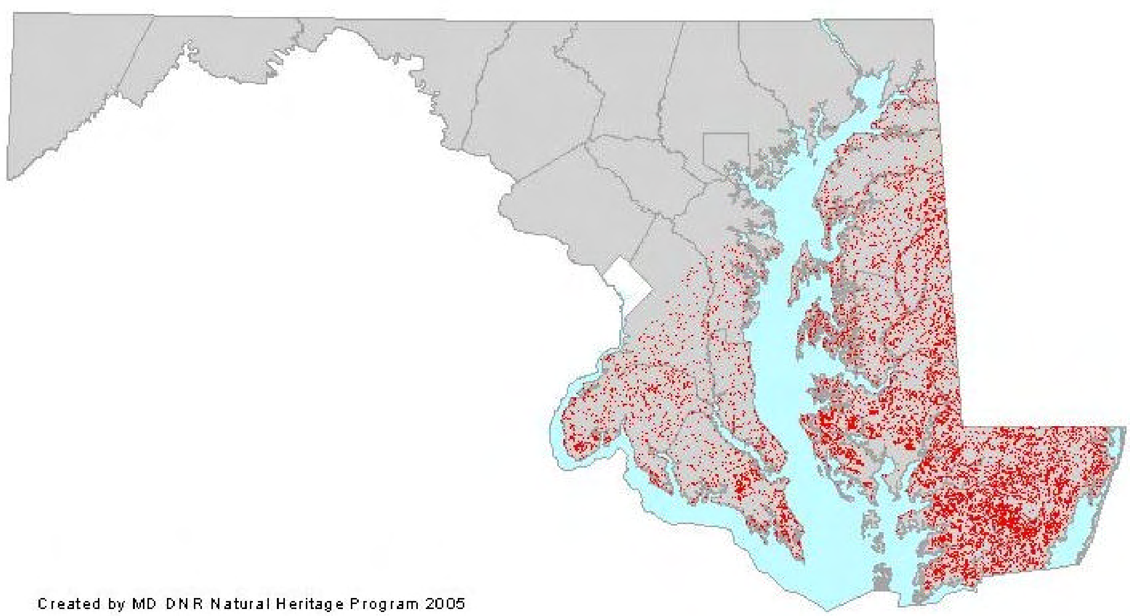
Description:

On the Lower Coastal Plain, loblolly pine dominates many upland and wetland habitats. Upland habitats vary from dry to mesic, with sands or sandy loam soils on gently rolling topography. Various hardwoods are present and may include such species as southern red oak, white oak, and post oak. Other associates may include sassafras, pignut hickory, black oak, willow oak, white flowering dogwood, and sweetgum. On extremely dry sites where growing conditions are unfavorable, trees may not reach full stature and canopies are generally open. Shrubs are predominately ericaceous and are characterized by patches of huckleberries, blueberries, and mountain laurel. American holly is often dominant in the understory of more mesic sites. Herbs are generally sparse but may include pink lady's slipper, bracken fern, wintergreen, and spotted wintergreen. Loblolly pine also dominates many temporarily flooded wetlands such as "wet flatwoods" throughout the lower Eastern Shore. These habitats develop on broad flats between stream drainages, but may also occur on floodplains and isolated upland depressions. Loblolly pine swamps usually retain water throughout the winter months when water tables are high, but are relatively dry late in the growing season. Soils are best characterized as sandy loams. Associated trees may include red maple, black gum, pond pine, white oak, willow oak, swamp chestnut oak, American holly, and bayberry. Shrubs and vines are common and include species such as sweet pepperbush, southern bayberry, highbush blueberry, poison-ivy, and common greenbrier. Herbs are sparse, generally consisting of patches of slender spikegrass, broomsedge, partridge berry, wool grass, and various sedges.

Location and Condition:

Natural loblolly pine-oak forests historically occurred throughout the lower portions of the Talbot formation reaching their northern limit in Kent and Queen Annes Counties (Shreve et al. 1910). During the time of Amerindian occupation, the Eastern Shore of Maryland was predominately hardwood dominated, though increasingly mixed with pine south of the Choptank River (Rountree and Davidson 1997). Although large stands exist, many of today's loblolly pine-oak stands are in second-growth form, the result of extensive clearing in historic times. In the nineteenth and early twentieth centuries loblolly pine became much more widespread, particularly south of the Choptank River largely due to economic factors. As an opportunistic species, loblolly pine was the first species to colonize abandoned farm fields (Shreve et al. 1910). In addition, recognizing the commercial value of loblolly pine, timber industries of the Eastern Shore accelerated the clearing of land and replanting of pines. Commercial logging industries also used steam locomotives to transport logs which were notorious for throwing sparks igniting widespread, intense fires during the late 1800s and early 1900s. Both the clearing of the forests by logging and the subsequent fires resulted in large areas of open, scarified land suitable for pine regeneration. By the middle of the twentieth century, loblolly pine was the dominant forest type in the lower counties of the Eastern Shore. Today's loblolly pine-oak stands are compositionally different than historical ones, most notably the hardwood component is not well-developed or absent altogether. Most of the natural loblolly pine-oak forests have been cutover in recent years and converted to pine plantations. Pine plantations are typically harvested on short rotations and trees rarely exceed 40 to 60 years in age. Species richness in plantations is dramatically lower than that of natural stands with canopy associates often limited to red maple and sweetgum and sparse or absent shrub and herb layers.

Figure 4.4 Location of Loblolly Pine - Oak Forests in Maryland (Sources: USGS MDN-GAP; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals	Bald eagle	Great egret
Delmarva fox squirrel	Barred owl	Hairy woodpecker
Eastern red bat	Bicknell's thrush	Hooded warbler
Southeastern shrew	Black-and-white warbler	Northern bobwhite
Southern bog lemming	Black-billed cuckoo	Ovenbird
Southern pygmy shrew	Brown-headed nuthatch	Pileated woodpecker
Birds	Chuck-will's-widow	Red-cockaded woodpecker
Acadian flycatcher	Common nighthawk	Red-eyed vireo
American redstart	Eastern towhee	Red-headed woodpecker
American woodcock	Great blue heron	Red-shouldered hawk

Scarlet tanager
Snowy egret
Summer tanager
Whip-poor-will
Wood thrush
Worm-eating warbler
Yellow-throated vireo
Reptiles

Broad-headed skink
Cornsnake
Eastern box turtle
Eastern hog-nosed snake
Northern pinesnake
Northern scarletsnake
Amphibians
Barking treefrog

Eastern narrow-mouthed toad
Eastern tiger salamander
New Jersey chorus frog
Rare Natural Communities
N/A

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, sika deer, eastern gray squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, nutria, wild turkey, northern bobwhite , American woodcock, mourning dove, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible management practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Loss or degradation of pine and oak barrens habitat
j. Imbalanced vegetation structure and species composition

Conservation Actions:

a. Conserve large blocks of contiguous forest where appropriate ***[Measure: # of acres contiguous forests conserved]***

b. Conserve or restore pine and oak barrens habitat ***[Measure: # of acres pine and oak barren habitat conserved or restored]***

c. Ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls) ***[Measure: # of acres maintained with structural diversity]***

d. Control the conversion of mixed stands to loblolly pine monocultures ***[Measure: # of acres mixed stands maintained]***

e. Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies ***[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]***

f. **Conserve appropriate corridors for movement and dispersal of GCN species** ***[Measure: # of acres forest corridors conserved]***
g. **Develop habitat management guidelines for use by foresters and land managers and work with them to implement such** ***[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]***
h. Maintain forested areas in close proximity to large bodies of open water, especially tidal waters *[Measure: # of acres forested areas near water conserved]*
i. Work with TNC to implement the Nanticoke River bioreserve strategy in conjunction with their ecoregional plan *[Measure: # of joint cooperative projects implemented; # of acres managed under cooperative projects]*
j. Minimize fragmentation of large, contiguous forest blocks *[Measure: % of large forest blocks remaining unfragmented]*
k. Protect and maintain habitat with dense thickets and downed logs within larger mature forest *[Measure: # of acres maintained with dense thickets and downed logs]*
l. Modify the loblolly pine seed tree law to more easily allow for a mixed pine-hardwood forest *[Measure: law modified to more easily allow for mixed forest composition]*
m. Discourage loblolly pine monocultures in favor of mixed stands of loblolly pine and hardwoods *[Measure: # of acres of pine monocultures converted to mixed stands]*
n. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
o. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*
p. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*
q. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
r. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
s. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

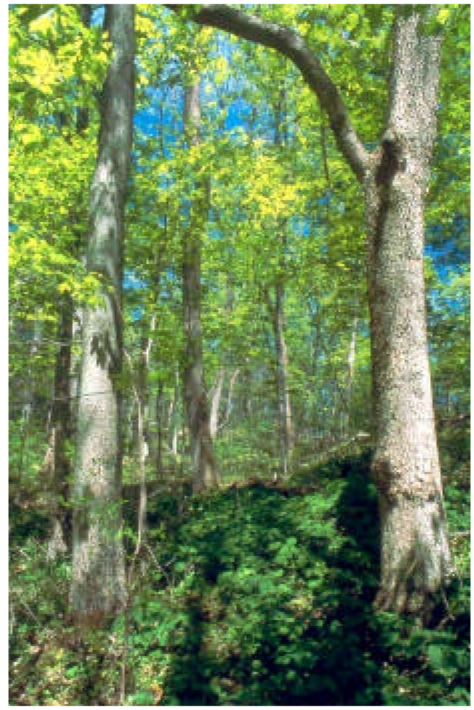
Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including forest interior birds and Delmarva fox squirrel *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of surveys completed]*
e. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*

f. Determine the effects of development activities on GCN species, including Delmarva fox squirrel *[Measure: # of research projects conducted; # of research papers published]*
g. Determine the effects of various timber harvest practices on GCN species, including forest interior birds, reptiles, amphibians, and Delmarva fox squirrel *[Measure: # of research projects conducted; # of research papers published]*
h. Determine historical range of this key wildlife habitat and target priority sites for monitoring and research *[Measure: historical range determined; # of priority monitoring and research sites established]*

(5) Mesic Deciduous Forests

Description:



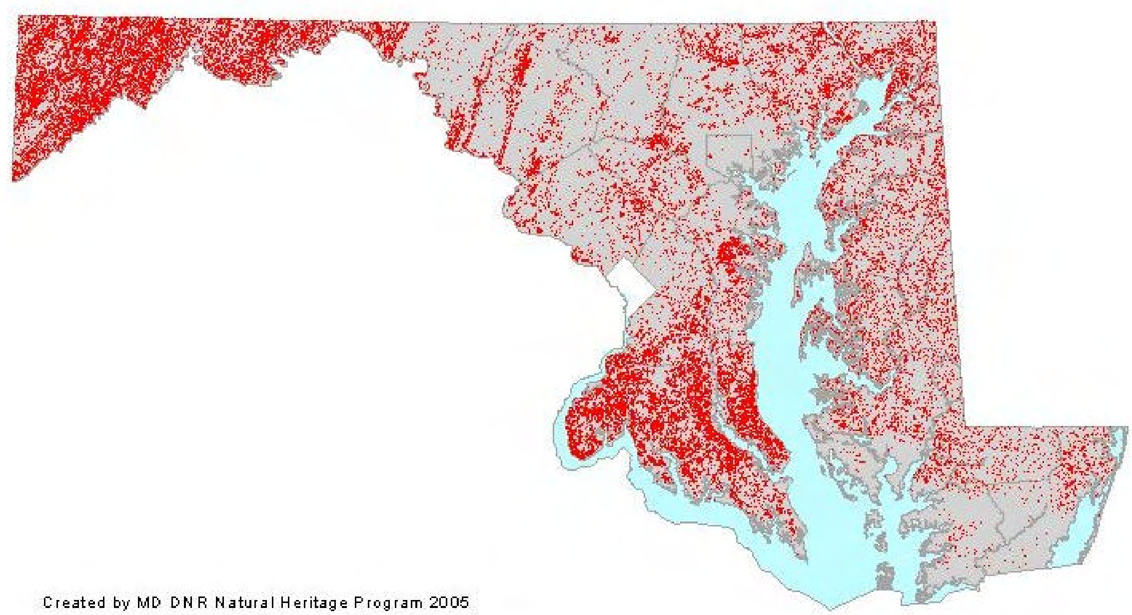
Mesic deciduous forests represent a broad group of forested habitats that occur throughout the Coastal Plain, Piedmont, and at low elevations in the Ridge and Valley and Appalachian Plateau physiographic provinces. These forests are found on both acidic and basic substrates and are characterized by an assortment of mixed hardwoods in moist habitats, such as sheltered ravines and coves, low mountain slopes, and well-drained terraces or flatwoods. Many different forest types fall into this category and are largely distinguished from one another by species composition and by the substrate on which they develop. In general, mesic forests over acidic substrates contain mixed canopies of tulip poplar, American beech, oaks, and hickories and understories of white flowering dogwood, pawpaw, and American hornbean. Many of the oaks and other associated trees of these forests vary by region. These forests are widespread occurring throughout much of Maryland on moist low slopes, steep north-facing slopes, ravines, and well-drained uplands and occasionally in stream bottoms. Soils are characterized as acidic and nutrient-poor and rarely support lush layers of herbaceous vegetation, although species such as Christmas fern may be abundant in patches. Sheltered coves and slopes in mountainous regions often support very fertile habitats with lush herbaceous layers containing a diverse assemblage of spring ephemerals. The soils are weathered from various substrates but can range from moderately acidic to moderately alkaline. Trees common in these "rich cove forests" include basswood and sugar maple, and tulip poplar often characterizes the canopy. Cove forests may also occur on substrates underlain by acidic bedrock, such as sandstone or quartzite. A mixture of hemlock and hardwoods such as yellow birches and a dense understory of rhododendron distinguish these forests from rich cove forests. Herbaceous species are limited by dense shade and poor soils, and are much sparser and less diverse than in rich cove forests.

On the Coastal Plain, slightly drier forests dominated by American beech and oaks such as white oak, red oak, and chestnut oak occur on north-facing bluffs and steep ravine slopes. The soils are very acidic and nutrient-poor, providing unsuitable conditions for many mesophytic plants; however, shrubs of blueberries and huckleberries often form dense colonies. In Maryland, these forests are widely, but locally, distributed in small patches across the dissected Upper Coastal Plain, Lower Coastal Plain, and perhaps portions of the Piedmont near the fall line. In Maryland, forests that have developed over fertile basic substrates are found in the Coastal Plain, Piedmont, and major mountain valleys. Typical sites are deep ravines, sheltered north- or east-facing slopes subtending large streams and rivers, and occasionally well-drained floodplain terraces. Soils are usually weathered from carbonate or mafic bedrock, or from calcareous, shell-rich deposits in the Coastal Plain. Many of these forests are similar in species composition to rich cove forests but also usually contain species such as chinkapin oak, bitternut hickory, white ash, eastern redbud, and eastern hophornbeam. The moist and fertile soils of these forests often support a lush and diverse herbaceous layer.

Location and Condition:

Although their quality and extent have been severely reduced by repeated logging, mesic deciduous forests are widespread throughout Maryland. Areas spared by logging are few and mostly limited to steep slopes, sheltered ravines and coves. Many areas have been selectively cut many times and have increased importance of species such as American beech and other noncommercial hardwoods relative to oaks. Other disturbed habitats have increased amounts of pines and weedy hardwoods such as tulip-tree and sweetgum. Very few mesic deciduous forests are free of invasion by garlic mustard, Japanese stiltgrass, and other shade tolerant exotic weeds. Some of the oldest and best remaining examples of this habitat can be found under state and federal ownership in Green Ridge State Forest, Belt Woods Natural Heritage Area, Chesapeake and Ohio Canal National Historical Park, and Fort Washington Historical Park.

Figure 4.5 Location of Mesic Deciduous Forests in Maryland (Source: USGS MDN-GAP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals	Eastern red bat	Indiana bat
Allegheny woodrat	Eastern small-footed myotis	Least weasel
Bobcat	Eastern spotted skunk	Long-tailed shrew
Delmarva fox squirrel	Hoary bat	New England cottontail

North American Porcupine
Silver-haired bat
Smoky shrew
Southeastern shrew
Southern bog lemming
Southern pygmy shrew
Southern water shrew
Birds
Acadian flycatcher
American redstart
Bald eagle
Barred owl
Bicknell's thrush
Black-and-white warbler
Black-billed cuckoo
Black-throated blue warbler
Black-throated green warbler
Broad-winged hawk
Brown creeper
Canada warbler
Cerulean warbler
Common raven
Dark-eyed junco
Eastern towhee
Great blue heron
Hairy woodpecker
Hooded warbler
Kentucky warbler
Least flycatcher
Northern parula
Ovenbird
Pileated woodpecker
Red-eyed vireo
Red-headed woodpecker

Red-shouldered hawk
Scarlet tanager
Sharp-shinned hawk
Veery
Whip-poor-will
Wood thrush
Worm-eating warbler
Yellow-throated vireo
Reptiles
Broad-headed skink
Cornsnake
Eastern box turtle
Eastern hog-nosed snake
Northern pinesnake
Northern scarletsnake
Timber rattlesnake
Wood turtle
Amphibians
Barking treefrog
Eastern narrow-mouthed toad
Eastern spadefoot
Eastern tiger salamander
Green salamander
Jefferson salamander
New Jersey chorus frog
Wehrle's salamander
Inverts: Butterflies & Moths
A noctuid moth
American chestnut nepticulid moth
Appalachian blue
Carolina satyr
Chestnut clearwing moth
Compton tortoiseshell
Dusky azure

Early hairstreak
Giant swallowtail
Golden-banded skipper
Gray comma
Hickory hairstreak
Marbled underwing
Northern crescent
Phleophagan chestnut nepticulid moth
Three-horned moth
West virginia white
Inverts: Beetles
A coccinellid beetle
American burying beetle
Giant stag beetle
Six-banded longhorn beetle
Inverts: Spiders
Red-legged purse-web spider
Inverts: Land Snails
Angular disc
Bear creek slitmouth
Cherrydrop snail
Cylindrically-ornate wood snail
Rader's snail
Rare Natural Communities
Rich Cove and Slope Forests
Basic Oak-Hickory Forests
Dry-Mesic Calcareous Forests
Low-Elevation Boulderfield Forests and Woodlands
Piedmont/Mountain Basic Woodlands

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, eastern fox squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink, woodchuck, wild turkey, ruffed grouse, northern bobwhite, American woodcock, mourning dove, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible management practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Human disturbance, including ATV use, which results in degradation of habitat

Conservation Actions:

a. Conserve large blocks of contiguous forest where appropriate ***[Measure: # of acres contiguous forests conserved]***
b. Control the conversion to other forest types ***[Measure: # of acres mesic deciduous forest protected from conversion]***
c. Establish and maintain landscape-scale protected habitat and movement corridors ***[Measure: # of existing targeted large forested patches connected by new corridors; # of acres new corridors established]***
d. Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies ***[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]***
e. Develop habitat management guidelines for use by foresters and land managers and work with them to implement such ***[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]***
f. Minimize fragmentation of large, contiguous forest blocks ***[Measure: % of large forest blocks remaining unfragmented]***
g. Increase presence of snags and vertical structure complexity to enhance existing habitat *[Measure: # of acres managed to increase presence of snags and vertical structure complexity]*
h. Incorporate appropriate forest management practices into forest stewardship plans *[Measure: # of forest stewardship plans with forest wildlife focused habitat management guidelines incorporated]*
i. Educate the public about the value of these forests and their conservation to address human disturbance issues *[Measure: # of educational materials developed and disseminated]*
j. Restore chestnut component where feasible *[Measure: # of acres with restored chestnut component]*
k. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
l. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*
m. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*

n. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
o. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
p. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including forest interior birds *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of surveys completed*
e. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
f. Determine the effects of various timber harvest practices on GCN species, including forest interior birds, reptiles, amphibians *[Measure: # of research projects conducted; # of research papers published]*
g. Assess the effects of gypsy moth spraying on GCN species *[Measure: # of research projects conducted; # of research papers published]*

(6) Dry Oak - Pine Forests

Description:

Dry oak-pine forests are a broad group of dry upland forests and woodlands. They occur on highly droughty, infertile soils that range from strongly acidic or basic. The associated plant communities are structurally intermediate between more mesic forests and ultra-xeric barrens and glades and, on many sites, may represent an ecotone between these two contrasting conditions. Examples of dry oak-pine forests occur in each physiographic region but the plant communities and site conditions differ markedly among the various types. Most of these habitats are kept from succeeding to closed forests or more mesic conditions by periodic fire, edaphic factors, insects (e.g., southern pine beetle), disease (e.g., sweet fern rust) and/or generally harsh growing conditions associated with mountain ridgetop settings.

This habitat is most widely represented by several oak-dominated plant communities. These occur in each of the five physiographic regions but are most prevalent west of the fall line. In the Ridge and Valley and Allegheny Plateau physiographic regions, it commonly occurs on upper, rocky mountain slopes and ridgetops overlying sandstone (Pottsville, Oriskany, Tuscarora) and quartzite (Weaverton) formations. In the Piedmont, it also exists on submesic to subxeric upland habitats over subacidic rocks such as siltstone, metasiltstone, shale, and certain granites. These areas are typically dominated by chestnut oak mixed with other oaks. Mountain laurel, blueberry, and huckleberry are common understory shrubs, often occurring as dense patches. Variants of these communities also frequently occur in xeric sandy areas on the Upper and Lower Coastal Plain. The soils exhibit a distinctly oligotrophic nutrient regime, i.e., strongly acidic, with low base cation levels and relatively high levels of iron. Accumulations of thick duff and high biomass of inflammable shrubs in these forests make them susceptible to periodic fires, which in turn favors recruitment of oaks. In some cases, particularly in the mountains, these communities have replaced former mixed oak–American chestnut forests following the decimation of American chestnut canopy trees during the early 20th century by chestnut blight, an introduced fungus.

In the Ridge and Valley and, to a lesser degree, the Allegheny Plateau, this habitat is also represented by xeric pine-dominated (table-mountain pine, pitch pine, and/or Virginia pine) woodlands. These are species-poor, fire-influenced communities. They are typically located along ridgetop outcrops, on convex south to west facets of steep spur ridges, narrow rocky crests, and cliff tops. They occur on a variety of soils but most commonly on acidic, sedimentary and metasedimentary substrates, e.g., sandstone, quartzite, and shale. Soils are very infertile, shallow, and droughty. Thick, poorly decomposed duff layers, along with dead wood and inflammable shrubs, make these habitats susceptible to fire.

On the Lower Coastal Plain, this habitat occurs, in part, on inland sand dune ridges which overly deep, late to post-Pleistocene deposits of Parsonsburg sands. Referred to as xeric sand ridge woodlands, this type of dry oak-pine forest is uncommon and mostly restricted to the lower Eastern Shore. Many areas have been replaced or degraded by development, agriculture and commercial forestland. The canopy is typically semi-open and dominated by a mix of loblolly pine, shortleaf pine, pitch pine, sand hickory, southern red oak, and black jack oak. The understory is somewhat dense to open with scattered huckleberry, blueberry, sweet fern, and sand blackberry. The herb layer is sparse to open with scattered lichens, dry leaf litter, and exposed patches of whitish sand.

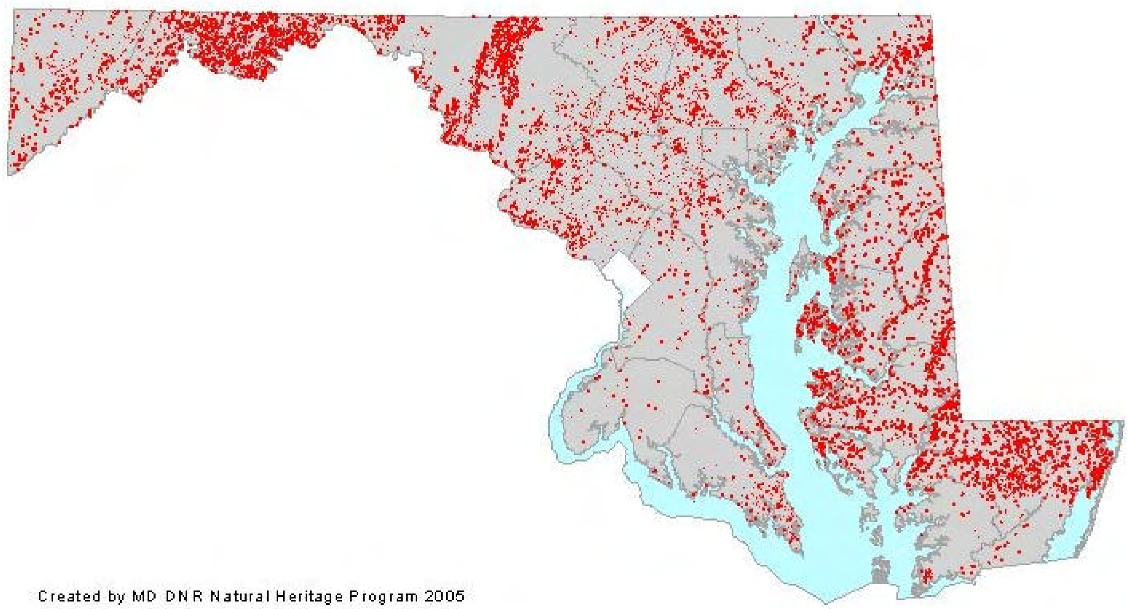
Dry oak-pine forests also include several types of dry calcareous woodlands and forests. On the Lower Coastal Plain, these exist as rare, localized, predominately hardwood forests and woodlands. They are nearly restricted to the upper Eastern Shore where they occur on steep, convex, south-facing slopes of deep ravines and stream-fronting bluffs that have downcut into Tertiary shell deposits. Examples can found along the upper portions of the Chesapeake Bay and tributaries of the Chester and Sassafras rivers. Soils are circumneutral to slightly alkaline with high calcium levels. The tree canopy ranges from semi-closed to very open and is characterized by chinquapin oak, hickories, and hackberry. The understory and herb layers are usually sparse to open. Characteristic herbaceous species include Robin's plantain, Bosc's panic grass, and slender wild rye.

Dry and dry-mesic calcareous forests and woodlands also occur, uncommonly, in western Maryland on steep, rocky south- to west-facing slopes at elevations of 400-900 m over carbonate formations of limestone or dolomite. Soils vary from circumneutral to moderately alkaline, and exhibit high calcium levels. As with the coastal plain type, characteristic trees include chinquapin oak, sugar maple and redbud. The understory and herb layers are variable from sparse to rich, depending on soil moisture, slope, aspect and elevation.

Location and Condition:

Dry-oak pine forests are a dominant habitat type on the mid- to upper slopes of many of the mountain ridges of western Maryland and hillsides in the Piedmont. However, their extent and condition have been greatly reduced by forest loss, fragmentation, logging, fire suppression and invasive plant species. Because of the predominance of oak, this habitat is particularly vulnerable to gypsy moth damage although, to some degree, infestations can mimic natural disturbance processes (e.g., scattered light gaps, increased structural diversity and coarse woody debris) that might otherwise be altered due to fire suppression, logging and other anthropogenic influences. On the Lower Coastal Plain, many of the largest remaining tracts occur along the leeward or eastern sides of the Pocomoke River, Nanticoke River and Marshyhope Creek and along some of their tributaries (e.g., Nassawango Creek). The condition of these "sand ridge" communities has been degraded by by fire suppression, logging, and conversion to loblolly pine stands. In addition, large acreages have been converted to cropland, residential development, and sand and gravel mining operations. Calcareous variants of this habitat are rare to uncommon, and confined to small, scattered sites on the upper Eastern Shore and western Maryland.

Figure 4.6 Location of Dry Oak - Pine Forests in Maryland (Sources: USGS MDN-GAP; USDA SCS STATSGO)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Allegheny woodrat
Bobcat
Eastern harvest mouse
Eastern red bat
Eastern small-footed myotis
Eastern spotted skunk
Indiana bat
Least weasel
New England cottontail
North American Porcupine
Silver-haired bat
Birds
Acadian flycatcher
Bachman's sparrow
Bicknell's thrush
Black-and-white warbler
Black-billed cuckoo
Broad-winged hawk
Chuck-will's-widow

Common nighthawk
Common raven
Eastern towhee
Hairy woodpecker
Northern bobwhite
Ovenbird
Pileated woodpecker
Red-eyed vireo
Red-headed woodpecker
Scarlet tanager
Summer tanager
Whip-poor-will
Wood thrush
Worm-eating warbler
Yellow-throated vireo
Reptiles
Broad-headed skink
Cornsnake
Eastern box turtle
Eastern hog-nosed snake

Northern pinesnake
Northern scarletsnake
Timber rattlesnake
Amphibians
Eastern narrow -mouthed toad
Eastern spadefoot
Inverts: Butterflies & Moths
A noctuid moth
American chestnut nepticulid moth
Chestnut clearwing moth
Cobweb skipper
Dotted skipper
Edwards' hairstreak
Frosted elfin
Giant swallowtail
Hoary elfin
Mottled duskywing
Northern metalmark
Persius duskywing
Phleophagan chestnut nepticulid

moth
Pine barrens zanclognatha
Silvery blue
Tawny crescent
The buckmoth
Inverts: Beetles
American burying beetle
Big sand tiger beetle

Cow Path Tiger Beetle
Eastern pinebarrens tiger beetle
Festive Tiger Beetle
Northern Barrens Tiger Beetle
One-spotted Tiger Beetle
Splendid Tiger Beetle
Inverts: Spiders
Red-legged purse-web spider

Rare Natural Communities
Coastal Plain Dry Calcareous Forests and Woodlands
Montane Acidic Woodlands
Montane Dry Calcareous Forests and Woodlands
Pine-Oak/Heath Forests and Woodlands
Sand Ridge/Inland Dune Woodlands

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, eastern fox squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, woodchuck, wild turkey, ruffed grouse, northern bobwhite, mourning dove, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible management practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Forest conversion to pine plantations
j. Windpower development on ridgetops that results in loss of habitat
k. Exclusion of natural fire regimes that promotes conversion of habitat
l. Sudden oak death that causes loss of oak component
m. Human disturbance, including ATV use, that results in degradation of habitat

Conservation Actions:

a. Re-establish natural fire regimes to restore and maintain habitats ***[Measure: # of acres maintained with contolled burn program; # of sites with natural fire regimes allowed]***
b. Conserve large blocks of contiguous forest where appropriate ***[Measure: # of acres contiguous forests conserved]***
c. Control the conversion of this habitat to pine plantations ***[Measure: # of acres dry oak pine forests protected from conversion]***
d. Conserve appropriate corridors for movement and dispersal of GCN species ***[Measure: # of acres forest corridors conserved]***
e. Minimize fragmentation of large, contiguous forest blocks ***[Measure: % of large forest blocks remaining unfragmented]***

f. **Develop habitat management guidelines for use by foresters and land managers and work with them to implement such** ***[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]***
g. **Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies** ***[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]***
h. Work through the Public Service Commission to reduce impacts of wind farms on this habitat and associated GCN species *[Measure: # of wind farm plans approved by Public Service Commission with input to mitigate impacts]*
i. Educate the public about the value of these forests and their conservation, especially addressing human disturbance issues *[Measure: # of educational materials developed and disseminated]*
j. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
k. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*
l. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*
m. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
n. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
o. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including forest interior birds *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species, especially insects *[Measure: # of surveys completed]*
e. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
f. Determine the effects of development activities on GCN species *[Measure: # of research projects conducted; # of research papers published]*

(7) Northern Conifer - Hardwood Forests

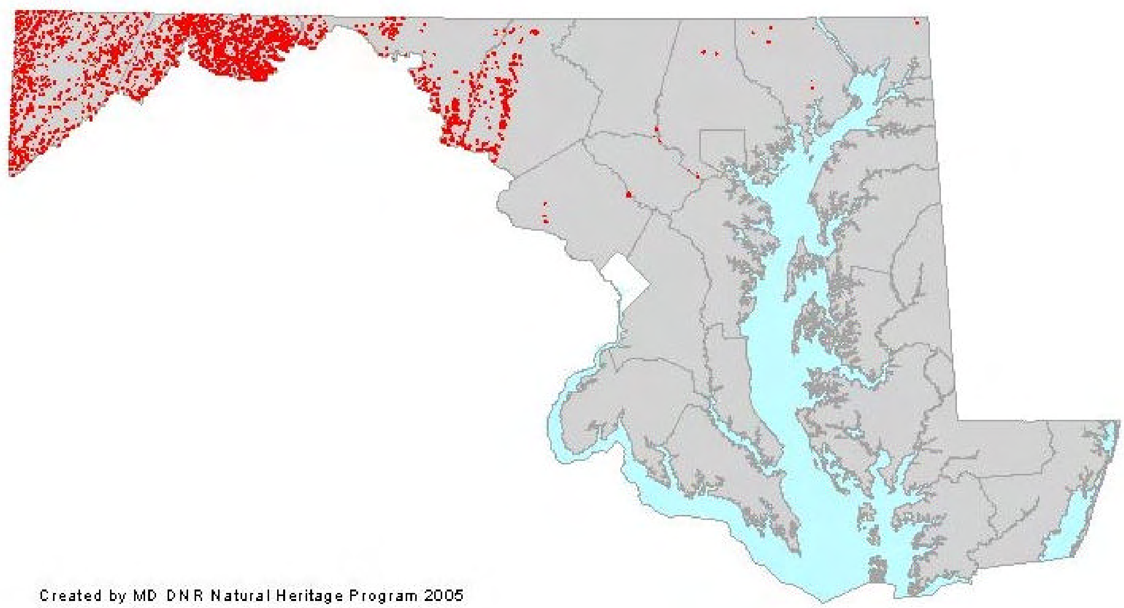
Description:

This habitat comprises two sub-boreal forest types, northern conifers and northern hardwoods. In Maryland, northern conifer-hardwood forests grow primarily on the Allegheny Plateau, typically on mesic sites above 600 m, as forest ecotones bordering high elevation wetlands, along stream bottoms and north-facing slopes, and in deep ravines. In northern conifer forests, eastern hemlock, red spruce, and/or white pine is co-dominant or dominant, and often mixed with northern hardwoods. Northern hardwood forests are dominated by sugar maple, yellow birch, and black cherry. Associates include basswood, white ash, northern red oak, red maple, American beech, and northern conifers. In both forest types, common midstory and understory species include striped maple, witch hazel, maple-leaf viburnum, and frequently dense patches of great laurel and mountain laurel. The herb layer is often quite diverse, especially in less acidic soils. In the Ridge and Valley physiographic region, this habitat is much more limited and mostly confined to mesic, north-facing slopes and stream ravines where eastern hemlock, white pine and northern hardwoods may be dominant. White pine also occurs as a dominant or co-dominant on drier slopes in association with various oaks and hickories, particularly in Allegany County. In the Piedmont and Coastal Plain, this habitat is rare and restricted to scattered, isolated sites on steep, mesic, north-facing slopes, ravines and stream valleys where eastern hemlock is a dominant or co-dominant.

Location and Condition:

Most of the state's remaining northern conifer-hardwood forests occur on the Allegheny Plateau followed by the Ridge and Valley where it is more local in distribution. The overall extent and quality of this habitat has been greatly diminished by logging, conversion to agriculture, strip mining and residential development. During the late 19th and early 20th centuries, logging all but eliminated most remaining tracts of old growth condition of this forest. On the Allegheny Plateau, red spruce was nearly logged out. Most of the few remaining forests containing red spruce are now confined to high elevation bog wetland systems. The extent and dominance of white pine, a highly sought after and formerly much more common tree species, has also been greatly reduced. In recent years, eastern hemlock has been impacted by infestations of hemlock wooly adelgid an accidentally introduced insect pest. Hemlock stands in the Blue Ridge, Piedmont and Coastal Plain have been particularly hard hit. Widespread declines in hemlock could have severe ripple effects on other flora and fauna dependant on hemlock-dominated forests.

Figure 4.7 Location of Northern Conifer - Hardwood Forests in Maryland (Sources: USGS MDN-GAP; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals	American redstart	Northern parula
Allegheny woodrat	Barred owl	Northern saw -whet owl
American marten	Bicknell's thrush	Ovenbird
Bobcat	Black-and-white warbler	Pileated woodpecker
Eastern red bat	Black-billed cuckoo	Red-breasted nuthatch
Eastern small-footed myotis	Blackburnian warbler	Red-eyed vireo
Eastern spotted skunk	Black-throated blue warbler	Scarlet tanager
Hoary bat	Black-throated green warbler	Sharp-shinned hawk
Indiana bat	Blue-headed vireo	Swainson's thrush
Least weasel	Broad-winged hawk	Veery
Long-tailed shrew	Brown creeper	Whip-poor-will
New England cottontail	Canada warbler	Winter wren
North American Porcupine	Common raven	Wood thrush
Northern flying squirrel	Dark-eyed junco	Worm-eating warbler
Silver-haired bat	Golden-crowned kinglet	Yellow -bellied sapsucker
Smoky shrew	Hairy woodpecker	Yellow -throated vireo
Snowshoe hare	Hermit thrush	**Reptiles**
Southern bog lemming	Hooded warbler	Eastern box turtle
Southern pygmy shrew	Least flycatcher	Timber rattlesnake
Southern rock vole	Long-eared owl	**Amphibians**
Southern water shrew	Magnolia warbler	Green salamander
Birds	Nashville warbler	Jefferson salamander
Acadian flycatcher	Northern goshawk	Wehrle's salamander

Inverts: Butterflies & Moths
Appalachian blue
Compton tortoiseshell
Dusky azure
Early hairstreak
Gray comma
Olympia marble

Three-horned moth
West virginia white
Inverts: Land Snails
Angular disc
Bear creek slitmouth
Spruce knob threetooth

Rare Natural Communities
Central Appalachian Northern Hardwood Forests
Central Appalachian Red Spruce Forests
Acidic Cove Forests
Eastern Hemlock Forests
Eastern White Pine-Hardwood Forests

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, red squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, fisher, mink, wild turkey, ruffed grouse, and American crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible silviculture practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Forest pests that cause loss of spruce component of forests
j. Hemlock wooly adelgid and other forest pests that cause loss of hemlock component of forests
k. Deer overbrowsing or other causes that result in loss of forest structural diversity
l. Acid precipitation
m. Development of wind farms on ridgetops that result in loss of habitat

Conservation Actions:

a. Maintain conifer component of forest or restore such where appropriate ***[Measure: # of acres with conifer component maintained; # of acres with conifer component restored]***
b. Conserve large blocks of contiguous forest where appropriate ***[Measure: # of acres contiguous forests conserved]***
c. Minimize fragmentation of large, contiguous forest blocks ***[Measure: % of large forest blocks remaining unfragmented]***
d. Establish and maintain landscape-scale protected habitat and movement corridors ***[Measure: # of existing targeted large forested patches connected by new corridors; # of acres new corridors established]***

e. **Develop and implement protocols to control invasive species in a manner compatible with GCN species** ***[Measure: # of protocols developed; # of sites with management implemented]***
f. Work through the Public Service Commission to reduce impacts of wind farms on this habitat and associated GCN species *[Measure: # of wind farm plans approved by Public Service Commission with input to mitigate impacts]*
g. Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies *[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]*
h. Develop habitat management guidelines for use by foresters and land managers and work with them to implement such *[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]*
i. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*
j. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*
k. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
l. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
m. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including forest interior birds and boreal mammals *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially boreal mammals, reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, especially boreal mammals, reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of surveys completed]*
e. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
f. Investigate the effects of invasive species, gypsy moth spraying, and deer overbrowsing on GCN species *[Measure: # of research projects conducted; # of research papers published]*
g. Assess the impacts of wooly adelgid on this habitat *[Measure: # of research projects conducted; # of research papers published]*

(8) Floodplain Forests

Description:

Floodplain forests comprise a variety of nontidal and tidal forest habitats that occur along streams and rivers and their adjacent floodplains. Examples of floodplain forests can be found statewide but some of the largest tracts occur on the Upper and Lower Coastal Plain. Along tidally influenced rivers in these regions, broad expanses of floodplain forests occur between gradually sloping uplands on the landward side and tidal shrublands followed by oligohaline and/or mesohaline marshes bordering the river channel. The forest canopy is often semi-open and, along many river sections, there is a gradual forest-shrubland-marsh wetland ecotone. Tidal floodplain forests range from bald cypress dominated swamps in parts of the Pocomoke River watershed to gum-maple (black gum, red maple, sweetgum) and red maple-green ash dominated bottomlands. At slightly higher elevations on hammocks and near the floodplain-upland edges, loblolly pine, sweetgum, and various oaks may be frequent. In the Nanticoke and Pocomoke river watersheds, Atlantic white-cedar also occurs in the upper or inland sections of tidal floodplain forests, mostly as scattered individuals but occasionally in small isolated stands. Atlantic white-cedar and bald cypress were formerly much more widespread and common on the lower Eastern Shore but were heavily logged out by the early 1900s. The shrub layer in tidal floodplain forests is usually dense and diverse often including species, such as northern arrow-wood, winterberry, silky dogwood, swamp azalea, swamp rose, fetterbush, and sweet pepperbush. Climbing vines are common in multiple layers and may include species such as common wild yam, poison-ivy, common greenbrier, and Virginia creeper. Pronounced hummock-and-hollows microtopography is characteristic of tidal floodplain forests. Hollows are regularly inundated by tidal water, whereas hummocks are less frequently flooded thus supporting the establishment of trees and mesophytic herbs. High species richness in the herb layer can be attributed to flooding frequency and hummock-and-hollow microtopography. Regularly flooded hollows support many flood-tolerant swamp species such as jewelweed, arrow arum, halberd-leaf tearthumb, lizard's-tail, and sedges such as tussock sedge. Elevated above normal high tides, hummocks provide habitat for marsh blue violet, water-hemlock, greenfruit clearweed, false nettle, and ferns such as royal fern, cinnamon fern, and marsh fern.

In brackish river systems, small fringing tidal woodlands dominated by loblolly pine occur along portions of tidal rivers and creeks, in narrow ecotones between "high salt marshes" and adjacent uplands, and as islands within extensive salt marshes. Examples of these tidal floodplain forests can be found in the lower “tidewater” areas of Dorchester, Wicomico, Somerset, Worcester and St. Mary’s counties. Frequency of tidal flooding is variable, often less than daily due to fluctuations in groundwater levels and landscape position. These habitats are species poor, with loblolly pine often forming a monospecific canopy and southern bayberry comprising the shrub layer. Indicative of brackish conditions, species diversity in the herbaceous layer is quite low and chiefly comprised of halophytic vegetation. Most frequent and dominant of these include small saltmeadow cordgrass, switchgrass, and saltgrass.

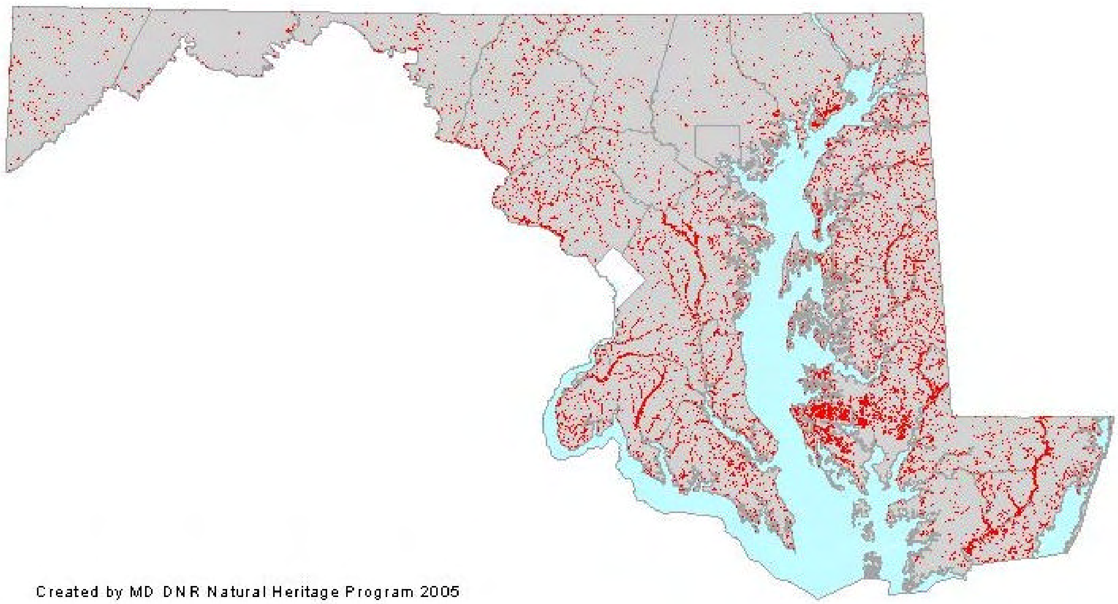
Nontidal floodplain forests on Maryland’s Coastal Plain are very diverse. Swamp forests extend up to the river’s edge, replacing the forest-shrub-marsh ecotone frequently found along tidal river sections. These seasonally flooded swamps are often dominated by combinations of green ash, red maple, sweetgum, swamp tupelo, willow oak, and overcup oak. Well-drained levees support swamp chestnut oak, cherrybark oak, American elm, and river birch is often abundant in disturbed, cut-over stands. Along small streams, trees typical of both levees and swamps may occur in mixed stands. On exceptionally well-drained small stream bottoms, tulip-poplar is often important. Small tree, shrub, and herbaceous composition are highly variable between sites.

In the Piedmont and Ridge and Valley provinces, most large stream and river floodplains consist of temporarily to intermittently flooded bottomland forests, dominated by sycamore, silver maple, boxelder, and American elm. Alluvial landforms such as gravel bars, levees, terraces, old oxbows and sloughs are usually present. Young, flood-scoured woodlands sometimes occur along shoreline areas and islands, especially in high-gradient rocky sections and along flood-deposited sand and gravel bars. Such areas are frequently dominated by dense, nearly pure stands of small (2-8 m tall) sycamore, boxelder, river birch and green ash trees. Embedded within floodplain forests are floodwater pools and seasonally flooded backswamps and sloughs dominated by red maple, silver maple, pin oak, swamp white oak, and sweetgum. These backwater areas usually exhibit distinctive hummock-and-hollow microtopography with maximum flood depths of 50-70 cm. Along smaller streams, where the floodplain is narrower and alluvial landforms occur at much smaller scales, floodplain forests also include more mesic species such as tulip poplar, sugar maple, basswood, American beech, eastern hemlock, and white pine. Small tree, shrub, and herbaceous composition are highly variable between sites. Farther west, on the Allegheny Plateau, northern hardwoods and northern conifers such as eastern hemlock, yellow birch, and black cherry tend to dominate and the understory often contains dense thickets of great-laurel.

Location and Condition:

Extensive tracts of floodplain forests remain along some of the streams and rivers of the Coastal Plain, especially in the Pocomoke, Nanticoke, Choptank and Patuxent drainages. However, many of these waterways, especially the smaller tributaries, have been ditched and channelized and the remaining floodplain forests areas have been drained and cleared for agriculture. From the Piedmont westward, many of the largest floodplain forests occur along the Potomac River and its major tributaries. However, much of this habitat has been converted to cropland or pasture, with concomitant decreases in stream water quality. Many floodplain forests also have been impacted by logging, dams and rapidly expanding populations of invasive species. On the lower Eastern Shore, logging has significantly reduced the extent of bald cypress and Atlantic white-cedar. Floodplain forests have also been impacted by changes in stream and river hydrology and declines in water quality due to reductions in forest cover and increases in impervious surfaces in the surrounding watershed.

Figure 4.8 Location of Floodplain Forests in Maryland (Sources: USFWS NWI; FEMA; MD DNR MBSS/Versar Inc.)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Delmarva fox squirrel
Eastern red bat
Hoary bat
Indiana bat
Least weasel
Rafinesque's big-eared bat
Silver-haired bat
Southeastern myotis
Southeastern shrew
Southeastern star-nosed mole
Southern pygmy shrew
Southern water shrew
Birds
Acadian flycatcher
American black duck
American redstart

American woodcock
Bald eagle
Bank swallow
Barred owl
Bicknell's thrush
Black-and-white warbler
Black-billed cuckoo
Blackburnian warbler
Black-crowned night-heron
Black-throated blue warbler
Black-throated green warbler
Blue-headed vireo
Broad-winged hawk
Brown creeper
Brown-headed nuthatch
Canada warbler
Cerulean warbler
Golden-crowned kinglet

Great blue heron
Great egret
Hairy woodpecker
Hermit thrush
Hooded warbler
Kentucky warbler
Louisiana waterthrush
Magnolia warbler
Northern parula
Ovenbird
Pileated woodpecker
Prothonotary warbler
Red-eyed vireo
Red-headed woodpecker
Red-shouldered hawk
Scarlet tanager
Solitary sandpiper
Swainson's warbler

Veery	Jefferson salamander	Northern crescent
Wayne's black-throated green warbler	New Jersey chorus frog	Palamedes swallowtail
Wood thrush	**Inverts: Dragonflies & Damselflies**	Pepper and salt skipper
Worm-eating warbler	Aurora damsel	Precious underwing
Yellow-crowned night-heron	Blue-faced meadowhawk	West virginia white
Yellow-throated vireo	Cyrano darner	**Inverts: Dipterans**
Reptiles	Fine-lined emerald	Pitcher-plant mosquito
Bog turtle	Harlequin darner	**Inverts: Beetles**
Broad-headed skink	Robust baskettail	Appalachian Tiger Beetle
Common ribbonsnake	Taper-tailed darner	Giant stag beetle
Eastern box turtle	White-faced meadowhawk	**Inverts: Freshwater Crustaceans**
Eastern spiny softshell	**Inverts: Butterflies & Moths**	An entocytherid ostracod
Northern map turtle	Baltimore checkerspot	An entocytherid ostracod
Northern red-bellied turtle	Carolina satyr	
Queen snake	Chermock's mulberry wing	**Rare Natural Communities**
Rainbow snake	Cypress sphinx moth	Riverside Outcrop Barrens
Red-bellied watersnake	Dion skipper	Floodplain Ponds and Pools
Spotted turtle	Giant swallowtail	Piedmont/Mountain Swamp Forests
Timber rattlesnake	Golden-banded skipper	River-Scour Woodlands
Wood turtle	Great purple hairstreak	Riverside Prairies
Amphibians	Hessel's hairstreak	Atlantic White Cedar Wetlands
Carpenter frog	King's hairstreak	Estuarine Fringe Loblolly Pine Forests
Eastern mud salamander	Long dash	Tidal Bald Cypress Woodlands/Forests
Eastern narrow-mouthed toad	Marbled underwing	
Eastern spadefoot		

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, sika deer, black bear, eastern gray squirrel, eastern fox squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink, northern river otter, American beaver, muskrat, woodchuck, wild turkey, ruffed grouse, northern bobwhite, American woodcock, mourning dove, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or forest types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Incompatible silviculture practices that result in degradation of habitat
d. Development and land use, including roadways and trails that results in forest fragmentation and isolation
e. Deer overbrowsing or other causes that result in loss of forest structural diversity
f. Forest pest species that may have landscape level effects
g. Invasive/exotic species that result in degradation of habitat

h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Incompatible agricultural practices such as ditching, channelization, livestock grazing, inadequate buffers, and pond construction that result in habitat degradation
j. Development and roads that cause reduced water quality and hydrological changes
k. Encroachment by woody vegetation or buffer planting on riverine prairies and rare herbaceous species
l. Altered natural disturbance patterns resulting in inadequate habitat conditions for certain GCN species
m. Acid mine drainage
n. Groundwater withdrawal for residential, commercial, and agricultural use that results in hydrologic changes
o. Removal of beaver populations
p. Human disturbance, including ATV use, that results in degradation of habitat

Conservation Actions:

a. **Restore floodplain forests including reestablishment of old growth, natural hydrology, and improved water quality** ***[Measure: # of acres restored]***
b. **Conserve large blocks of contiguous forest where appropriate** ***[Measure: # of acres contiguous forests conserved]***
c. **Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to forested wetland areas and surrounding watershed** ***[Measure: # of development projects near forested wetlands with improved storm water and sediment management incorporated into plans]***
d. **Establish and maintain landscape-scale protected habitat and movement corridors** ***[Measure: # of existing targeted large forested patches connected by new corridors; # of acres new corridors established]***
e. **Promote and support watershed-based initiatives to restore and protect watersheds** ***[Measure: # of watershed-based initiatives implemented]***
f. **Minimize fragmentation of large, contiguous forest blocks** ***[Measure: % of large forest blocks remaining unfragmented]***
g. **Establish and maintain adequate forest buffers along streams and rivers** ***[Measure: # of miles of stream/river forested buffers established and maintained]***
h. **Incorporate forest conservation actions into land use and land planning efforts by local, state, and federal agencies** ***[Measure: # of local, state, and federal agency plans incorporating forest wildlife focused habitat management actions]***
i. Work with farming community to conserve, restore, and protect floodplain forests *[Measure: # of acres floodplain forest protected or restored from agricultural use; # of sites with cooperative management projects]*
j. Enforce and modify, as needed, nontidal wetland protection regulations especially as they relate to Wetlands of Special State Concern *[Measure: # of regulation modifications proposed; # of violations prosecuted; # of citations issued]*
k. Develop habitat management guidelines for use by foresters and land managers and work with them to implement such *[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]*

l. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
m. Protect target riverside prairie habitat *[Measure: # of acres protected]*
n. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*
o. Maintain natural beaver populations *[Measure: # of viable beaver populations; # of miles of stream influenced by beaver activity]*
p. Remove certain dams to allow for flooded areas to revert back to forest *[Measure: # of dams removed; # of acres reverted to floodplain forest]*
q. Work with watershed groups to encourage forest conservation as a strategy for water conservation *[Measure: # of groups contacted; # of cooperative projects and meetings with watershed groups]*
r. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites or acres with reduced quantity or frequency of pesticide use]*
s. Restore degraded habitats through appropriate techniques *[Measure: # of sites or acres with degraded habitat restored]*
t. Implement appropriate IPM practices to minimize the effects of serious forest pest species *[Measure: # of sites or acres with IPM practices implemented]*
u. Work with Maryland DOT to improve transportation planning for new roads to minimize fragmentation of habitat *[Measure: # or miles of new roads planned with comments/input to minimize forest fragmentation]*

Inventory, Monitoring and Research Needs:

a. Conduct surveys to better determine the distribution, abundance, population strongholds and status of GCN species, especially odonates, southern water shrew, bats, reptiles, amphibians, butterflies, and forest interior birds *[Measure: # of surveys completed]*
b. Conduct research on life history, habitat requirements, metapopulation dynamics and movement/dispersal patterns of GCN species *[Measure: # of research projects conducted; # of research papers published]*
c. Determine effective buffer widths as it relates to development, timber harvesting and farming practices; include upland life zone requirements of reptiles and amphibians, foraging areas for bats, and area-sensitive species like forest interior birds and bobcat *[Measure: # of research projects conducted; # of research papers published]*
d. Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed *[Measure: # of monitoring studies established; # of monitoring studies conducted]*

(9) Upland Depressional Swamps

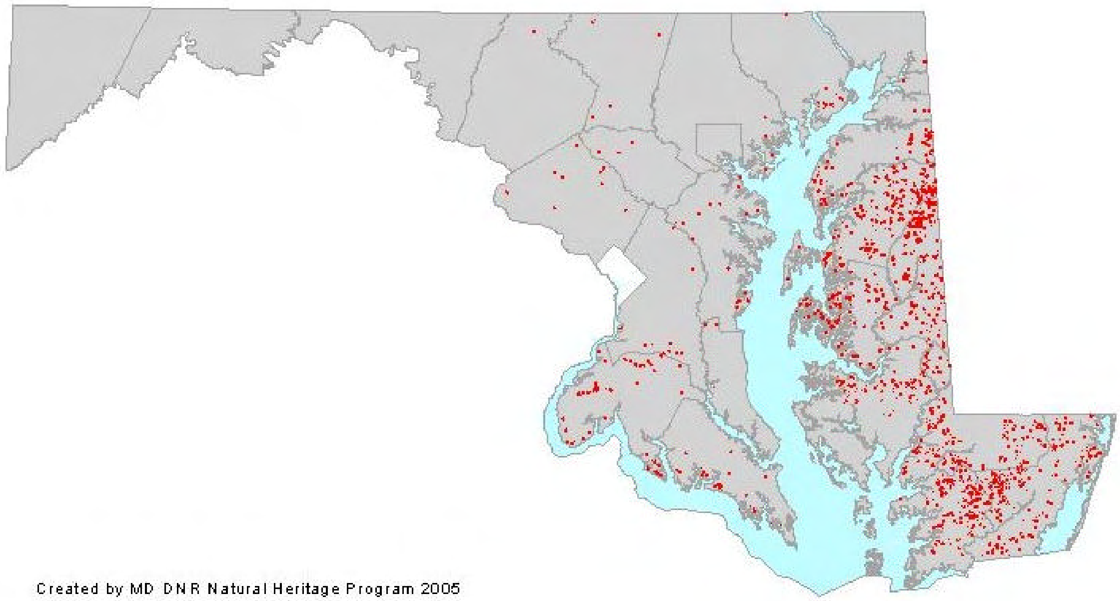
Description:

Upland depression swamps are seasonally flooded forested wetlands in the Piedmont and Coastal Plain. In the Piedmont, upland depression swamps are isolated, depressional wetlands characterized by shallow bedrock or clay hardpans that impede soil drainage. In the Coastal Plain, these habitats form in basin depressions on hardpan soils with shallow seasonal flooding induced by perched water tables. This results in standing water throughout the early part of the growing season, followed by a period of drawdown. Hydroperiods are variable between swamps and largely dependent on rainfall and drought cycles. The forested canopy structure of upland depression swamps ranges from open to closed and is primarily oak-dominated with other hardwoods less frequent. Common tree species include willow oak, pin oak, swamp chestnut oak, green ash, red maple, and black gum. In the understory, shrubs and vines are common but variable, often including an abundance of common greenbrier. The herbaceous layer is often sparse and may include species of sedges, manna-grasses, and rushes. Slightly elevated hummocks of sphagnum mosses frequently form large patches. Upland depression swamps are isolated wetlands subject to major disturbances such as logging, draining, and development. In Maryland, many community types associated with upland depression swamps are considered rare.

Location and Condition:

Upland depression swamps are widespread throughout the Coastal Plain occupying broad flats between drainage streams. Swamps with clay hardpan soils are most numerous in Queen Annes, Dorchester, Wicomico, Somerset, and Worcester Counties. In the Piedmont, upland depression swamps are scattered but are most numerous in Triassic basins. Documented sites are found over areas of Balls Bluff siltstone, diabase, and bedrock terraces of the Potomac River. The majority of upland depression swamps have been altered through logging, draining, development, and conversion to agriculture. Relatively few high quality examples remain.

Figure 4.9 Location of Upland Depressional Swamps in Maryland (Sources: USFWS NWI)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Eastern red bat
Hoary bat
Southeastern myotis
Southeastern shrew
Southeastern star-nosed mole
Southern pygmy shrew
Birds
Acadian flycatcher
American redstart
American woodcock
Barred owl
Black-and-white warbler
Black-billed cuckoo
Blackburnian warbler
Black-throated blue warbler
Black-throated green warbler
Brown creeper
Brown-headed nuthatch
Canada warbler
Great blue heron
Great egret
Hairy woodpecker
Hooded warbler

Kentucky warbler
Louisiana waterthrush
Magnolia warbler
Northern waterthrush
Ovenbird
Pileated woodpecker
Prothonotary warbler
Red-shouldered hawk
Scarlet tanager
Swainson's warbler
Wayne's black-throated green warbler
Wood thrush
Reptiles
Common ribbonsnake
Northern red-bellied turtle
Spotted turtle
Amphibians
Carpenter frog
Eastern mud salamander
Eastern spadefoot
New Jersey chorus frog
Inverts: Dragonflies & Damselflies
Amber-winged spreadwing
American emerald

Atlantic bluet
Attenuated bluet
Aurora damsel
Azure bluet
Bar-winged skimmer
Beaverpond baskettail
Black-tipped darner
Blue-faced meadowhawk
Burgundy bluet
Canada darner
Chalk-fronted skimmer
Cherry-faced meadowhawk
Comet darner
Cyrano darner
Dot-tailed whiteface
Eastern red damsel
Elfin skimmer
Emerald spreadwing
Four-spotted pennant
Golden-winged skimmer
Great spreadwing
Hagen's bluet
Harlequin darner
Little blue dragonlet
Lyre-tipped spreadwing

Mantled baskettail	Taper-tailed darner	Pepper and salt skipper
Pale bluet	Treetop emerald	Precious underwing
Petite emerald	Tule bluet	**Inverts: Dipterans**
Rainbow bluet	Vesper bluet	Pitcher-plant mosquito
Sedge sprite	White corporal	**Inverts: Beetles**
Seepage dancer	White-faced meadowhawk	A dytiscid beetle
Ski-tailed emerald	Yellow-sided skimmer	A hydrophilid beetle
Slender bluet	**Inverts: Butterflies & Moths**	**Inverts: Freshwater Crustaceans**
Southern sprite	Baltimore checkerspot	An entocytherid ostracod
Sphagnum sprite	Dion skipper	An entocytherid ostracod
Spotted spreadwing	Great purple hairstreak	
Spring blue darner	Hessel's hairstreak	**Rare Natural Communities**
Stripe-winged baskettail	King's hairstreak	Atlantic White Cedar Wetlands
Sweetflag spreadwing	Palamedes swallowtail	

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, eastern gray squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink, northern river otter, muskrat, American woodcock, mallard, wood duck, American crow, fish crow, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Incompatible silviculture practices that results in habitat degradation
j. Nontarget impacts of gypsy moth control
k. Mosquito control practices (larvicides, adulticides, introduction of *Gambusia*)
l. Human disturbance, including ORV use, that results in habitat degradation
m. Decline of Atlantic white cedar in the Coastal Plain
n. Hemlock wooly adelgid that cause loss of hemlock component

Conservation Actions:

a. **Protect and restore best remaining upland depressional wetlands** ***[Measure: # of acres of priority upland depressional wetlands protected and restored]***
b. **Enforce and modify, as needed, nontidal wetland protection regulations especially as it relates to Nontidal Wetlands of Special Concern** ***[Measure: # of regulation modifications proposed; # of violations prosecuted; # of citations issued]***
c. **Establish and maintain effective buffers along wetlands by restoring natural communities where possible** ***[Measure: # of miles wetland buffers established; # of acres of natural communities restored adjacent to wetlands]***
d. **Work with farming community to restore and protect wetlands through NRCS, FSA, USFWS, and MDA programs** ***[Measure: # of acres wetland restored and protected]***
e. **Protect wetlands through acquisitions and easements** ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
f. **Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
g. **Incorporate wetland conservation actions into land planning efforts and public land management plans** ***[Measure: # of acres of wetlands conserved during land planning efforts; # of public land management plans incorporating wetland wildlife focused habitat conservation actions]***
h. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
i. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
j. Limit development impacts within wetland areas and surrounding watershed *[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]*
k. Regulate mosquito control, gypsy moth control, and control of other pests in upland depressional wetlands and surrounding landscape *[Measure: # of sites with reduced quantity or frequency of pesticide use and other control methods]*
l. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
m. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
n. Develop and implement protocols to control invasive species and prevent their establishment *[Measure: # of protocols developed; # of sites with management implemented]*
o. Provide sufficient landscape connectivity *[Measure: # of wetland sites with sufficient landscape connectivity]*
p. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
q. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
r. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
s. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

t. Educate public about human disturbance issues *[Measure: # of educational materials developed and distributed]*
u. Restore hemlock/Atlantic white cedar component where feasible *[Measure: # of acres upland depressional wetland with hemlock/Atlantic white cedar components restored]*

Inventory, Monitoring and Research Needs:

a. Conduct surveys to better determine the distribution, characteristics and condition of upland depressional wetlands *[Measure: # of surveys completed]*
b. Conduct surveys to better determine the distribution, abundance, population strongholds and status of GCN species, especially odonates, reptiles, amphibians, and butterflies *[Measure: # of surveys completed]*
c. Conduct research on life history, habitat requirements, metapopulation dynamics and movement/dispersal patterns of GCN species *[Measure: # of research projects conducted; # of research papers published]*
d. Determine effective buffer widths as it relates to development, timber harvesting, and farming practices; include upland life zone requirements of reptiles, amphibians, foraging areas for bats, and area-sensitive species like forest-nesting birds and bobcat *[Measure: # of research projects conducted; # of research papers published]*
e. Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed *[Measure: # of monitoring studies established; # of monitoring studies conducted]*

(10) Carolina Bays

Description:

Carolina bays (also known as Coastal Plain ponds and Delmarva bays) are rare habitats generally described as shallow, seasonally flooded depression wetlands on Maryland's Lower Coastal Plain. Research suggests these habitats developed from ancient interdunal depressions approximately 16,000 years ago when the climate of the Coastal Plain was very cold and windy and supported an extensive sand dune ecosystem. The majority of Carolina bays have been shaped by these wind processes into elliptical depressions up to one meter in depth with prominent sand rims. A perched water table and seasonal fluctuations in groundwater recharge and precipitation cause these wetlands to be irregularly flooded or seasonally inundated. During very dry seasons, surface water may be absent or limited to the deepest point within the bay. Likewise, during very wet years when rainfall is abundant, bays may retain water throughout the entire growing season. Depth and duration of seasonal inundation are apparently the most important factors influencing plant communities and the degree to which woody species become established. Dry-season fires in adjacent uplands may spread into bays and may be another factor limiting the invasion of woody species, although fire frequencies throughout the region have been much reduced in recent decades. The vegetation of Carolina bays is closely linked to its hydrologic regime. As water levels draw down or recede during the growing season, plant communities typically develop concentric rings from the outer edge towards the center or deepest point in the bay. Outer rings of a bay may include shrubs of buttonbush, fetterbush, swamp loosestrife, and sweet pepperbush or nearly monospecific stands of Walter's sedge, maidencane and Virginia chain fern. Interior portions of bays may include species such as Eaton's witchgrass, warty panicgrass, and Virginia meadow-beauty. Many of these species grade into the "draw down pocket" or lowest portion of a bay, which is the last to desiccate during the growing season. Common to this zone are slender fimbry and flood tolerant shrubs of buttonbush. Carolina bays are often embedded in a matrix of seasonally flooded swamp forests that are dominated by red maple, sweetgum, and persimmon. Many plants and animals considered rare in Maryland are known to occur in Carolina bays.

Location and Condition:

In Maryland, Carolina bays are restricted to the Lower Coastal Plain and are most abundant in Kent, Queen Annes, Caroline, and Dorchester Counties. Although high quality examples of each of these habitats exist, most of these bays suffer from significant abiotic and biotic threats. There are heavy impacts on Carolina bays from suspected lowering ground water, causing an increase in woody plant invasion and succession of historically herbaceous types to shrub and forested types (Berdine and Gould 1999). It has been estimated that 10,000 acres of palustrine wetlands were lost to agricultural practices between 1955 and 1978 and 2062 acres were lost due to agricultural practices between 1982 and 1989 (Tiner and Burke 1995). The impacts of traditional land use are accompanied by the pressures from land development. The conversion of land from natural cover and agricultural uses to commercial and residential uses poses one of the single largest threats to palustrine wetlands in Maryland.

An ongoing inventory of natural communities by NHP has documented 175 acres of this extremely rare habitat type remaining in Maryland. Approximately 25% of this key wildlife habitat is owned by the state, 25% is owned by conservation organizations (primarily TNC), and 50% is in private ownership.

Figure 4.10 Location of Carolina Bays in Maryland (Sources: USFWS NWI; MD DNR Wetlands; MD DNR NHP)

GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Southeastern star-nosed mole
Birds
Pied-billed grebe
Reptiles
Spotted turtle
Amphibians
Barking treefrog
Carpenter frog
Eastern spadefoot

Eastern tiger salamander
New Jersey chorus frog
Inverts: Dragonflies & Damselflies
Attenuated bluet
Aurora damsel
Azure bluet
Bar-winged skimmer
Blue-faced meadowhawk
Comet darner

Cyrano darner
Fine-lined emerald
Harlequin darner
Slender bluet
Sphagnum sprite
Spotted spreadwing
Sweetflag spreadwing
Taper-tailed darner
Vesper bluet

Rare Natural Communities	Carolina Bays

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink, northern river otter, eastern cottontail, woodchuck, muskrat, wild turkey, northern bobwhite, American woodcock, common snipe, mallard, American black duck, wood duck, blue-winged teal, green-winged teal, ring-necked duck, hooded merganser, American crow, fish crow, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Woody encroachment (buttonbush, red maple, sweetgum, and other species succeeding into formerly open-canopy herbaceous-dominated seasonal wetlands)
j. Exclusion of natural fire regimes that promote conversion of habitat
k. Incompatible silviculture practices that results in habitat degradation

Conservation Actions:

a. Conserve and maintain the integrity of Carolina bay wetland systems, including targeting the highest quality areas for acquisition and working with appropriate planning and zoning agencies ***[Measure: # of priority Carolina bays protected]***
b. Maintain wetland breeding habitat and adjacent upland non-breeding habitats (life zones) of GCN species ***[Measure: # of acres of habitat for GCN species protected]***
c. Protect wetlands through acquisition and easements, including surrounding buffers ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
d. Restore hydrology through ditch plugging and other appropriate practices ***[Measure: # of Carolina bays with restored hydrology]***
e. Restore wetland conditions where appropriate ***[Measure: # of acres wetlands restored]***

f. **Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
g. **Incorporate wetland conservation actions into land planning efforts and public land management plans** ***[Measure: # of acres of wetlands conserved during land planning efforts; # of public land management plans incorporating wetland wildlife focused habitat conservation actions]***
h. Limit development impacts within wetland areas and surrounding watershed *[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]*
i. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
j. Implement prescribed burn programs to control woody vegetation *[Measure: # of acres maintained with controlled burn program]*
k. Identify forest management practices that would improve habitat suitability *[Measure: guidelines developed]*
l. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
m. Work with watershed groups, watershed based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
n. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
o. Develop and implement protocols to control invasive species and prevent their establishment *[Measure: # of protocols developed; # of sites with management implemented]*
p. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
q. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
r. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Implement effective assessment of population abundance, trends, distribution, and movement patterns, and for improved monitoring GCN species, especially amphibians and odonates *[Measure: # of surveys completed; # of monitoring programs implemented]*
b. Conduct studies on the factors limiting species abundance, such as predation rates, reproductive success, contamination, and prey availability *[Measure: # of research studies completed; # of research papers published]*
c. Determine landscape attributes and preserve designs that will allow the persistence of populations *[Measure: # of research studies completed; # of research papers published]*
d. Determine management needs and best management practices for GCN species *[Measure: # of research studies completed; # of BMPs developed]*
e. Monitoring programs should accompany management activities to assess effects of techniques on GCN species and long-term habitat suitability *[Measure: # of monitoring programs established; # of monitoring programs conducted]*
f. Determine and monitor hydrologic conditions, including the impacts of irrigation *[Measure: # of hydrologic monitoring sites established; impacts of irrigation determined]*

(11) Vernal Pools

Description:

Vernal pools are small (~0.1-2 ha), nontidal palustrine forested wetlands. They exhibit a well-defined, discrete basin and lack a permanent, above ground outlet. The basin overlies a clay hardpan or some other impermeable soil or rock layer that impedes drainage. As the water table rises in fall and winter, the basin fills, forming a shallow pool. By spring, the pool typically reaches maximum depth (~0.5-2.5 m) following snowmelt and the onset of spring rains. By mid-late summer, the pool usually dries up completely, although some surface water may persist in relatively deep basins, especially in years with above average precipitation. This periodic, seasonal drying prevents fish populations from becoming established, an important biotic feature of vernal pools. Many species have evolved to use these temporary, fish-free wetlands. Some are obligate vernal pools species, so called because they require a vernal pool to complete all or part of their life cycle.

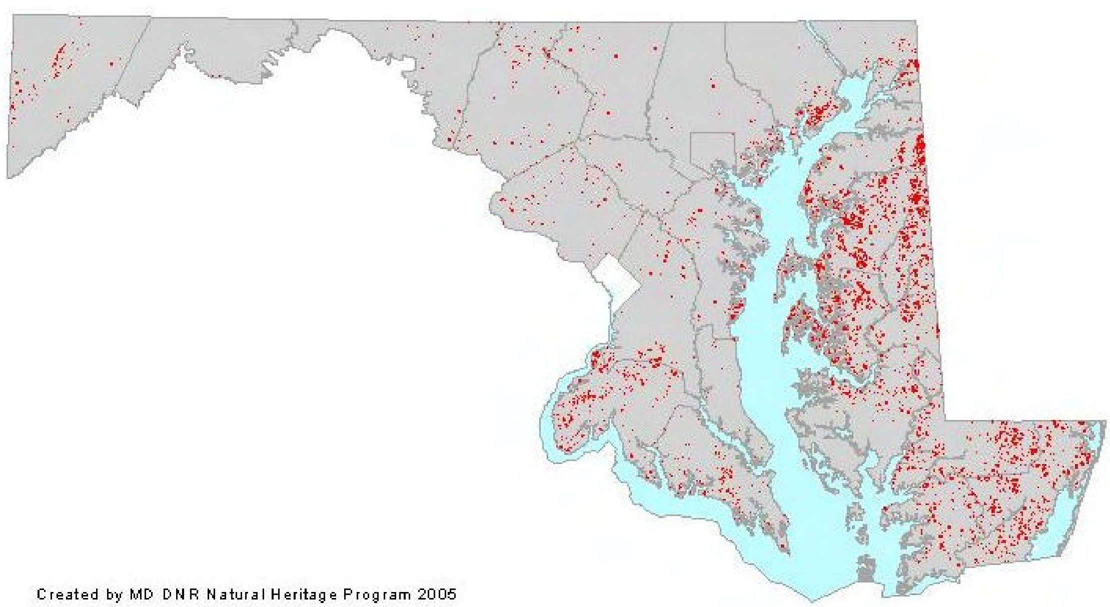
Vernal pools occur throughout the state as scattered, isolated habitats. They are most numerous on the Lower Coastal Plain, especially on the mid- to upper Eastern Shore, and uncommon west of the Fall Line. They are typically situated in low areas or depressions in a forest but they can also occur in floodplain forests as isolated floodwaters, backwaters of old beaver impoundments, old sinkholes, or as perched spring- or seep-fed basins along mountain slope benches or at the base of slopes. Vernal pools may persist in cleared areas such as cropland, pastures and clearcuts but usually in a highly degraded ecological state.

Because vernal pools occur throughout the state in a variety of forest types and settings, the vegetation in and around these habitats varies considerably. However, many vernal pools exhibit similar vegetative structure. For example, pools tend have a semi-open to closed forest canopy and the degree of canopy closure generally decreases with pool size. The basin substrate consists of dense mats of submerged leaf litter and scattered, coarse woody debris. Herbaceous vegetation is usually absent to sparse in and around the basin, although small sphagnum patches may occur along the basin edge. A dense shrub layer may occur along the shoreline or in small patches within the basin, especially on the Coastal Plain, but many pools also lack a well-developed shrub layer.

Location and Condition:

Most of the state's remaining vernal pools occur on the Coastal Plain, with the largest numbers, perhaps several thousand or more, occurring on the mid- and upper Eastern Shore. Relatively few vernal pools occur west of the Fall Line and perhaps only several hundred occur in the Allegheny Plateau and Ridge and Valley physiographic regions. Vernal pools in these latter regions are also much more scattered and isolated. Information on the number, distribution, and ecological conditions of these relatively small wetland systems is inadequate or lacking for all regions in the state. However, it is likely that a large percentage of the state's vernal pools have been destroyed or degraded by development, agriculture and logging practices.

Figure 4.11 Location of Vernal Pools in Maryland (Sources: USFWS NWI; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Southeastern star-nosed mole
Amphibians
Carpenter frog
Eastern narrow-mouthed toad
Eastern spadefoot
Jefferson salamander
New Jersey chorus frog
Inverts: Dragonflies & Damselflies
Amber-winged spreadwing
Attenuated bluet

Aurora damsel
Azure bluet
Bar-winged skimmer
Blue-faced meadowhawk
Comet darner
Cyrano darner
Harlequin darner
Lyre-tipped spreadwing
Slender bluet
Sphagnum sprite
Spotted spreadwing

Sweetflag spreadwing
Taper-tailed darner
Vesper bluet
Inverts: Beetles
Seth forest water scavenger beetle
Inverts: Freshwater Crustaceans
An entocytherid ostracod
An entocytherid ostracod
Rare Natural Communities
N/A

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, eastern fox squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, long-tailed weasel, mink, striped skunk, American woodcock, wood duck, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Recreational activities, such as off-road vehicles, that cause increased human disturbance of habitat
j. Mosquito control practices such as adulticide use and introduction of larvicides or biological control agents such as mosquitofish or mudminnows to control mosquito larva
k. Groundwater contamination from development and agriculture
l. Woody encroachment of formerly open-canopy herbaceous dominated habitat
m. Misidentification of vernal pools by development contractors and consultants

Conservation Actions:

a. Protect wetlands through acquisitions and easements ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
b. Amend state wetlands laws to protect all GCN vernal pool habitats ***[Measure: # of law and regulation modifications passed]***
c. Limit development impacts within wetland areas and surrounding watershed ***[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]***
d. Ensure that surrounding land uses do not alter hydrological conditions in vernal pools ***[Measure: # of vernal pool focused hydrologic guidelines incorporated into land use and planning efforts]***
e. Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***

f. **Promote BMPs to appropriate public and private land managers, agencies and industries that have the greatest potential to influence protection of vernal pool habitat and buffers** ***[Measure: # of BMPs developed and promoted; # of BMPs incorporated into local, state, and federal agency plans and private lands stewardship plans]***
g. **Reduce impacts of mosquito control and gypsy moth control in the vicinity of known vernal pool habitat** ***[Measure: # of sites with vernal pool habitat protected from impacts of development, groundwater withdrawal and pest management]***
h. Delineate habitat boundaries and sensitive management areas for all populations and metapopulations of GCN species *[Measure: # of acres of habitat boundaries and sensitive management areas mapped; # of species with distribution maps updated]*
i. Work with landowners to obtain protection for known vernal pools on private property *[Measure: # of landowners participating in conservation programs; # of sites with vernal pools protected]*
j. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
k. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
l. Eliminate human disturbance, such as off-road vehicles, in and around vernal pool habitats *[Measure: # of sites with limited access and educational signage]*
m. Coordinate conservation with federal farm bill programs, MD DNR, SHA, MDA, and local jurisdictions *[Measure: # of acres conserved through coordination of local, state, and federal agency activities]*
n. Maintain or restore forest connectivity between vernal pool habitats *[Measure: # of sites with vernal pool habitat that have forest corridors maintained or restored]*
o. Create or restore vernal pools *[Measure: # of vernal pools established or restored]*
p. Develop and implement protocols to control invasive species and prevent their establishment *[Measure: # of protocols developed; # of sites with management implemented]*
q. Incorporate wetland conservation actions into land planning efforts and public land management plans *[Measure: # of acres of wetlands conserved during land planning efforts; # of public land management plans incorporating wetland wildlife focused habitat conservation actions]*
r. Coordinate with regulatory agencies to protect vernal pool habitat *[Measure: # of vernal pool sites protected through coordination with regulatory agencies]*
s. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
t. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
u. Educate the public about the values of vernal pools and their conservation *[Measure: # of educational materials developed and distributed]*
v. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
w. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
x. Coordinate conservation with NE PARC *[Measure: # of cooperative projects implemented]*
y. Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands *[Measure: # of sites with BMPs implemented for reduction of nutrient contamination]*
z. Work with landowners and the farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*

aa. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including reptiles, amphibians, and invertebrates *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct research to determine movement patterns and dispersal of GCN species, especially reptiles amphibians *[Measure: # of research projects conducted; # of research papers published]*
e. Conduct an inventory and characteristics of vernal pool habitat *[Measure: # of surveys completed]*
f. Determine beneficial long-term management needs and practices *[Measure: # of research projects conducted; # of research papers published; # of BMP's developed]*
g. Conduct hydrological studies *[Measure: # of hydrologic monitoring sites established; # of research projects conducted; # of research papers published]*

(12) Forested Seepage Wetlands

Description:

Forested seepage wetlands occur around large seepage areas or springs, along the uppermost reaches of gently sloping headwater streams, and along ravine bottoms and toe slopes. Although present in each physiographic region, these wetlands are scattered, local and uncommon. They occur where groundwater is forced to the surface along an impermeable clay or rock layer due to hydrostatic pressure resulting from gravity or artesian flow. Surface water appears as broad, diffuse zones of wetness, percolation and/or highly braided, small rivulets where soils usually remain saturated during most or all of the year. Soils are typically moderately to strongly acidic and nutrient-poor. Occasionally, circumneutral conditions exist where sites overlie calcareous rock strata. These are predominantly forested wetlands with a mostly closed to semi-open canopy. However, often a mosaic of small shrub and open, sedge- and graminoid-dominated emergent wetland patches are also present. The forest floor is characterized by spaghnum-covered hummocks, dense fern and skunk-cabbage patches, and saturated sand, muck- or peat-filled depressions. On the coastal plain, a red maple-black gum-swamp magnolia forest community is usually dominant. The understory tends be dense with swamp azalea, huckleberries, greenbrier, poison-ivy, and blueberries. West of the Fall Line, red maple and black gum continue to be frequent dominants but various ashes, yellow and black birch, and tulip poplar may be common canopy species as well. Common understory species include spicebush, winterberry, and arrowwood. On the Allegheny Plateau, eastern hemlock and red spruce may be dominant at some sites along with dense rhododendron thickets.

Location and Condition:

Because of the difficulty in remotely mapping this small, mostly closed canopy wetland system, very little information is available on the extent, location and condition of forested seepage wetlands. It is likely, however, that this habitat is most common in the southern Upper Coastal Plain where it often occurs in steep, dissected forested ravine systems. Some of the best known examples of forested seepage wetlands occur in Charles County near Douglas Point. Other high quality examples occur on the Allegheny Plateau in association with high elevation bog wetland complexes and in the Ridge and Valley province as circumneutral seepage wetlands. Much remains to be learned about the status and distribution of this key wildlife habitat in Maryland.

[No location map is available.]

GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Eastern red bat
Hoary bat
Silver-haired bat
Southeastern shrew
Southeastern star-nosed mole
Southern bog lemming
Southern rock vole
Birds
Acadian flycatcher
American redstart
American woodcock
Barred owl
Black-and-white warbler
Black-billed cuckoo
Black-throated blue warbler
Black-throated green warbler
Canada warbler
Hairy woodpecker
Hermit thrush
Hooded warbler
Kentucky warbler
Louisiana waterthrush
Magnolia warbler
Northern waterthrush
Ovenbird
Pileated woodpecker
Red-eyed vireo

Red-shouldered hawk
Scarlet tanager
Veery
Wood thrush
Reptiles
Bog turtle
Common ribbonsnake
Eastern box turtle
Queen snake
Spotted turtle
Amphibians
Allegheny Mountain dusky salamander
Carpenter frog
Eastern mud salamander
Eastern spadefoot
Long-tailed salamander
Mountain chorus frog
New Jersey chorus frog
Northern red salamander
Seal salamander
Inverts: Dragonflies & Damselflies
Arrowhead spiketail
Aurora damsel
Brown spiketail
Delta-spotted spiketail
Eastern red damsel
Elfin skimmer
Fine-lined emerald

Gray petaltail
Sedge sprite
Seepage dancer
Ski-tailed emerald
Sphagnum sprite
Tiger spiketail
Treetop emerald
Yellow-sided skimmer
Inverts: Butterflies & Moths
Baltimore checkerspot
Chermock's mulberry wing
Dion skipper
Indian skipper
Long dash
Pepper and salt skipper
Inverts: Freshwater Crustaceans
An entocytherid ostracod
An entocytherid ostracod
Inverts: Land Snails
Cylindrically-ornate wood snail
Rare Natural Communities
Coastal Plain/Piedmont Acidic Seepage Swamps
High Elevation Seepage Swamps
Mountain/Piedmont Acidic Seepage Swamps
Mountain/Piedmont Basic Seepage Swamps

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, red fox, common gray fox, common raccoon, Virginia opossum, long-tailed weasel, striped skunk, fisher, mink, American beaver, muskrat, American woodcock, , American crow, fish crow, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat

b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Incompatible silviculture practices that results in habitat degradation
j. Nontarget impacts of gypsy moth control
k. Mosquito control practices such as adulticide use and introduction of larvicides or biological control agents such as mosquitofish or mudminnows to control mosquito larva
l. Altered natural disturbance patterns resulting in inadequate habitat conditions for some GCN species
m. Misidentification of seepage wetlands by development contractors and consultants

Conservation Actions:

a. **Establish and maintain protected networks of wetland sites and movement corridors within an extensive forest matrix** ***[Measure: # of acres wetland/forest matrix and corridors protected]***
b. **Establish and maintain effective buffers along wetlands, by restoring natural communities where possible** ***[Measure: # of miles wetland buffers established; # of acres of natural communities restored adjacent to wetlands]***
c. **Protect wetlands through acquisitions and easements** ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
d. **Restore and protect forested seepage wetlands, other associated wetlands and surrounding watersheds** ***[Measure: # of acres degraded habitat restored and protected]***
e. **Limit development impacts to wetland areas and surrounding watershed** ***[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]***
f. **Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
g. **Incorporate wetland conservation actions into land planning efforts and public land management plans** ***[Measure: # of acres of wetlands conserved during land use and land planning efforts; # of public land management plans incorporating wetland wildlife focused habitat conservation actions]***
h. **Develop habitat management guidelines for use by foresters and land managers and work with them to implement such** ***[Measure: habitat management guidelines developed; # of wildlife focused habitat management guidelines incorporated into land use and planning effort]***
i. Work with Maryland DOT to construct roads in such a way that minimizes effects on movement patterns of GCN species, especially for amphibians and reptiles that use

these wetlands year-round or seasonally as breeding habitat *[Measure: # or miles of new roads constructed to minimize habitat fragmentation]*

j. Enforce and modify, as needed, nontidal wetland protection regulations especially as it relates to Nontidal Wetlands of Special Concern *[Measure: # of regulation modifications proposed; # of violations prosecuted; # of citations issued]*
k. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
l. Develop and implement protocols to control invasive species and prevent their establishment *[Measure: # of protocols developed; # of sites with management implemented]*
m. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
n. Minimize mosquito control and gypsy moth control in forested seepage wetland sites and surrounding landscape *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
o. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
p. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
q. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
r. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
s. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
t. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

1. Conduct surveys to better determine the distribution, characteristics and condition of forested seepage wetlands *[Measure: # of surveys completed]*
2. Conduct surveys to better determine the distribution, abundance, population strongholds and status of GCN species, especially odonates, reptiles, amphibians, butterflies, and subterranean/groundwater invertebrates *[Measure: # of surveys completed]*
3. Conduct research on life history, habitat requirements, metapopulation dynamics and movement/dispersal patterns of GCN species *[Measure: # of research projects conducted; # of research papers published]*
4. Determine effective buffer widths as it relates to development, timber harvesting and farming practices; include upland life zone requirements of reptiles and amphibians, foraging requirements of bats, and area-sensitive species (e.g., bobcat) *[Measure: # of research projects conducted; # of research papers published]*
5. Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed *[Measure: # of monitoring studies established; # of monitoring studies conducted]*

(13) Bog and Fen Wetland Complexes

Description:

Bogs and fens are open seepage wetlands supporting a patchwork of saturated shrub and herbaceous vegetation. The term "bog" is actually a technical misnomer, and in strict usage applies only to peatlands that are fed by rainwater (ombrotrophic). We have adopted it here for consistency since this term is so widely used throughout much of the region to describe open, acidic seepage wetlands. In Maryland, bogs and fens are groundwater-fed (minerotrophic) and best developed on seepage slopes, along headwater streams, oxbows of streams, and margins of beaver ponds, established millponds, and sandpits. Bog soils vary from mineral to deep peat, are extremely acidic, nutrient-poor, and often support a variety of sphagnum mosses. Bogs on the Appalachian Plateau are uncommon habitats, often occurring in openings on seepage slopes and along streams bordered by forests of red spruce, eastern hemlock, white pine, larch, red maple, and black gum. Shrubs common to these habitats include speckled alder, narrow-leaved meadowsweet, mountain holly, and black chokeberry. Small openings interspersed amongst the shrub growth support dense mats of sphagnum and haircap mosses and herbaceous species such as Virginia cotton-grass, rose pogonia, round-leaved sundew, and a variety of ferns, rushes, and sedges.

On the Coastal Plain, bogs are rare habitats associated with seepage toeslopes, small stream bottoms, and long-established millponds and sandpits. Bogs locally referred to as "Magnolia bogs" occur at the bases of sand and gravel terraces near streams where groundwater seepage is abundant and forced to the surface by an impermeable clay lens or aquiclude. Unlike true bogs, Magnolia bogs are not characterized by accumulations of peat or organic soils. Nutrient-poor and acidic seepage flows from groundwater, often forming mucky depressions and braided channels around hummocks of sphagnum mosses. Historic accounts of Magnolia bogs describe these areas with sweetbay magnolia and various shrubs fringing and forming clumps within a more open center dominated by herbaceous plants. Today, remaining examples exist mostly as open woodlands of black gum and sweetbay magnolia with very dense shrubs and very small, scattered herbaceous patches. Shrubs common to these habitats include sweetbay magnolia, swamp azalea, highbush blueberry, fetterbush, dangleberry, poison sumac, and possum haw. Herbaceous openings include species such as cinnamon fern, cypress panicgrass, partridge-berry, coastal carrionflower, wild yam, Indian cucumber-root, brownish beaksedge, and primrose-leaved violet. Regionally uncommon or rare "bog" species persisting in Magnolia bogs include bog goldenrod, ten-angled pipewort, Long's rush, spatulate-leaved sundew, red milkweed, and sheep laurel.

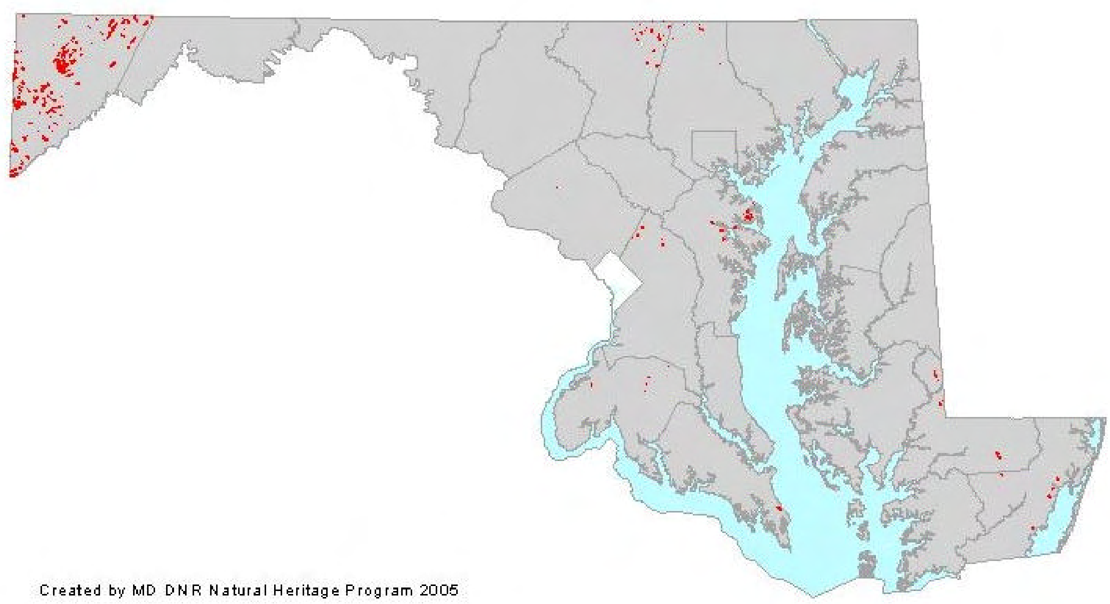
Unlike Magnolia bogs, which are restricted to areas just east of the fall line, similar seepage wetlands occur throughout the Coastal Plain and Piedmont in a variety of settings. In the Coastal Plain, these habitats are differentiated from Magnolia bogs by dense layers of accumulated peat. Openings along the margins of slow-moving streams, millponds, and abandoned sandpits often support patches of such shrub species as large cranberry, sweet pepperbush, swamp loosestrife, and giant cane. Hummocks of sphagnum mosses are characteristic and usually support species such as white beak-rush, rose pogonia, common St. John's-wort, and Virginia meadow-beauty. Orchids, sundews, bladderworts, and yellow-eyed grasses are also common. Similar wetlands in the Piedmont occur over a variety of substrates and have a much different plant composition. Characteristic species may include smooth alder, swamp rose, black willow, skunk-cabbage, spotted jewelweed, tussock sedge, and rice cutgrass. Regionally rare species that may occur in Piedmont seepage wetlands include Canada burnet and brown bog sedge.

Sea-level fens are small, maritime seepage wetlands that occur above the high tide line at the bases of slopes where abundant groundwater discharges along the upper edges of estuarine bays. The hydrology of these sites is best characterized as saturated, although shallow standing water and small, muck-filled pools are locally present at all sites. Soils are characterized as organic and nutrient-poor. The vegetation exhibits characteristics of both inland seepage bogs and slightly brackish tidal marshes. Stands are generally a physiognomic mosaic of open woodland, scrub, and herbaceous patches. Woody species include red maple, black gum, bayberry, and southern bayberry. Characteristic herbs include twig rush, beaked spikerush, white beakrush, spatulate-leaved sundew, ten-angled pipewort, coinleaf, brownfruited rush, and bladderworts.

Location and Condition:

A significant portion of Maryland's bogs and fens have been destroyed or seriously impacted by strip mining, agricultural conversion, lake and pond construction, and development. Although the ecological dynamics of these habitats are not fully understood, many have suffered from shrub and tree succession. Factors that may have been responsible for creating and maintaining these habitats include fire, grazing, beavers, and deep deposition of unstable soils. Bog and fen habitats are most numerous in Garrett County where the best remaining examples are found on property owned and managed by TNC. Bogs and fens throughout the Coastal Plain and Piedmont are rare, concentrated around the Mid-Atlantic fall line zone and Magothy River watershed. Examples also occur throughout the Coastal Plain in managed habitats such as powerline rights-of-way. They have always had a limited distribution in the Mid-Atlantic fall line zone and have probably always been rare. Today, less than 10 sites of this type remain in very small patches degraded by fire exclusion, woody succession, and various anthropogenic impacts. Sea-level fens are extremely rare in Maryland and throughout much of their range. Remnant sea-level fens have been documented in Anne Arundel, Wicomico, and Worcester Counties. Many of these habitats have been severely degraded by tidal flooding associated with ditching and chronic sea-level rise, excessive nutrient input through localized runoff, and invasion of common reed.

Figure 4.13 Location of Bog and Fen Wetland Complexes in Maryland (Sources: USFWS NWI; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
American marten
Bobcat
Eastern red bat
Hoary bat
Indiana bat
North American Porcupine
Northern flying squirrel
Silver-haired bat
Smoky shrew
Snowshoe hare
Southeastern myotis
Southeastern star-nosed mole
Southern bog lemming
Southern pygmy shrew
Southern water shrew
Birds
Acadian flycatcher
Alder flycatcher
American black duck
American redstart
American woodcock
Barred owl

Black-and-white warbler
Black-billed cuckoo
Blackburnian warbler
Black-throated blue warbler
Black-throated green warbler
Blue-headed vireo
Blue-winged warbler
Broad-winged hawk
Brown creeper
Brown thrasher
Canada warbler
Chestnut-sided warbler
Common raven
Dark-eyed junco
Eastern towhee
Field sparrow
Golden-crowned kinglet
Golden-winged warbler
Hairy woodpecker
Hermit thrush
Hooded warbler
Kentucky warbler
Least flycatcher

Louisiana waterthrush
Magnolia warbler
Mourning warbler
Nashville warbler
Northern parula
Northern saw-whet owl
Northern waterthrush
Olive-sided flycatcher
Ovenbird
Pileated woodpecker
Prairie warbler
Prothonotary warbler
Red-breasted nuthatch
Red-eyed vireo
Red-shouldered hawk
Scarlet tanager
Sedge wren
Sharp-shinned hawk
Swainson's thrush
Veery
Willow flycatcher
Winter wren
Wood thrush

Worm-eating warbler
Yellow-bellied sapsucker
Yellow-throated vireo
Reptiles
Bog turtle
Common ribbonsnake
Eastern box turtle
Mountain earthsnake
Northern coal skink
Queen snake
Spotted turtle
Amphibians
Allegheny Mountain dusky salamander
Eastern mud salamander
Mountain chorus frog
New Jersey chorus frog
Seal salamander
Inverts: Dragonflies & Damselflies
Amber-winged spreadwing
American emerald
Atlantic bluet
Attenuated bluet
Aurora damsel
Azure bluet
Band-winged meadowhawk
Bar-winged skimmer
Beaverpond baskettail
Black-tipped darner
Blue-faced meadowhawk
Canada darner
Chalk-fronted skimmer
Cherry-faced meadowhawk
Comet darner
Crimson-ringed whiteface
Cyrano darner
Dot-tailed whiteface
Eastern red damsel
Elfin skimmer
Fine-lined emerald
Golden-winged skimmer
Green-striped darner
Hagen's bluet
Harlequin darner
Hudsonian whiteface
Lance-tipped darner
Little blue dragonlet
Lyre-tipped spreadwing
Mantled baskettail
Petite emerald
Rainbow bluet
Sedge sprite
Seepage dancer
Ski-tailed emerald
Slender bluet
Southern sprite
Sphagnum sprite
Spotted spreadwing
Spring blue darner
Stripe-winged baskettail
Sweetflag spreadwing
Taper-tailed darner
Treetop emerald
Tule bluet
Vesper bluet
White corporal
White-faced meadowhawk
Yellow-sided skimmer
Inverts: Butterflies & Moths
A noctuid moth
Atlantis fritillary
Baltimore checkerspot
Bog copper
Dion skipper
Harris's checkerspot
Hessel's hairstreak
Long dash
Mitchell's satyr
Pepper and salt skipper
Pink-edged sulphur
Silver-bordered fritillary
Two-spotted skipper
Inverts: Dipterans
Pitcher-plant mosquito
Inverts: Land Snails
Spruce knob threetooth
Striped whitelip
Rare Natural Communities
Atlantic White Cedar Wetlands
Appalachian Bogs/Fens
Coastal Plain Acidic Seepage Bogs/Fens
Interdunal Swales
Sea-level Fens

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, eastern gray squirrel, red squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, fisher, mink, northern river otter, eastern cottontail, woodchuck, American beaver, muskrat, American woodcock, common snipe, sora, Canada goose, mallard, American black duck, wood duck, ring-necked duck, hooded merganser, American crow, fish crow, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Acid mine drainage
j. Incompatible silviculture practices that results in habitat degradation
k. In Allegheny Plateau, timber harvesting that results in loss of northern conifers (red spruce, eastern white pine, balsam fir, eastern hemlock)
l. Decline of Atlantic white-cedar in the Coastal Plain
m. Hemlock wooly adelgid that causes loss of eastern hemlock component
n. High deer densities resulting in overbrowsing
o. Habitat degradation by ORV's and other human disturbances
p. Altered natural disturbance patterns or lack of certain management practices
q. Acid precipitation that results in habitat degradation
r. Nontarget impacts of gypsy moth control.
s. Increase in nutrients as a result of septic and stormwater runoff
t. Lack of adequate buffers in development areas
u. Sea-level rise and increased erosion rates that result in loss of habitat and increased flooding events

Conservation Actions:

a. Establish and maintain protected networks of bog-fen wetland sites and provide sufficient landscape connectivity within an extensive forest matrix ***[Measure: # of acres wetland/forest matrix and corridors protected]***
b. Avoid or minimize timber harvesting impacts in wetland areas and surrounding forest matrix ***[Measure: # of wetland wildlife focused habitat management guidelines incorporated into silviculture plans]***
c. Protect wetlands through acquisitions and easements ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
d. Incorporate wetland conservation actions into land planning efforts and public land management plans ***[Measure: # of acres of wetlands conserved during land use and land planning efforts; # of public land management plans incorporating wetland wildlife focused habitat conservation actions]***
e. Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***

f. **Work with farming community to restore and protect wetlands** ***[Measure: # of sites with cooperative management projects; # of acres wetlands restored and protected]***
g. **Develop and implement protocols to control invasive species and prevent their establishment** ***[Measure: # of protocols developed; # of sites with management implemented]***
h. **Enforce and improve, as needed, nontidal wetland protection regulations especially as it relates to Nontidal Wetlands of Special Concern** ***[Measure: # of regulation modifications proposed; # of violations prosecuted; # of citations issued]***
i. Restore northern conifer component of bog-fen wetland complexes on Allegheny Plateau and Atlantic white-cedar component on Coastal Plain, including working with TNC to accomplish such *[Measure: # of acres restored]*
j. Prohibit ORV's in and around wetland sites *[Measure: # of sites with limited access and educational signage]*
k. Limit development impacts within wetland areas and surrounding watershed *[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]*
l. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
m. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
n. Manage or control livestock grazing within the wetlands *[Measure: # of sites with livestock grazing impacts reduced or eliminated]*
o. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
p. Restore wetlands affected by acid mine drainage *[Measure: # of acres restored]*
q. Educate the public to reduce impacts and disturbances to wetlands *[Measure: # of educational materials developed and distributed]*
r. Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff *[Measure: # of sites with nutrient reduction strategies implemented]*
s. Develop and implement protocols to control deer populations to reduce browsing levels *[Measure: protocols developed; # of sites or acres with management implemented]*
t. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
u. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
v. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
w. Implement controlled burn programs as appropriate *[Measure: # of acres maintained with controlled burn program; # of sites with natural fire regimes allowed]*
x. Avoid gypsy moth control in wetland areas and surrounding forest matrix *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
y. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
z. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including reptiles and amphibians *[Measure: # of monitoring studies established; # of monitoring studies conducted]*

b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians, and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
e. Conduct surveys to better determine the distribution, abundance, population strongholds, and status of GCN species, especially odonates, butterflies, bats, other small mammals (e.g., southern water shrew, southern bog lemming), birds, reptiles, and amphibians *[Measure: # of surveys completed]*
f. Determine effective buffer widths as it relates to development, timber harvesting and farming practices; include upland life zone requirements of reptiles and amphibians, foraging areas for bats, and area-sensitive species like forest-nesting birds and bobcat *[Measure: # of research projects conducted; # of research papers published]*
g. Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed *[Measure: # of monitoring studies established; # of monitoring studies conducted]*

(14) Nontidal Shrub Wetlands

Description:

Nontidal shrub wetlands are inland freshwater wetlands dominated by shrubs and small trees (< 8 m tall). They usually exist as small patch plant communities (< 10 ha) or as transitional or ecotonal habitats within larger freshwater wetland systems. On Maryland's coastal plain, this habitat occurs in seasonally to semi-permanently flooded depressional wetlands such as Delmarva bays (also referred to as coastal plain ponds) and vernal pools. It also occurs in beaver impoundments, along shorelines of millponds and farm ponds, and as scattered patches in floodplain forest openings created by windthrow, floods and beavers. Common dominants include buttonbush, silky dogwood, southern arrowwood, highbush blueberry, and/or smooth alder mixed with small deciduous trees such as red maple, black gum, sweetbay magnolia, black willow, and green ash. On the western shore in Anne Arundel and Prince George's Counties, nontidal shrub wetlands occur within unique seepage wetland complexes often referred to as "magnolia bogs". There, the dominant shrubs include sweetbay magnolia, swamp azalea, highbush blueberry, fetterbush, dangleberry, poison sumac, and possum haw.. Nontidal shrub wetlands on Assateague Island and in coastal areas along the Chesapeake Bay are dominated by wax myrtle and high-tide bushhigh-tide bush tree. These shrublands exist in interdunal depressions characterized by perched water tables and intermittent to seasonal flooding with occasional salt intrusion resulting from storm surges.

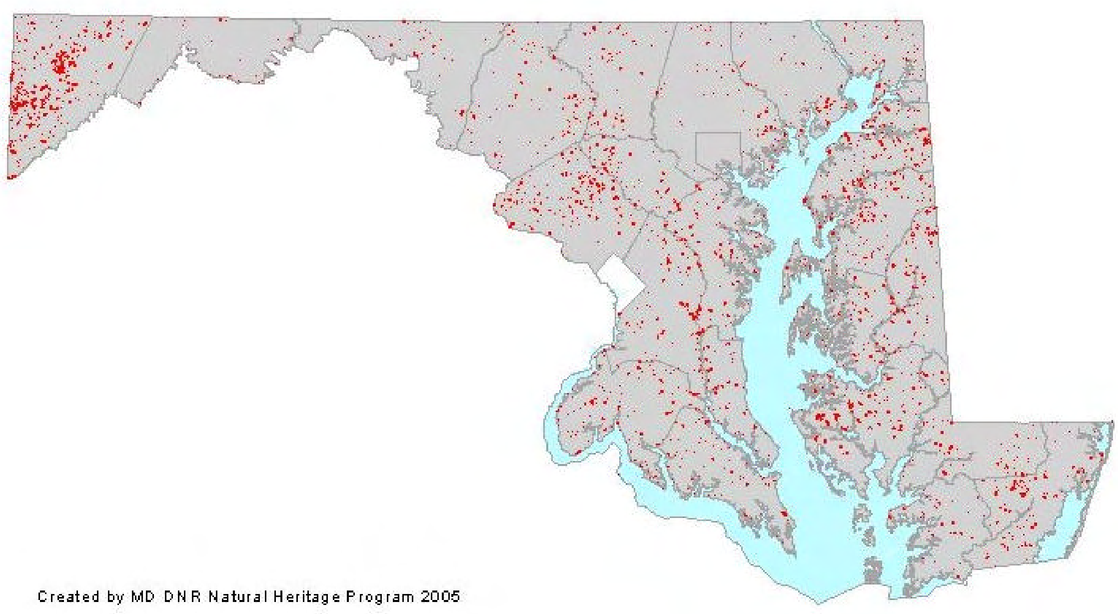
In the Piedmont and Ridge and Valley Provinces, nontidal shrub wetlands occur in a number of settings, including wet meadows, beaver impoundments, seepage swamps and floodplain forest openings. The dominant species include buttonbush, spicebush, smooth alder, black willow, silky dogwood, common elderberry, and multiflora rose, an introduced species. Seepage swamps are primarily a forested wetland type occurring along braided headwater streams, large spring seeps and ravine bottoms underlain by sandstone, quartzite or base-poor granite. They are usually dominated by red maple and black gum but sometimes include a shrub wetland component comprised of smooth alder, spicebush and winterberry. Where these habitats have been cleared for pasture, wet meadows form which often retain some form of shrub wetland.

Shrub wetlands on the Allegheny Plateau typically occur within a variety of larger wetland complexes such as high elevation "bogs", fens, seepage wetlands and beaver impounded streams. These areas usually include one or more types of forested and/or emergent wetlands. A variety of species may be dominant in the shrub wetlands including smooth alder, speckled alder, northern arrowwood, smooth winterberry, black chokeberry, red chokeberry, and mountain holly. Other shrub species potentially present are broad-leaved meadowsweet, narrow-leaved meadowsweet, common elderberry, and great-laurel. Diverse herb layer may be scattered within the shrub wetlands. Wetlands that have been converted to pasture or cleared by strip mining are usually dominated by dense thickets of alder or silky cornel.

Location and Condition:

At present, approximately 15,000 acres of nontidal shrub wetlands occur in the state. This habitat type occurs in every physiographic region, usually as scattered, small (< 10 ha) wetlands. The greatest acreage and many of the state's best examples occur in high elevation bog wetland systems on the Allegheny Plateau. Other examples can be found in Carolina Bays, floodplain forests and along millponds and farm ponds. Many areas have been destroyed or degraded due to conversion to cropland and pasture, as well as to hydrological changes resulting from development and groundwater withdrawal. In many parts of the state, especially along headwater streams, beavers continue to play an important role in creating and maintaining nontidal shrub wetlands.

Figure 4.14 Location of Nontidal Shrub Wetlands in Maryland (Sources: USFWS NWI)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Southeastern star-nosed mole
Birds
Alder flycatcher

American black duck
American woodcock
Black-crowned night-heron
Blue-winged warbler
Chestnut-sided warbler

Golden-winged warbler
Great blue heron
Great egret
Marsh wren
Northern waterthrush

Prothonotary warbler	Rainbow snake	Great purple hairstreak
Red-shouldered hawk	Spotted turtle	Long dash
Willow flycatcher	**Amphibians**	Palamedes swallowtail
Yellow-crowned night-heron	Carpenter frog	
Reptiles	Eastern spadefoot	**Rare Natural Communities**
Bog turtle	New Jersey chorus frog	Appalachian Bogs/Fens
Common ribbonsnake	**Inverts: Butterflies & Moths**	Coastal Plain Acidic Seepage Bogs/Fens
Northern red-bellied turtle	Baltimore checkerspot	Sea-level Fens
Queen snake	Dion skipper	Maritime Shrub Swamps

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, sika deer, black bear, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, fisher, mink, northern river otter, eastern cottontail, muskrat, American woodcock, mallard, American black duck, wood duck, blue-winged teal, green-winged teal, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Incompatible silviculture practices that results in habitat degradation
j. Acid mine drainage
k. Altered natural disturbance patterns resulting in inadequate habitat conditions for some GCN species
l. Mosquito control practices such as adulticide use and introduction of larvicides or biological control agents such as mosquitofish or mudminnows to control mosquito larva

Conservation Actions:

a. **Establish and maintain protected networks of nontidal shrub wetland sites, adjacent wetland types and movement corridors within an extensive forest matrix** ***[Measure: # of acres wetland/forest matrix and corridors protected]***
b. **Establish and maintain effective buffers along wetlands, by restoring natural communities where possible** ***[Measure: # of miles wetland buffers established; # of acres of natural communities restored adjacent to wetlands]***
c. **Protect wetlands through acquisitions and easements** ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
d. **Limit development impacts within wetland areas and surrounding watershed** ***[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]***
e. **Incorporate wetland conservation actions into land planning efforts and public lands management plans** ***[Measure: # of acres of wetlands conserved during land use and land planning efforts; # of public lands management plans incorporating wetland wildlife focused habitat conservation actions]***
f. **Enforce and modify, as needed, nontidal wetland protection regulations especially as it relates to Nontidal Wetlands of Special Concern** ***[Measure: # of regulation modifications proposed; # of violations prosecuted; # of citations issued]***
g. **Work with farming community to restore and protect wetlands** ***[Measure: # of sites with cooperative management projects; # of acres wetlands restored and protected]***
h. **Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
i. Work with Maryland DOT to construct roads in such a way that minimizes effects on movement patterns of GNC species *[Measure: # or miles of new roads constructed to minimize habitat fragmentation]*
j. Manage beaver populations to create and expand nontidal shrub wetlands where appropriate *[Measure: # of beaver populations managed]*
k. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
l. Develop and implement protocols to control invasive species and prevent their establishment *[Measure: # of protocols developed; # of sites with management implemented]*
m. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
n. Minimize mosquito control in nontidal shrub wetland sites *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
o. Restore and protect nontidal shrub wetlands, other associated wetlands and surrounding watersheds *[Measure: # of acres restored and protected]*
p. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
q. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
r. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
s. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
t. Restore wetlands affected by acid mine drainage *[Measure: # of acres restored]*

u. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
v. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Conduct surveys to better determine the distribution, abundance, population strongholds and status of GCN species, especially reptiles and amphibians, breeding sites for American woodcock and songbirds, and butterflies *[Measure: # of surveys conducted]*
b. Conduct research on life history, habitat requirements, metapopulation dynamics and movement/dispersal patterns of GCN species *[Measure: # of research projects conducted; # of research papers published]*
c. Determine effective buffer widths as it relates to development, timber harvesting and farming practices; include upland life zone requirements of reptiles and amphibians, area-sensitive species (e.g., bobcat), and foraging areas (e.g., American woodcock) *[Measure: # of research projects conducted; # of research papers published]*
d. Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed *[Measure: # of monitoring programs conducted]*

(15) Tidal Shrub Wetlands

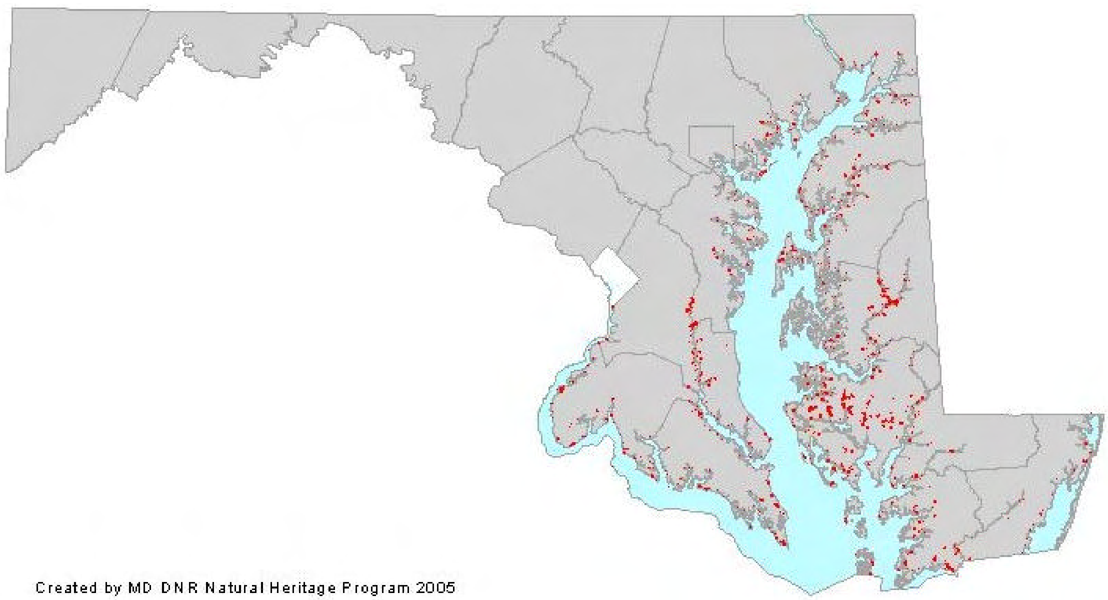
Description:

In Maryland, tidal shrub wetlands are shrub-dominated transitional habitats of freshwater and brackish systems. In freshwater portions of tidal rivers they commonly form small, linear patches on floodplains between tidal emergent marshes and tidal swamp forests. On narrow or constricted floodplains, discrete shrub-dominated communities occur along ecotones or transitional areas and may not be physiognomically distinct. Stands occupying rather expansive marshes or large estuary meanders on broader floodplains are commonly fronted or surrounded by emergent marshes forming depositional islands. Slightly elevated and distanced from tidal influence, these communities tend to be less frequently flooded. The vegetation of tidal freshwater shrub wetlands is very diverse and typically contains species characteristic of both tidal marshes and swamp forests. Shrubs such as smooth alder, winterberry, swamp rose, northern arrow-wood, and silky dogwood are common. Pronounced hummock and hollow microtopography is characteristic and contributes to relatively high species richness with most species confined to irregularly flooded hummocks. Hollows are regularly flooded and typically contain only those species tolerant of frequent inundation. Much like the marshes in brackish systems, "salt scrub" wetlands are generally species poor and composed only of plants tolerant of high salinity such as southern bayberry, high-tide bush, and marsh-elder. These communities are found in saline environments throughout the Lower Coastal Plain. Although salt scrub does occur in tidal habitats, it more commonly occupies higher, only irregularly flooded landscape positions in a mosaic with lower, regularly flooded salt marsh. Salt scrub stands often occur in maritime environments, where they are influenced especially by high winds and salt spray.

Location and Condition:

Tidal shrubland habitats are found in every county on the Coastal Plain. They account for approximately 1.0% (2,490 acres) of estuarine wetlands and 4.4% (14,963 acres) of palustrine wetlands in Maryland (Tiner and Burke 1995). Although typically small and discrete, habitats of freshwater systems are intact and well buffered by surrounding marsh and swamp forest habitats. Many tidal shrublands of brackish systems have been hydrologically altered by ditching and are susceptible to invasion of common reed. In addition, the ecological dynamics of these habitats are poorly understood.

Figure 4.15 Location of Tidal Shrub Wetlands in Maryland (Sources: USFWS NWI)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Birds
American black duck
Black-crowned night-heron
Boat-tailed grackle
Brown pelican
Coastal Plain swamp sparrow
Glossy ibis
Great blue heron
Great egret
Least bittern
Little blue heron
Marsh wren
Prothonotary warbler
Snowy egret
Tricolored heron
Willow flycatcher
Yellow-crowned night-heron
Reptiles
Northern red-bellied turtle
Rainbow snake
Red-bellied watersnake
Inverts: Butterflies & Moths
Rare skipper
Rare Natural Communities
N/A

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, sika deer, red fox, common gray fox, coyote, common raccoon, Virginia opossum, long-tailed weasel, mink, striped skunk, northern river otter, eastern cottontail, muskrat, northern bobwhite, American woodcock, mallard, American black duck, wood duck, blue-winged teal, green-winged teal, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

Tiner and Burke (1995) summarize the major causes of wetland loss and degradation in Maryland by the following: 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 spoil 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, and irrigation, 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 siliviculture plantations, 10) Sediment diversion by dams, deep channels, and other structures, and 11) Hydrologic alterations by canals, spoils banks, roads, and other structures. Natural threats such as droughts, subsidence/sea-level rise, storm events, erosion, and mechanical damage by wildlife (e.g., muskrats, mute swans, snow geese, Canada geese) could also have severe impacts on wetlands systems.

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Loss of habitat and increased flooding events due to sea-level rise, subduction, channalization, and increased erosion rates
j. Hardening of shoreline

Conservation Actions:

a. **Initiate coordinated efforts to conserve habitat and maintain the integrity of wetland systems across wide geographic areas, including targeting the highest quality areas** ***[Measure: # of acres of high quality tidal shrub wetlands targeted and conserved]***
b. **Utilize U.S. Army Corp of Engineers, MDE, and Critical Area regulatory processes to protect habitat** ***[Measure: # of acres of habitat protected via wetlands regulatory processes]***
c. **Limit development impacts within wetland areas and surrounding watershed** ***[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]***

d. **Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
e. Protect wetlands through acquisitions and easements *[Measure: # of acres of wetlands newly protected through acquisitions and easements]*
f. Implement BMPs and adaptive management methods *[Measure: # of sites with BMPs incorporated into management with evaluation of effectiveness]*
g. Restore and enhance breeding and nonbreeding habitats of high priority GCN species *[Measure: # of acres of habitat restored and enhanced]*
h. Develop and implement protocols to control invasive species and prevent their establishment *[Measure: # of protocols developed; # of sites with management implemented]*
i. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
j. Incorporate wetland conservation actions into land use and land planning efforts *[Measure: # of acres of wetlands conserved during land use and land planning efforts]*
k. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
l. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
m. Incorporate wetland conservation actions into public land management plans *[Measure: # of local, state, and federal agency plans incorporating wetland wildlife focused habitat conservation actions]*
n. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
o. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
p. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
q. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
r. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Research the impact of fire/burning *[Measure: # of research projects conducted; # of research papers published]*
b. Research the successional processes *[Measure: # of research projects conducted; # of research papers published]*
c. Monitor and assess the impact of phragmites control on GCN species *[Measure: # of research projects conducted; # of research papers published]*
d. Develop regional, standardized methodologies for effective assessment of population abundance, trends, distribution, and movement patterns, and for improved monitoring of Maryland populations *[Measure: # of standardized methodologies developed]*
e. Conduct studies on the factors limiting species abundance, such as predation rates, reproductive success, contamination, and prey availability *[Measure: # of research projects conducted; # of research papers published]*
f. Determine precise habitat characterizations and needs, including area sensitivity, habitat quality, and habitat availability *[Measure: # of research projects conducted; # of research papers published]*

g. Determine management needs and best management practices for populations, especially effects of various habitat management practices on species' productivity and on long-term habitat suitability *[Measure: # of research projects conducted; # of research papers published; # of BMP's developed]*
h. Monitoring programs should accompany management activities to assess effects of techniques on GCN species and long-term habitat suitability *[Measure: # of monitoring programs conducted; # of conservation actions modified and re-prioritized based on evaluation of effectiveness]*

(16) Nontidal Emergent Wetlands

Description:

Nontidal emergent wetlands are inland freshwater wetlands dominated by herbaceous vegetation. Unlike tidal fresh marshes (see description under Tidal Marshes), which can encompass large areas (> 100 ha), most nontidal emergent wetlands are small (< 10 ha), frequently occurring as small patches within nontidal forest, shrub and emergent wetland complexes. Across the state, their composition and hydrology vary greatly. On the coastal plain, nontidal emergent wetlands frequently occur in Carolina bays where they dominate the center of these seasonally to semi-permanently flooded depressional wetlands. Common dominants include Walter's sedge, twig rush, giant beardgrass, maidencane, warty panic grass, and mild water-pepper. Emergent wetlands also occur within coastal plain seepage bogs. These acidic wetlands are associated with oligotrophic spring-heads, toe slope seepage areas and small, braided headwater streams. The vegetation is typically a mosaic of shrubs, sphagnum and graminoid-dominated herbaceous vegetation. On Assateague Island, nontidal emergent wetlands occur as interdunal swales. These seasonally to semi-permanently flooded wetlands are situated in interdunal depressions where the water table is perched. Although saltwater occasionally enters the swales during storm surges, it is diluted by precipitation and ground water to the point that freshwater or at least oligohaline (< 0.5 ppt) conditions are maintained. Common dominants include three-square, spikerushes, rushes, switch grass, and spatulate-leaved sundew.

West of the Fall Line, seasonally flooded meadows are the most common type of emergent wetland. Common plant species include cattails, soft rush, rice cutgrass, tussock sedge, halbeard-leaved tearthumb, sweetflag, and skunk-cabbage. Most of these wetlands have been highly altered by forest clearing, farming and high nutrient input. Some were former floodplain forests or old oxbows and sloughs along stream and river valleys. Others represent degraded seepage wetlands. It is likely that, prior to disturbance, most of these wetlands were less open, occurring as predominantly forested wetlands or forest-shrub-emergent wetland complexes. Where these wetlands still exist in a relatively undisturbed state, small graminoid-dominated emergent wetlands may be present.

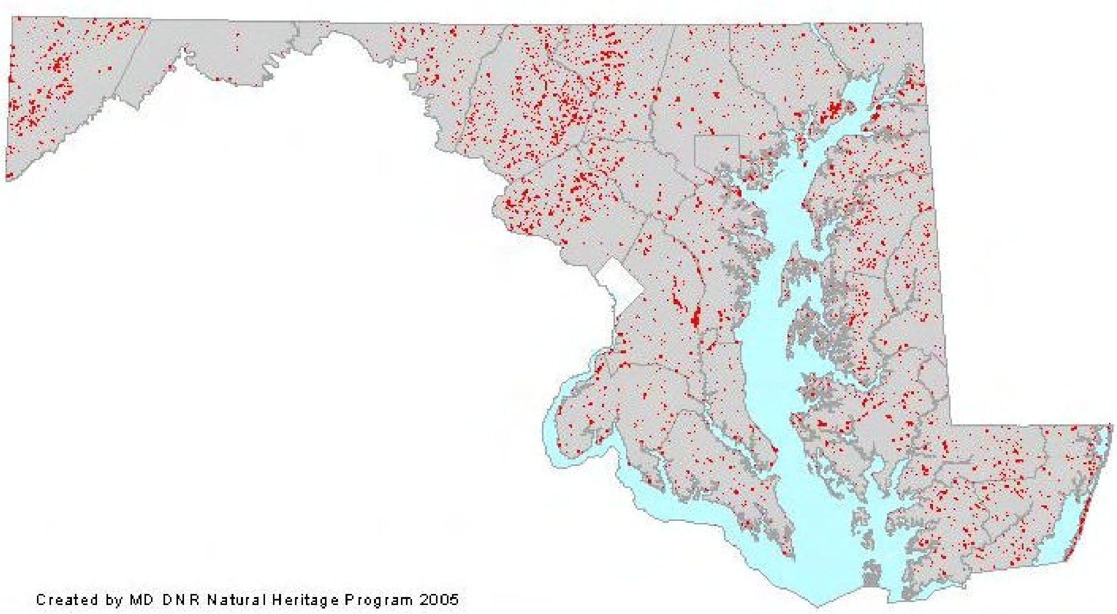
Nontidal emergent wetlands also occur along the Potomac River and other large Piedmont and montane rivers. These wetlands are situated in sloughs, old oxbows and other floodplain forest openings where lizard's tail, water-willow, and smartweed are common. An uncommon wetland type unique to the Ridge and Valley are sinkhole wetlands, some of which contain small emergent wetlands. Common emergent plant species include three-way sedge, manna grasses, and sallow sedge. A variety of emergent wetlands, some quite large, also occur in Allegheny Plateau "bogs". Vegetation can be quite diverse and it varies considerably depending on site conditions. Some of the more dominant plants are soft rush, spike-rushes, goldenrods, Virginia cottongrass, various sedges, white beak-rush, and sphagnum mosses.

Across the state, this habitat occurs in a variety of other natural and man-made settings including beaver impounded stream valleys, as scattered patches in floodplain forest openings created by windthrow, floods and beavers; the shorelines of millponds and farm ponds; and moist soil impoundments (cropland converted to seasonally and semi-permanently flooded emergent wetlands). The vegetation in these wetlands varies widely depending on the region, wetland hydrology, depth, size, substrate and other conditions.

Location and Condition:

Over 18,000 acres of nontidal emergent wetlands remain in Maryland. It occurs statewide in a variety of ecological settings from interdunal swales on Assateague Island to spring-fed meadows in the Piedmont. As with nontidal shrub wetlands, this habitat usually occurs as scattered, small (< 10 ha) wetlands and the greatest acreage and many of the state's best examples occur in high elevation bog wetland systems on the Allegheny Plateau. Other examples can be found along Piedmont and montane rivers, in floodplain forest openings and along millponds and beaver impoundments. Many areas have been destroyed or degraded due to conversion to cropland and pasture, and hydrological changes due to development and groundwater withdrawal. Invasive plant species are also a significant threat. In many areas, especially along headwater streams, beavers continue to play an important role in creating and maintaining nontidal emergent wetlands.

Figure 4.16 Location of Nontidal Emergent Wetlands in Maryland (Sources: USFWS NWI)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Least shrew
Southern bog lemming
Birds
American bittern
American black duck
American woodcock
Bald eagle
Black rail
Black tern
Black-bellied plover
Black-crowned night-heron
Common moorhen
Dunlin
Eastern meadowlark
Great blue heron
Great egret
Greater yellowlegs
King rail
Least bittern
Little blue heron
Marsh wren
Northern harrier
Pied-billed grebe
Sedge wren
Semipalmated sandpiper
Short-billed Dowitcher
Snowy egret

Solitary sandpiper
Wilson's snipe
Yellow-crowned night-heron
Reptiles
Bog turtle
Common ribbonsnake
Eastern box turtle
Northern red-bellied turtle
Queen snake
Spotted turtle
Amphibians
Carpenter frog
Eastern spadefoot
New Jersey chorus frog
Inverts: Dragonflies & Damselflies
Band-winged meadowhawk
Eastern red damsel
Elfin skimmer
Faded pennant
Fine-lined emerald
Four-spotted pennant
Green-striped darner
Hagen's bluet
Lance-tipped darner
Little blue dragonlet
Marsh bluet
Martha's pennant
Sedge sprite

White-faced meadowhawk
Inverts: Butterflies & Moths
A noctuid moth
Atlantis fritillary
Baltimore checkerspot
Dion skipper
Harris's checkerspot
Long dash
Mitchell's satyr
Silver-bordered fritillary
Tawny crescent
Two-spotted skipper
Inverts: Homopterans
A cicadellid leafhopper
Inverts: Freshwater Crustaceans
A cyclopoid copepod
Inverts: Land Snails
Striped whitelip
Rare Natural Communities
Appalachian Bogs/Fens
Coastal Plain Acidic Seepage Bogs/Fens
Interdunal Swales
Mountain/Piedmont Acidic Seepage Swamps
Sea-level Fens

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink, northern river otter, eastern cottontail, woodchuck, American beaver, muskrat, American woodcock, common snipe, Virginia rail, king rail, sora, Canada goose, mallard, American black duck, wood duck, gadwall, blue-winged teal, green-winged teal, northern pintail, American widgeon, northern shoveler, ring-necked duck, hooded merganser, American crow, fish crow, and eastern snapping turtle. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Succession and woody vegetation invasion
j. Channelization and damming of streams feeding wetlands
k. Eutrophication or excessive nutrient loading due to agriculture runoff, chemical lawn treatments, and failing septic systems
l. Sedimentation and siltation within the wetlands
m. Conversion to impoundments

Conservation Actions:

a. **Encourage acquisition of buffers to protect large complexes of wetlands from development** ***[Measure: # of miles buffers protected]***
b. **Protect wetlands from contamination, siltation, and eutrophication. (improve stormwater management practices and emergent control measures)** ***[Measure: # of acres protected from contamination, siltation and eutrophication]***
c. **Encourage beneficial agricultural practices (farm bill programs and other landowner incentives), involvement in Conservation Reserve programs, and the development of incentives for the maintenance of wetland habitat** ***[Measure: # of sites with cooperative management projects; # of acres wetlands protected]***
d. **Protect wetlands through acquisitions and easements** ***[Measure: # of acres of wetlands newly protected through acquisitions and easements]***
e. **Establish and maintain adequate buffers of upland habitat around wetlands** ***[Measure: # of miles buffer established]***
f. **Incorporate wetland conservation actions into land planning efforts and public land management plans** ***[Measure: # of acres of wetlands conserved during land use and land planning efforts;*** *# of public land management plans incorporating wetland wildlife focused habitat conservation actions****]***
g. **Work with landowners to encourage retention of emergent wetlands (e.g. DO NOT impound)** ***[Measure: # of sites with cooperative management projects]***
h. **Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
i. **Develop and implement protocols to control invasive species and prevent their establishment** ***[Measure: # of protocols developed; # of sites with management implemented]***

j. Encourage the maintenance of forested habitat adjacent to open-canopy aquatic habitat *[Measure: # of miles adjacent forested habitat protected]*
k. Conduct watershed-level stream restoration and protection efforts (e.g. water source) *[Measure: # of miles streams restored and protected]*
l. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
m. Limit development impacts within wetland areas and surrounding watershed *[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]*
n. Incorporate wetland conservation actions into public land management plans *[Measure:]*
o. Consider making minor alterations of existing management schemes on wetlands managed for waterfowl by state and federal agencies to improve habitat for GCN species *[Measure: # of management alterations proposed for wetlands managed by public agencies; # of sites where new management adjustments implemented]*
p. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
q. Establish and maintain habitat linkages between wetlands *[Measure: # of wetlands connected by new habitat linkages]*
r. Restore prior converted and other degraded wetlands *[Measure: # of acres restored]*
s. Limit the use of non-native fish as BMPs for mosquito control and vegetation management *[Measure: # of sites with alternative or control methods using native species implemented]*
t. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
u. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
v. Restore wetlands where appropriate *[Measure: # of acres wetlands restored]*
w. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
x. Promote the establishment and growth of floating-leaved and submerged vegetation *[Measure: # of sites or acres with floating and submerged vegetation management implemented]*
y. Restore semi-permanent and permanent open water habitats and flats within wetlands where appropriate *[Measure: # of sites with restored open water habitats and flats]*
z. Ensure adequate buffer in spraying of habitat for Gypsy Moth and other insect control *[Measure: # of sites with targeted pesticide use with adequate buffers]*
aa. Implement prescribed burn programs to control woody vegetation within the wetlands *[Measure: # of acres maintained with controlled burn program; # of sites with natural fire regimes allowed]*
bb. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
cc. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species *[Measure: # of research projects conducted; # of research papers published]*

c. Conduct research on habitat use and requirements of GCN species *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of surveys completed]*
e. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
f. Evaluate the effects of the invasion of phragmites and purple loosestrife and other invasives on GCN species *[Measure: # of research projects conducted; # of research papers published]*
g. Determine the effects of development activities on GCN species *[Measure: # of research projects conducted; # of research papers published]*
h. Determine the effects of environmental contaminants on GCN species *[Measure: # of research projects conducted; # of research papers published]*
i. Determine the ranges/current distribution of Gambusia *[Measure: # of surveys completed]*

(17) Tidal Marshes

Description:

Tidal marshes include freshwater, brackish, and salt marshes that are flooded twice daily by lunar tides. In Maryland, they are widely distributed along tidal rivers and shores of the Chesapeake Bay. Tidal freshwater marshes occur in upper sections of tidal rivers and creeks where water is consistently fresh (salinity less than 0.5 ppt). Pulses of higher salinity are common during spring high tides and episodes of low river discharge during drought cycles. The vegetation is very diverse, dominated by aquatics that are emergent at high tide. Typically there are two distinct zones in a tidal freshwater marsh: a low elevation zone dominated by short, broad-leaf emergents bordering mudflats or open water, and a slightly higher-elevation area dominated by tall graminoids. Plants in the low zone may include spadderdock, arrow arum, and pickerel weed, while higher zones often support species such as wild rice, jewelweed, sweetflag, dotted smartweed, rice cutgrass, tearthumbs, and beggar-ticks. This zonation can be attributed to flooding depth, duration, and frequency. As the salinity gradient increases downstream, subtle changes in community composition occur as plants tolerant of saltier, brackish marshes mix with predominately freshwater plants. Marshes in this zone are diverse and typically include species such as narrow-leaved cattail, saltmarsh bulrush, eastern rose-mallow, seashore mallow, and big cordgrass.

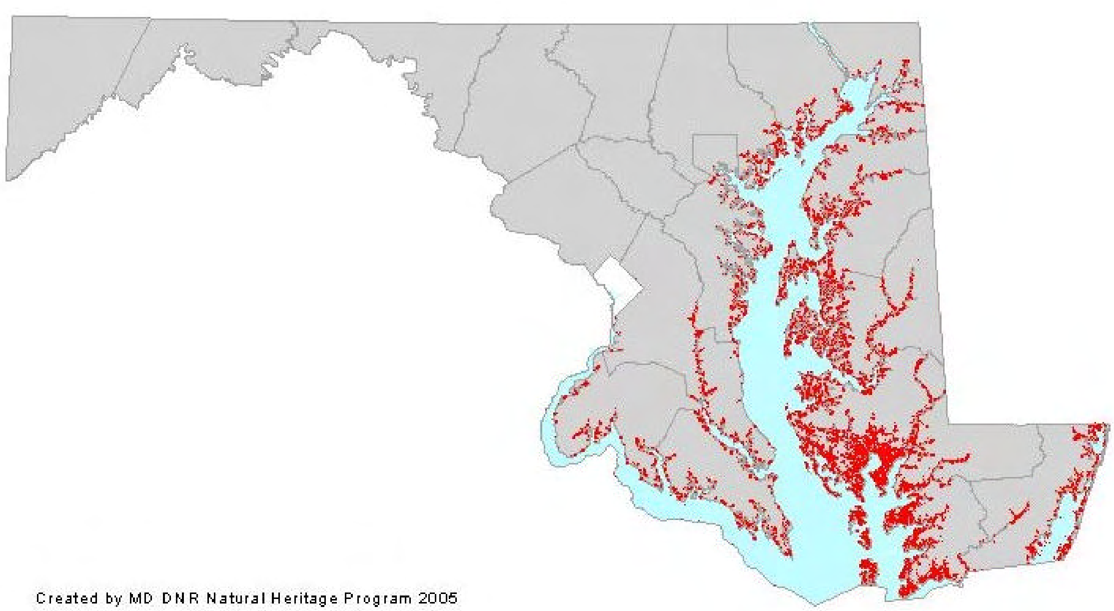
Tidal brackish marshes are transitional wetlands between tidal freshwater systems and salt marshes. They are the most extensive wetland type in Maryland occurring along the many miles of rivers and shores where the salinity of water ranges from 0.5 -18 ppt. Species diversity in brackish marshes is low and dominated by graminoids that often form extensive dense patches.

Salt marshes or salt meadows along the coast and lower portions of the Chesapeake Bay form essentially flat plains of low-statured vegetation with moderate species diversity and distinct zonation between low and high salt marshes. Lower, more regularly flooded salt zones with lower salinity are often dominated by saltmarsh cordgrass and extensive stands of black needlerush. Shorter-statured salt marshes or salt meadows are dominated by saltgrass and small saltmeadow cordgrass and generally occur on slightly elevated surfaces where tides may be less regular and where soils may concentrate salts. High salt marsh zones often support a diverse assemblage of plants that may include species such as annual salt-marsh aster, perennial salt-marsh aster, sea-oxeye, sea-lavender, glassworts, sea rose-pink, salt-marsh false foxglove, and narrow-leaved loosestrife. The salinity of tidal water is usually 18 - 30 ppt and flooding is less regular because of slightly elevated landscapes. Embedded in some salt marshes are shallow, poorly drained depressions called “Salt panes.” Like the adjacent salt marsh, salt pannes are flooded by tidal water, but water does not drain freely into creeks or guts. After a panne has been flooded the standing water evaporates and the salinity of the soil water greatly increases above the level of seawater, thus supporting the most salt-tolerant perennials and annuals, such as saltgrass, saltwort, and glassworts.

Location and Condition:

Tidal marshes are found in every county on the Coastal Plain occupying 81.8% (205,815 acres) of estuarine wetlands and 1.2% (3,799 acres) of palustrine wetlands (Tiner and Burke 1995). The best examples of tidal freshwater marshes are found on sediments deposited by large meanders of the Patuxent, Potomac, Choptank, Nanticoke, Wicomico, and Pocomoke Rivers. The majority of these marshes are in good condition however, chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes. Tidal Freshwater Marshes are also threatened by invasive plants such as marsh dewflower and common reed which displace native vegetation. Tidal brackish marshes are most abundant in the lower counties of the Coastal Plain such as Dorchester, Wicomico, Somerset, and Worcester Counties. Many of these marshes have been impacted by ditching, shoreline stabilization and destruction by nutria, a naturalized exotic mammal. In addition, dredge spoils and other disturbed areas often support dense, nearly monospecific colonies of common reed, a highly aggressive, invasive species that constitutes a serious threat to all tidal marshes throughout the Coastal Plain.

Figure 4.17 Location of Tidal Marshes in Maryland (Source: USFWS NWI)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Least shrew

Birds
American bittern

American black duck
American oystercatcher

American peregrine falcon
Bald eagle
Barn owl
Black rail
Black skimmer
Black tern
Black-bellied plover
Black-crowned night-heron
Boat-tailed grackle
Brant
Brown pelican
Coastal Plain swamp sparrow
Common moorhen
Common nighthawk
Common tern
Dunlin
Eastern meadowlark
Forster's tern
Glossy ibis
Golden eagle
Grasshopper sparrow
Great blue heron
Great egret

Greater yellowlegs
Gull-billed tern
King rail
Laughing gull
Least bittern
Least tern
Little blue heron
Marsh wren
Northern harrier
Pied-billed grebe
Red knot
Royal tern
Ruddy duck
Ruddy turnstone
Saltmarsh sharp-tailed sparrow
Sanderling
Sandwich tern
Seaside sparrow
Sedge wren
Semipalmated sandpiper
Short-billed Dowitcher
Short-eared owl
Snowy egret

Tricolored heron
Whimbrel
Willet
Wilson's snipe
Yellow-crowned night-heron
Reptiles
Northern diamond-backed terrapin
Northern red-bellied turtle
Fishes
Spotfin killifish
Inverts: Dragonflies & Damselflies
Four-spotted pennant
Inverts: Butterflies & Moths
A noctuid moth
Rare skipper
Seaside goldenrod stem borer
Inverts: Beetles
A hydrophilid beetle
Rare Natural Communities
N/A

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, red fox, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, mink, northern river otter, muskrat, nutria, common snipe, Virginia rail, clapper rail, king rail, sora, Canada goose, snow goose, brant, mallard, American black duck, wood duck, gadwall, blue-winged teal, green-winged teal, northern pintail, American widgeon, northern shoveler, ring-necked duck, canvasback, redhead, hooded merganser, ruddy duck, American crow, fish crow, eastern snapping turtle, and northern diamond-backed terrapin. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

Tiner and Burke (1995) summarize the major causes of wetland loss and degradation in Maryland by the following: 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 spoil 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, and irrigation, 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 siliviculture plantations, 10) Sediment diversion by dams, deep channels, and other structures, and 11) Hydrologic alterations by canals, spoils banks, roads, and other structures. Natural threats such as droughts, subsidence/sea-level rise, storm events, erosion, and mechanical damage by wildlife (e.g., muskrats, mute swans, snow geese, Canada geese) could also have severe impacts on wetlands systems.

a. Conversion to agriculture that results in loss of habitat
b. Development and land use, including roadways, that result in fragmentation and isolation
c. Incompatible agricultural practices, such as ditching, channelization, pond construction, livestock grazing, and inadequate buffers, that result in habitat degradation
d. Hydrologic changes from residential development, agricultural practices, mining, and other impacts such as ditching, water withdrawal, and pond construction
e. Reduced water quality through chemical contamination, siltation, and pollution
f. Invasive species that result in degradation of habitat
g. Pesticide use and contamination that directly or indirectly affects GCN species
h. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
i. Eutrophication, siltation, and pollution of habitat primarily by pesticide and nutrient contamination
j. Sea-level rise, subduction, and increased erosion rates that result in loss of habitat and increased flooding events
k. Channalization, piers, docks, and boat wakes that result in habitat degradation
l. Shoreline stabilization through rip-rap placement and bulkhead construction
m. Contamination from oil spills, boat fuels, and other sources of harmful chemicals
n. Impoundments

Conservation Actions:

a. **Limit development impacts within wetland areas and surrounding watershed** ***[Measure: # of development projects implementing BMPs to limit surrounding wetland impacts; % of development permits denied for wetland protection]***
b. **Protect appropriate buffers for tidal marshes through acquisition and easements** ***[Measure: # of acres of appropriate wetland buffers protected]***
c. **Restore and enhance breeding and nonbreeding habitats of high priority GCN species** ***[Measure: # of acres restored and enhanced]***
d. **Develop and implement protocols to control invasive species and prevent their establishment** ***[Measure: # of protocols developed; # of sites with management implemented]***

- **e. Initiate coordinated efforts to conserve habitat and maintain the integrity of wetland systems across wide geographic areas, including targeting the highest quality areas** ***[Measure: # of acres targeted tidal marshes conserved]***
- **f. Develop and implement methods to restore hydrology to wetlands degraded by ditching** ***[Measure: # of protocols developed; # of acres of ditched marshes with hydrology restored]***
- **g. Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology** ***[Measure: # of acres of wetlands protected from practices that alter hydrology]***
- **h. Minimize mosquito control practices to those conducive to GCN species** ***[Measure: # of acres with compatible pest management implemented; # of local, state, and federal agency plans incorporating compatible pest management]***
- **i. Restore wetlands where appropriate** ***[Measure: # of acres wetlands restored]***
- j. Reduce impacts of water pollution from boats and other sources *[Measure: # of guidelines developed and distributed; # of sites with guidelines implemented]*
- k. Protect wetlands through acquisitions and easements *[Measure: # of acres of wetlands newly protected through acquisitions and easements]*
- l. Acquire habitat through the North American Wetland Conservation Act (NAWCA) *[Measure: # of acres acquired through NAWCA program]*
- m. Implement BMPs and adaptive management methods for tidal marshes and associated impoundments *[Measure: # of sites with BMPs implemented; # of BMPs incorporated into local, state, and federal agency plans]*
- n. Develop new technologies to accelerate tidal marsh accretion *[Measure: # of protocols developed and evaluated for effectiveness; # of sites with protocols implemented]*
- o. Minimize runoff from roads, including silt, salt and contaminants *[Measure: # of sites with improved runoff BMPs implemented]*
- p. Strictly enforce existing federal and state wetland protection laws *[Measure: # of violations prosecuted; # of citations issued]*
- q. Utilize U.S. Army Corp of Engineers and MDE regulatory processes to protect tidal marsh habitat *[Measure: # of acres of habitat protected via wetlands regulatory processes]*
- r. Minimize and reduce habitat fragmentation *[Measure: # of development projects designed and developed to minimize habitat fragmentation]*
- s. Incorporate wetland conservation actions into land planning efforts and public land management plans *[Measure: # of acres of wetlands conserved during land use and land planning efforts; # of public land management plans incorporating wetland wildlife focused habitat conservation actions]*
- t. Collaborate with the implementation of the North American Waterfowl Plan *[Measure: # of joint cooperative conservation projects implemented; # of acres protected under cooperative projects]*
- u. Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts *[Measure: # acres of wetlands conserved through expanded and coordinated multi-partner cooperative programs]*
- v. Better train certified wetland delineators to identify wetland types *[Measure: # of certified wetland delineators with updated training]*
- w. Work with landowners and farming community to develop and encourage BMPs for agricultural practices *[Measure: # of BMPs developed and promoted; # of sites with BMPs implemented]*
- x. Work with Maryland DOT to minimize wetland impacts and explore offsite mitigation for wetland complexes *[Measure: # or miles of new roads planned with comments/input to minimize wetland impacts; # of offsite mitigation projects established]*

Inventory, Monitoring and Research Needs:

a. Determine precise habitat characterizations and needs of high priority GCN species, including area sensitivity, habitat quality, and habitat availability *[Measure: # of research projects conducted; # of research papers published]*
b. Determine management needs and best management practices for populations, especially effects of various marsh management practices on species' productivity and on long-term habitat suitability *[Measure: # of research projects conducted; # of research papers published; # BMP's developed]*
c. Develop regional, standardized methodologies for effective assessment of population abundance, trends, distribution, and movement patterns, and for improved monitoring of Maryland populations *[Measure: # of research projects conducted; # of research papers published; # of standardized methodologies developed]*
d. Conduct studies on the factors limiting species abundance, such as predation rates, reproductive success, contamination, and prey availability *[Measure: # of research projects conducted; # of research papers published]*
e. Monitoring programs should accompany management activities to assess effects of techniques on GCN species and long-term habitat suitability *[Measure: # of monitoring programs conducted; # of conservation actions modified and re-prioritized based on evaluation of effectiveness]*
f. Establish long-term habitat monitoring programs *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
g. Develop more effective methods of controlling phragmites *[Measure: # of methods tested; # of methods developed]*

(18) Grasslands

Description:

Grasslands are upland treeless areas dominated (> 80% cover) by herbaceous vegetation. Historically, parts of Maryland supported large expanses of natural grasslands and savanna-like habitats. Tens of thousands of acres of grassland dotted with Blackjack and Post Oaks once stretched across northern Maryland and nearby Pennsylvania. Prior to European settlement, much of Baltimore, Harford and Carroll Counties and adjacent counties in Pennsylvania were covered by this prairie-like grassland intermingled among wooded valleys (Mayre 1920). Also, early 18th and 19th century accounts depict large natural grasslands in the Hagerstown, Middletown and Frederick valleys (Mayre 1955) and around The Glades area of Garrett County. It is believed that these openings were created and maintained by a combination of soil conditions, large grazing mammals (e.g., woodland bison, elk) and periodic fires. These grassland ecosystems have since nearly vanished due to habitat loss resulting from development, agriculture, fire suppression and the disappearance of large ungulates. Most of the state's remaining grassland fauna mostly persists in one or more of the following settings: (1) agricultural fields (e.g., hayfields, pastures, certain croplands, grass buffer plantings); (2) fallow fields; (3) recent clearcuts (within 1-3 years after logging); (4) reclaimed strip mines on the Allegheny Plateau; (5) mowed edges of airports and military airfields; and (6) remnant natural grassland communities. Some grassland species of conservation concern also occur in nontidal and/or tidal marshes.

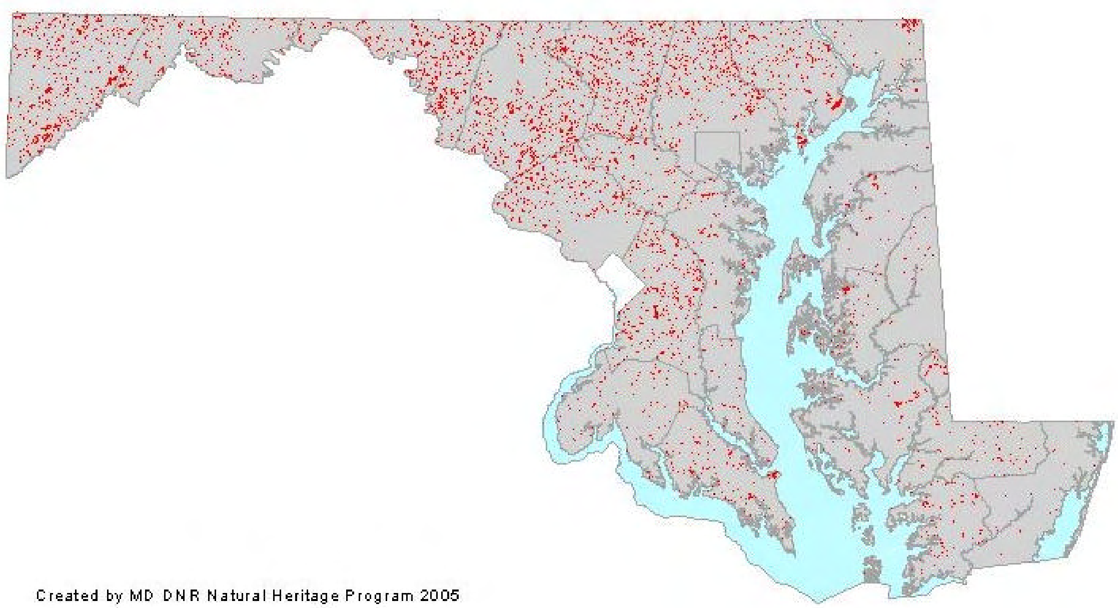
Grassland habitat suitability generally increases with the size and area:edge ratio of a grassland site. A number of grassland species (e.g., regal fritillary, grasshopper sparrow, Henslow's sparrow) are considered area-sensitive, occurring only in relatively large (> 50-100 ha), unfragmented grasslands and/or exhibiting positive, area-dependent changes in population density or viability. Depending on the taxon, other important predictors of habitat suitability may include vegetative composition, height, structure and patchiness; surrounding landscape conditions; and topography.

Location and Condition:

The grasslands that occurred in Maryland prior to European settlement have all but vanished. However, approximately 240,000 acres of anthropogenic grasslands occur in the state, much of it as pasture, hayfields, and fallow fields. The vast majority (89%) of this acreage is on private land. Some of the largest grasslands occur around commercial and military airfields like those at Aberdeen Proving Ground, Patuxent Naval Air Station and Baltimore-

Washington International Airport. Expansive grasslands also occur on reclaimed strip mines in western Allegany and Garrett Counties. Loss and fragmentation of agricultural land to development along with incompatible farming and mowing practices are among the most significant threats to grassland habitat and GCN species within this habitat in Maryland. Nearly all of the few remaining native grasslands occur as small isolated natural communities. Perhaps the best remaining example of a native grassland is located at Soldiers Delight Natural Environment Area in Baltimore County (see the section on "Barrens and Dry Glades" for details). Restoration of this globally rare serpentine habitat is on-going. With few opportunities for restoring native grasslands, especially on a scale large enough to support area-sensitive species and viable metapopulations of habitat specialists, the future of grassland habitat conservation in Maryland depends, in large part, on proper management of anthropogenic grasslands in a manner that does not compromise the conservation goals of native species and ecosystems.

Figure 4.18 Location of Grasslands in Maryland (Sources: MD Dept of Planning; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Bobcat
Eastern harvest mouse
Least shrew
Birds
American woodcock
Barn owl
Bobolink
Common nighthawk
Dickcissel
Eastern meadowlark

Field sparrow
Golden eagle
Grasshopper sparrow
Gull-billed tern
Henslow's sparrow
Laughing gull
Loggerhead shrike
Northern bobwhite
Northern harrier
Savannah sparrow
Sedge wren

Short-eared owl
Upland sandpiper
Vesper sparrow
Inverts: Butterflies & Moths
Indian skipper
Regal fritillary
Rare Natural Communities
Serpentine Barrens

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, red fox, coyote, common raccoon, striped skunk, long-tailed weasel, eastern cottontail, woodchuck, northern bobwhite, ring-necked pheasant, American woodcock, mourning dove, and American crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or habitat types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Human disturbance and other incompatible practices that result in habitat degradation
d. Invasive species that result in habitat degradation
e. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
f. Fragmentation and isolation
g. Loss of natural fire regime
h. Lack of disturbance allowing succession over time
i. Incompatible mowing (time of year, mower height)
j. Aforestation

Conservation Actions:

a. Encourage beneficial agricultural practices, such as late mowing; involvement in the Conservation Reserve programs; and including grass forb buffers in agricultural settings ***[Measure: # of sites with cooperative management projects; # of acres farmland managed for this habitat]***
b. Incorporate conservation actions into land use and land planning efforts by local, state, and federal agencies ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
c. Develop and implement protocols to control invasive species in a manner compatible with GCN species ***[Measure: # of protocols developed and evaluated for effectiveness; # of sites with management implemented]***
d. Focus land preservation efforts on protecting large tracts of open grassland and minimize edge effects for area dependent grassland species ***[Measure: # of acres large tracts of grassland preserved]***
e. Restore and maintain native grassland communities ***[Measure: # of acres restored and maintained]***
f. Convert exotic pasture/hayland to native warm-season grasses *[Measure: # of acres exotic pasture/hayland converted to native warm-season grasses]*
g. Restore savannah conditions on private and public lands *[Measure: # of acres of savannah conditions restored]*
h. Encourage management for grassland species, including upland sandpipers, on airport lands and reclaimed mine lands *[Measure: # of wildlife focused habitat management guidelines incorporated into airport and reclaimed mine land management]*

i. Utilize appropriate prescribed burning in or light disking of selected portions of individual fields to maintain mid-successional seral stages and increase coverage of tall forbs *[Measure: # of acres maintained with controlled burn program; # of sites with natural fire regimes allowed]*
j. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
k. Incorporate best management practices into land management plans *[Measure: # of development BMPs developed; # of private and public land management plans implementing BMPs]*
l. Limit access and educate the public about the value of these habitats to minimize human disturbance *[Measure: # of sites with limited access and educational signage; # of educational materials developed and distributed]*
m. Minimize fragmentation of existing large grasslands used by GCN species *[Measure: # of land use projects developed in a manner that minimizes fragmentation]*
n. Utilize landowner incentive programs, including Farm Bill programs, to develop and maintain this habitat type *[Measure: # of acres created and maintained utilizing landowner incentive programs]*
o. Work with sportsmen organizations, such as Quail Unlimited, to promote and manage this habitat *[Measure: # of acres managed for this habitat type through cooperative projects with sportsmen organizations]*
p. Work with farmers to conserve and manage for this habitat on marginal croplands *[Measure: # of acres marginal cropland managed for this habitat type]*
q. Encourage the use of native seed stock for warm season grass plantings *[Measure: # of acres warm season grass plantings using native seed stock; # of educational materials developed and disseminated about sources and use of native seed]*
r. Convert agricultural fields on public lands to grassland habitat where feasible *[# acres converted]*

Inventory, Monitoring and Research Needs:

a. Initiate long-term monitoring studies of GCN species, including grassland nesting birds *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially insects *[Measure: # of research projects conducted; # of research papers published]*
c. Conduct research on habitat use and requirements of GCN species, including bobwhite, grassland birds, and insects *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of research projects conducted; # of research papers published]*
e. Conduct research to determine movement patterns and dispersal of GCN species *[Measure: # of research projects conducted; # of research papers published]*
f. Develop standardized regional monitoring protocols for GCN species *[Measure: # of standardized protocols developed]*
g. Identify agricultural practices beneficial to GCN grassland species, including appropriate mowing regimes *[Measure: # of research projects conducted; # of research papers published; # of BMPs developed]*
h. Implement accurate and standardized survey methods to determine regional population trends *[Measure: # of surveys completed]*
i. Monitor success of populations in different habitat types, including restoration efforts *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
j. Conduct studies on the limiting factors and management needs of GCN populations *[Measure: # of research projects conducted; # of research papers published]*

k. Conduct a comprehensive survey of grassland habitats and determine how they can be preserved *[Measure: # of surveys completed]*
l. Determine historical extent, range, and condition of native grassland communities *[Measure: Historical extent, range, and condition of native grassland communities determined]*
m. Compare habitat succession of fallow fields to that of planted grasslands for GCN species benefits *[Measure: # of research projects conducted, # of research papers published]*

(19) Barrens and Dry Glades

Description:

In Maryland, barrens and dry glades include habitats that have developed on shallow soils over bedrock of serpentine, sandstone, and shale. The plant communities associated with them are structurally intermediate between forests and open canopy uplands, often consisting of sparse woodlands, shrublands, and grass-savannas. Most of these habitats are kept from succeeding to closed forests by periodic fire, edaphic factors, and unstable substrates. Serpentine soils derive from ultramafic rocks, which occur in a discontinuous band east of the Appalachian Mountains from Canada to Alabama. Serpentine Barrens are best developed in the Piedmont of southeastern Pennsylvania and northern Maryland. One of the four remaining serpentine areas in Maryland, the Soldiers' Delight Natural Environmental Area near Baltimore, is the largest in eastern North America, encompassing 2,000 acres of woodlands and grassland savannas, and is among the most species-rich in the world. Serpentine, or serpentinite, is a mineral producing dry, nutrient-poor soil deadly to plants not specially adapted to its unusual chemistry. In folklore, the name "serpentine" is attributed to the soil's resemblance to a mottled greenish-brown snake dwelling on similar soils in northern Italy. The greenish soil color comes from fragments of the underlying bedrock containing magnesium silicate. Toxic to plants, as much as one-third of the bedrock may be made of magnesium. The soil can be very dark in color, depending on its iron, chromite, and magnesium content. High levels of magnesium in the soil block a plant's ability to take in soil nutrients, especially calcium. Because they are shallow and low in organic material and clay, serpentine soils also cannot hold water or nutrients well. Serpentine soils often have pockets of naturally occurring heavy metals toxic to plants, such as chromium, cobalt, and nickel. Also, these soils are normally acidic near the surface, but less so in deeper layers. As wind and water erode the soil, non-acidic layers are exposed, creating varied habitat for plants. Plants characteristic of serpentine barrens include little bluestem, Indian grass, purplish three-awn grass, serpentine aster, and roundleaf fameflower. Woodlands bordering grassland vegetation consist of common greenbrier, blackjack oak, post oak, and the fire-intolerant Virginia pine.

Shale barrens consist of sparse woodlands with scattered herbaceous openings on rock outcrops of acidic and calcareous shales in the Ridge and Valley physiographic province of Maryland. They are best developed on steep, dry slopes with south to west-facing exposures where surface temperatures are seasonally extremely high. In addition, shales are highly friable and many steep slopes contain loose and unstable channery derived from the continual undercutting of bedrock by streams. This mechanical erosion from constant downslope movement of loose fissile shale combined with very little soil development, very low soil moisture, rapid water drainage, lack of shading vegetation, and longer daily/annual exposure to the sun (due to southerly aspect) results in harsh growing conditions and drought stress. Only species well adapted to these harsh conditions thrive in such habitat. These conditions favor the development of open woodlands containing stunted trees of chestnut oak, Virginia pine, eastern red cedar, and pignut hickory. Other characteristic trees include white ash, post oak, black oak, red oak, table-mountain pine, white pine, shagbark hickory, and pignut hickory. Shrubs common to shale barrens include shadbush, black huckleberry, deerberry, and bear oak. Calcareous shales often include shrubs such as shrubby St. Johnswort, fragrant sumac, dwarf sumac, and Carolina rose. Herbaceous openings are sparsely vegetated and often scattered within a woodland matrix. Such openings contain many endemic or near-endemic shale barren species such as shale-barren pussytoes, shale-barren ragwort, shale-barren evening primrose, low false bindweed, and Kate's-mountain-clover. Also characteristic are species such as Pennsylvania sedge, wavy hairgrass, common dittany, rattlesnake-weed, poverty oat-grass, little bluestem, northern moss phlox, birdfoot violet and reindeer lichens.

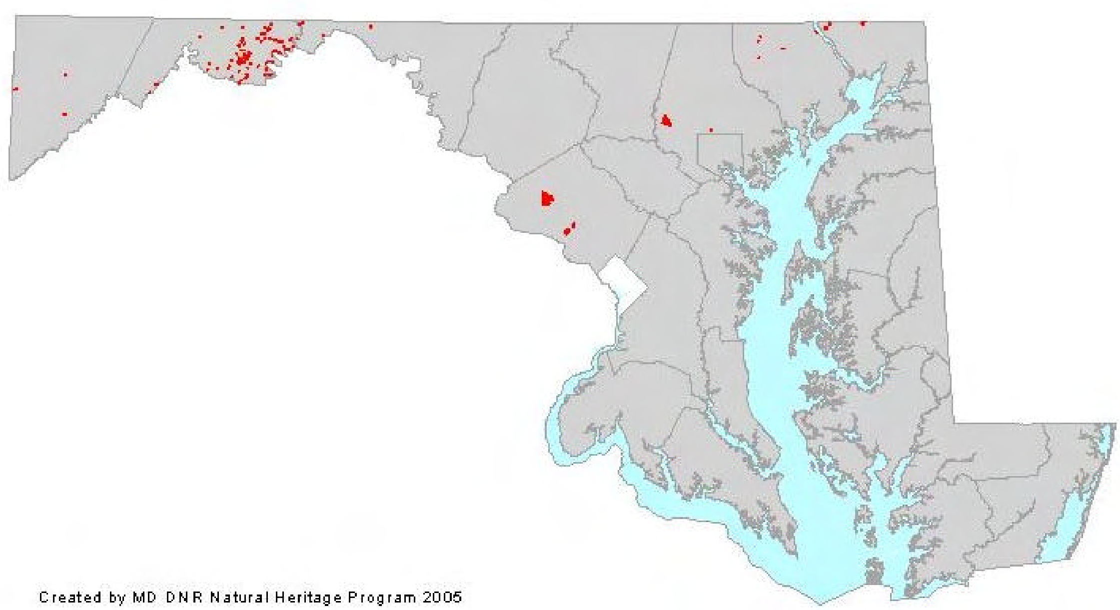
Sandstone glades are characterized by scrub and herbaceous vegetation on exposed acidic sandstone outcrops in the Allegheny Plateau physiographic province of the Central Appalachian Mountains in Maryland. The vegetation is best characterized as a mosaic of scrub thickets, herbaceous openings, and exposed bedrock with substantial lichen growth. Plant growth is typically confined to crevices or depressions where organic material has accumulated over time. Sandstone glades exhibit very harsh growing conditions resulting from very little soil development, low moisture retention, rapid runoff, and often great sun exposure. Combined these conditions make sandstone glades extremely drought-prone. Woody scrub usually consists of scattered, stunted trees of chestnut oak, bear oak, black gum, black birch and shrub thickets of black huckleberry, early low blueberry, northern lowbush blueberry, and glaucus greenbrier. Openings in the woody scrub are interspersed and if the right conditions are present, they typically support herbaceous species such as wintergreen, little bluestem, broomsedge, Pennsylvania sedge, and oat-grasses. Reindeer lichens are especially abundant.

Limestone glades are small, localized habitats of exposed carbonate rock outcrops in the Ridge and Valley physiographic province of Maryland. Habitats typically occur on dry, steep, south to west facing slopes containing very shallow soils and variable amounts of exposed bedrock and gravel. Soils are characterized by high pH (>7.0) and calcium levels, thus supporting a variety of calciphiles. The vegetation structure of limestone glades is best described as scrub with scattered herbaceous openings. Characteristic species include stunted trees and shrubs of chinkapin oak, eastern red cedar, white ash, red bud, common hackberry, fragrant sumac, American bladdernut, and common prickly-ash. The herbaceous layer often contains warm-season prairies grasses such as side-oats grama and little bluestem mixed with hoary puccoon, downy woodmint, bottlebrush grass, and hoary mountain-mint. In addition, ledges and crevices may support northern moss phlox and purple-stem cliff-brake.

Location and Condition:

Prior to European settlement (circa 1750), serpentine barrens and grasslands covered expansive areas in Maryland, concentrated in the upper portions of Baltimore, Harford, and Carroll Counties (Mayre 1920). Although edaphic factors are generally thought of as major contributors to serpentine habitats, use of fire by Amerindians prior to settlement was even a larger contributor in maintaining barren conditions. Between 1580 and 1730, the Susquehannock Indians and other tribes used these areas to harvest deer by "fire hunting". This practice has since been determined to be responsible for maintaining vegetative conditions on serpentine barrens throughout this region (Mayre 1955). Following European settlement and well into the 1900s, most of the barrens became farmed, grazed, or left to succeed into wooded timber following the absence of fire. Today, remaining examples are threatened by the invasion of fire intolerant Virginia pine and thickets of common greenbrier. And frequent prescribed burns are necessary to maintain them. Examples of serpentine barrens in Maryland are known from Soldiers' Delight Natural Environmental Area, Cherry Hill, Robert E. Lee Park, and Pilot Preserve (TNC). Soldiers' Delight Natural Environmental Area remains the largest (nearly 2,000 acres) and best example.

Figure 4.19 Location of Barrens and Dry Glades in Maryland (Source: MD DNR NHP)



Shale and sandstone barrens are small, localized habitats found in Garrett and Allegany Counties. Examples of shale barrens are scattered throughout Green Ridge State Forest. The primary threat to most shale barrens is invasion by exotic species such as barren bromegrass, cheat grass, Japanese bromegrass, spotted knapweed, Japanese honeysuckle, garlic-mustard, and tree-of-heaven. In Garrett County, excellent examples of sandstone glades can be found in Savage River State Forest on Big Savage and Meadow Mountains. In Allegany County, examples of sandstone glades are known from Martin and Warrior Mountains. The majority of sandstone glades are in good condition with only a few threatened by invasives such as tree-of-heaven, which can quickly colonize recently logged adjacent habitats.

The best remaining examples of Limestone glades are found on Fort Hill in Allegany County. A few scattered, degraded occurrences have also been documented from the Frederick Valley. These habitats are considered state-rare, small, highly localized, and threatened by invasive exotic species, quarrying, and grazing. There are at least 6,920 acres of barrens and dry glades in Maryland, of which most is either owned by private landowners (37.6%) or owned and managed by the state (33.8%). The rest is owned by the federal government (3.1%), by county/municipal agencies (23.4%), or by non-profit conservation organizations (2.1%).

GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Allegheny woodrat
Bobcat
Eastern harvest mouse
Eastern red bat
Least shrew
Silver-haired bat
Birds
Brown thrasher
Chuck-will's-widow
Common raven
Eastern meadowlark
Eastern towhee
Field sparrow
Golden-winged warbler
Grasshopper sparrow
Ovenbird
Prairie warbler
Whip-poor-will

Reptiles
Broad-headed skink
Cornsnake
Eastern hog-nosed snake
Timber rattlesnake
Inverts: Butterflies & Moths
A geometrid moth
A noctuid moth
Cobweb skipper
Dotted skipper
Edwards' hairstreak
Frosted elfin
Giant swallowtail
Indian skipper
Mottled duskywing
Northern crescent
Northern hairstreak
Northern metalmark
Olympia marble

Pepper and salt skipper
Persius duskywing
Pine barrens zanclognatha
Silvery blue
Southern grizzled skipper
The buckmoth
Inverts: Homopterans
Eastern sedge barrens planthopper
Inverts: Beetles
Cow Path Tiger Beetle
Splendid Tiger Beetle
Rare Natural Communities
Central Appalachian Shale Barrens
Sandstone Glades
Serpentine Barrens
Limestone Glades

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, eastern gray squirrel, eastern fox squirrel, red fox, common gray fox, coyote, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, woodchuck, wild turkey, ruffed grouse, northern bobwhite, mourning dove, and American crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or habitat types that results in loss of habitat
b. Lack of periodic fire
c. Pesticide use and contamination that directly or indirectly affects GCN species

d. Human disturbance and other incompatible practices that result in habitat degradation
e. Invasive species that result in habitat degradation
f. Lack of scientific understanding of appropriate habitat requirements and management needs for all GCN species
g. Fragmentation and isolation
h. Resource utilization from mining and wind farms
i. Succession
j. Deer overbrowsing or other causes that result in loss of structural diversity
k. Towers that fragment and degrade habitat

Conservation Actions:

a. **Develop habitat management guidelines for use by foresters and land managers** ***[Measure: habitat management guidelines developed]***
b. **Incorporate conservation actions into land use and land planning efforts by local, state, and federal agencies** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
c. **Work with private landowners to maintain suitable habitat, including the use of a private lands registry program** ***[Measure: # of acres habitat conserved; # of landowners participating in private land registry program]***
d. **Develop and implement protocols to control invasive species in a manner compatible with GCN species** ***[Measure: # of protocols developed; # of sites with management implemented]***
e. **Restore and maintain habitat through re-establishing natural fire regimes where feasible and conducting controlled burns** ***[Measure: # of acres maintained with controlled burn program; # of sites with natural fire regimes allowed]***
f. **Conserve appropriate corridors for movement and dispersal of GCN species** ***[Measure: # of acres corridors conserved; # of acres existing barrens and dry glades connected by corridors]***
g. Minimize fragmentation *[Measure: # of development projects and land use plans that incorporate measures to minimize habitat fragmentation]*
h. Restore degraded sites *[Measure: # of acres restored]*
i. Incorporate best management practices into land management plans *[# of development projects and other land management plans implementing BMPs]*
j. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
k. Control deer populations to reduce browsing levels *[Measure: # of acres with reduced deer browsing levels]*
l. Limit access and educate the public about the value of these habitats to minimize human disturbance *[Measure: # of sites with limited access and educational signage; # of educational materials developed and distributed]*

Inventory, Monitoring and Research Needs:

a. Conduct targeted inventories of certain GCN species *[Measure: # of surveys completed]*
b. Conduct long-term monitoring of certain GCN species *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
c. Conduct research on movement patterns, population trends and basic biology of certain GCN species *[Measure: # of research projects conducted; # of research papers published]*

d. Conduct research on effects of pesticide use on GCN species, especially invertebrates *[Measure: # of research projects conducted; # of research papers published]*
e. Conduct habitat research to determine the best management practices and the effects from fire *[Measure: # of research projects conducted; # of research papers published; # of BMPs developed]*
f. Determine natural fire regime *[Measure: # of research projects conducted; # of research papers published]*

(20) Cliffs and Rock Outcrops

Description:
Rock outcrops and cliffs are tall (up to 50 m high), steep to vertical expanses of bare to sparsely vegetated bedrock and/or soil. The differences between the two are subtle but cliffs are generally considered tall, sheer vertical walls of rock or soil while outcrops consist of steep to vertical, exposed rock formations with well-developed fissures and crevices. Both are most numerous and prominent in the Allegheny Plateau and Ridge and Valley physiographic regions, although significant examples also occur in the Piedmont and along parts of the Chesapeake Bay shoreline.

On the Allegheny Plateau, this habitat is typified by extensive (in places at least 0.5 km long) Pottsville sandstone outcrops along the upper slopes and ridges (600-1000 m) of the state's highest mountains, including Dan's, Big Savage, Meadow and Backbone Mountains. In the Ridge and Valley, large sandstone ridgetop outcrops also occur in the Tuscarora Formation on Haystack, Wills and Evitts mountains, and in the Bear Pond Mountains; the Purslane Formation on Sideling Hill and Town Hill; and in the Oriskany Formation on numerous ridges such as Fort Hill, Rountop Hill and Warrior Mountain. Farther east, between Hagerstown and Frederick, the Weverton Quartzite Formation forms major outcrops along the crests of South and Catoctin Mountains. Many of these outcrops include massive cliff and boulder faces with numerous, deep fissures. The outcrop base is often surrounded by extensive, open talus that grades into forested boulder fields. Cool, windswept conditions along with frequent ice storms and heavy snows greatly limit soil development and, thus, the type and extent of plant communities present. Vegetation in and around outcrops also varies depending on the physiographic region, elevation, slope, aspect, geological formation and other factors. On the steepest, most exposed sections, vegetation is absent except for patches of lichens and mosses growing on rock surfaces. On less exposed areas, scattered, sometimes dense patches of shrubs (e.g., mountain laurel, great-laurel), huckleberry, and blueberry along with scattered, stunted trees (e.g., chestnut oak, pitch pine, America mountain-ash, table mountain pine, and eastern hemlock) may be present. The surrounding vegetation, which influences the types of outcrop fauna present, ranges from northern conifer-hardwoods and mesic deciduous forest to dry oak-pine forest. Prior to the introduction of chestnut blight in the early-mid 1900's, American chestnut was a frequent to dominant tree species in many of the forests surrounding ridgetop outcrops.

At lower elevations in western Maryland, large outcrops and cliffs also occur along many of the larger streams and rivers. In Garrett County, for example, Pottsville sandstone outcrops overlook sections of the Youghiogheny River and North Branch of the Potomac River. A variety of formations outcrop along the main stem of the Potomac. One spectacular example is the Weverton Quartzite Formation which forms tall, sheer cliffs near Harper's Ferry and Point of Rocks. Shale and limestone outcrops and ledges also occur along the Potomac in Allegheny, Washington and Frederick counties.

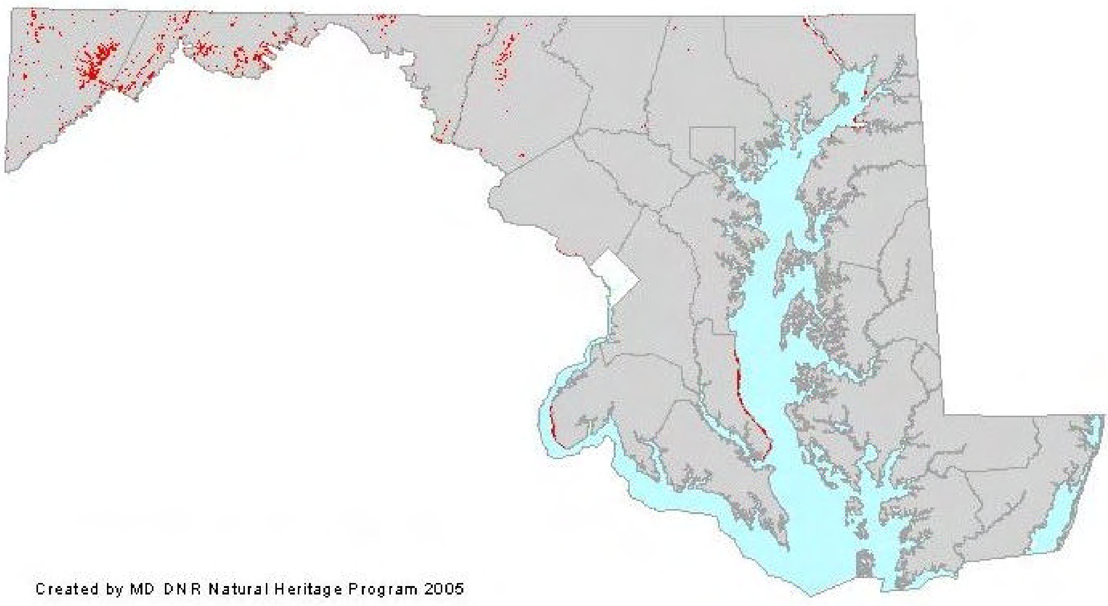
Cliffs and outcrops are much less common in the Piedmont and most are relatively small. The largest occur along the Susquehanna River, on Sugarloaf Mountain and in the Great Falls region of the Potomac River. On the Coastal Plain, this habitat type is limited to tall (5-40 m), steep to vertical earthen bluffs of Miocene origin along the shorelines of the mid- and upper Chesapeake Bay and large tidal rivers. Calvert Cliffs in Calvert County and Grove Point at the mouth of the Sassafras River typify this habitat type. Vegetation is usually absent to sparse due to naturally high erosion rates resulting from a combination of shoreline wave action, groundwater percolation and the weathering effects of wind and precipitation, especially during major storm events (e.g., hurricanes and "nor'easters"). A sparse early successional community may become temporarily established on less steep or exposed cliff faces. Vegetation composition varies but small trees such as black locust and sassafras are among the more frequent tree species present. Smaller (3-8 m tall) earthen bluffs also occur along inland rivers such as the Potomac and Monocacy. Large quarries and borrow pits occasionally serve as surrogate habitats for some cliff- and bluff-dwelling wildlife species.

Location and Condition:

Most cliffs and rock outcrops occur in mountain ridgetop settings in western Maryland; however, scattered outcrops are located in the Piedmont with the largest ones occurring along the Susquehanna River. Some of the largest, most ecologically significant examples exist along Big Savage Mountain and Backbone Mountain in Garrett County, Wills Mountain in Allegany County, and the Catoctin Mountains in Frederick and Washington Counties. Although few areas of cliff and rock outcrop ecosystems have been destroyed, many areas are significantly threatened by logging, introduced insect pests (e.g., gypsy moth, hemlock wooly adelgid), acid precipitation, vandalism and excessive human disturbance, and invasive plant species. Windpower development on ridgetops also poses a very serious new threat.

On the Coastal Plain, tall earthen bluffs occur along the Chesapeake Bay shoreline, with the most spectacular examples in Calvert, Kent and Cecil Counties. These naturally eroding cliffs are severely threatened by shoreline erosion control practices that alter or reduce natural erosion processes. The effects of sea-level rise are also of great concern.

Figure 4.20 Location of Cliffs and Rock Outcrops in Maryland (Sources: MD DNR NHP; USGS NED)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Allegheny woodrat
Bobcat
Eastern small-footed myotis
Eastern spotted skunk
Indiana bat
Least weasel
Long-tailed shrew
New England cottontail
North American Porcupine
Birds
American peregrine falcon

Bank swallow
Common raven
Dark-eyed junco
Mourning warbler
Winter wren
Reptiles
Cornsnake
Eastern hog-nosed snake
Timber rattlesnake
Amphibians
Green salamander
Inverts: Beetles

Cow Path Tiger Beetle
Northern Barrens Tiger Beetle
One-spotted Tiger Beetle
Puritan tiger beetle
Inverts: Land Snails
Cherrydrop snail
Rader's snail
Rare Natural Communities
Piedmont/Mountain Cliffs
Riverside Outcrop Barrens

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: white-tailed deer, black bear, common gray fox, common raccoon, Virginia opossum, striped skunk, long-tailed weasel, woodchuck, wild turkey, ruffed grouse, American crow, and fish crow. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or habitat types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species

c. Human disturbance and other incompatible practices that result in habitat degradation
d. Invasive species that result in habitat degradation
e. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
f. Fragmentation and isolation
g. Incompatible silviculture, wind farms, and mining that result in habitat degradation
h. Inappropriate shore erosion control
i. For sand and clay cliffs, nutrient loading from septic systems that enhance vegetation establishment

Conservation Actions:

a. **Develop habitat management guidelines for use by foresters and land managers and work with them to implement such** ***[Measure: guidelines developed; # of sites with cooperative management project; # of acres of this habitat managed for GCN species]***
b. **Provide adequate forest buffers** ***[Measure: # of acres of adequate forested buffers established]***
c. **Develop and implement shore erosion control practices that are compatible with cliff maintenance and the needs of GCN species** ***[Measure: # of BMPs developed; # of projects that incorporate BMPs into land management efforts]***
d. **Educate the general public, land owners, and land managers about the value of these habitats** ***[Measure: # of educational materials developed and distributed]***
e. **Incorporate conservation actions into land use and land planning efforts by local, state, and federal agencies** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
f. **Limit access to minimize human disturbance** ***[Measure: # of sites with limited access]***
g. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
h. Reduce impacts of wind turbines through appropriate siting/micrositing *[Measure: # of new wind turbine plans that incorporate comments/input for siting to minimize impacts]*
i. Incorporate best management practices into land management plans *[# of development projects and other land management plans implementing BMPs]*
j. Minimize fragmentation *[Measure: # of development projects and land use plans that incorporate measures to minimize habitat fragmentation]*
k. Maintain functioning subsurface habitats *[Measure: # of acres with functioning subsurface habitats]*
l. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
m. Reintroduce blight resistant American chestnut to appropriate rock outcrops *[Measure: # of sites with blight resistant American chestnut restored]*
n. Work with climbing clubs to minimize degradation and disturbance *[Measure: # of groups with cooperative management projects; # of sites with human disturbance minimized]*

Inventory, Monitoring and Research Needs:

a. Conduct long-term monitoring studies of GCN species, including woodrats and Puritan tiger beetles *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Conduct research on basic ecology, breeding parameters, and life histories of GCN species *[Measure: # of research projects conducted; # of research papers published]*

c. Conduct research on habitat use and requirements of GCN species, especially invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct species surveys and determine distribution and abundance of GCN species, especially invertebrates *[Measure: # of surveys completed]*
e. Conduct research to determine movement patterns and dispersal of GCN species, including woodrats, reptiles, and tiger beetles *[Measure: # of research projects conducted; # of research papers published]*
f. Determine forest matrix requirements to sustain functionality of these habitats *[Measure: # of research projects conducted; # of research papers published; forest matrix requirements determined]*
g. Conduct research to determine best management practices for GCN species *[Measure: # of research projects conducted; # of research papers published; # of BMPs determined]*

(21) Caves, Mines, and Springs

Description:

Caves are natural underground cavities or tunnels. They contain unique, fragile environments that support highly specialized animal communities and often a variety of rare species. Over 160 caves have been documented in Maryland. Most are located in the Ridge and Valley and Allegheny Plateau physiographic regions, but a few small caves occur in the Piedmont. Caves are most numerous in Washington County followed by Allegany, Garrett and Frederick counties. Crabtree Cave in Garrett County is the largest with over 1,200 m of passage. Two general types of caves exist in Maryland: solutional and non-solutional caves. The latter are formed by mechanical processes, occurring as joints or fractures in bedrock. Fissure caves and rock shelters are examples of this cave type. They are less numerous than solutional caves and are usually relatively small, shallow and lack extensive passageways. They occur in a variety of rock formations including the Pottsville Sandstone Formation in Garrett County, Tuscarora Sandstone Formation in Allegany and Washington counties, and Weverton Quartzite Formation in Frederick County. Solutional caves, however, can be quite deep and extensive and they represent, by far, the largest caves in Maryland. They are formed by the dissolving action of groundwater, which is naturally slightly acidic, on soluble, carbonate rock (usually limestone). Over millennia, these and related processes lead to the development of complex passages or tunnels and various speleothems or "formations" (carbonate deposits on cave surfaces) such as stalagmites, stalactites, helictites, and cave "coral". Some caves also contain subterranean streams that are hydrologically linked to karst landforms such as sinkholes, sinking streams, and springs. Solutional caves and other karst features are most numerous in the Tomstown Limestone Formation in Washington County which contains massive dolomites and limestones over 300 m thick. Other important cave-bearing formations include the Greenbrier Formation in Garrett County and the Tonoloway, Waynesboro, Beekmantown and Stones River formations in Washington County.

Mines are human-made underground tunnels from which coal and other mineral resources (e.g., limestone, copper, gold, chromium) are extracted. Most occur on the Allegheny Plateau but some smaller, now inactive mines also occur in the Ridge and Valley and Piedmont regions. Most rare cave-dwelling species are absent in mines. However, some abandoned mines can provide surrogate or cave-like habitat for a limited number of cave-dwelling species, especially more mobile vertebrates such as bats. The habitat suitability of abandoned mines for cave-dwelling animals depends on a variety of factors but especially the level of human disturbance, mine size and depth, passage complexity, rock formation type, temperature, humidity, and the presence or absence of groundwater.

A spring is a concentrated discharge of groundwater at a small (usually < 1 m^2), distinct site or opening in the ground. Springs are uncommon, isolated features and most occur west of the Fall Line. They provide critical habitat for highly rare aquatic snails and subterranean invertebrates, salamanders, crayfish and other invertebrates. Because some springs discharge directly into streams or wetlands, they also play a vital role in maintaining the ecological integrity of these habitats that, in turn, may harbor species of conservation concern (e.g., pearl dace, brook trout, rare dragonflies and damselflies). Springs emit groundwater due to hydrostatic pressure resulting from gravity or artesian flow, although other physical forces may play a role (e.g., buoyant effect of dissolved gases). Several types of springs exist in Maryland including contact, scree, and fault springs. Perhaps the most common type is fracture or crevice springs. Here, groundwater moves downward due to gravity, flowing through fractures and crevices underneath the ground and emerging as a spring where a major fracture in a rock formation occurs at the earth's surface, usually along a ravine or swale. The flow or discharge rate of Maryland's springs ranges from less than one gallon per minute to nearly 10,000 gallons per minute. Seeps differ from springs in that they appear on the ground surface as broad, diffuse zones of wetness or percolation rather than distinct discharge sites. Also, seeps and associated wetlands often support distinct plant communities while springs are essentially aquatic and geological features.

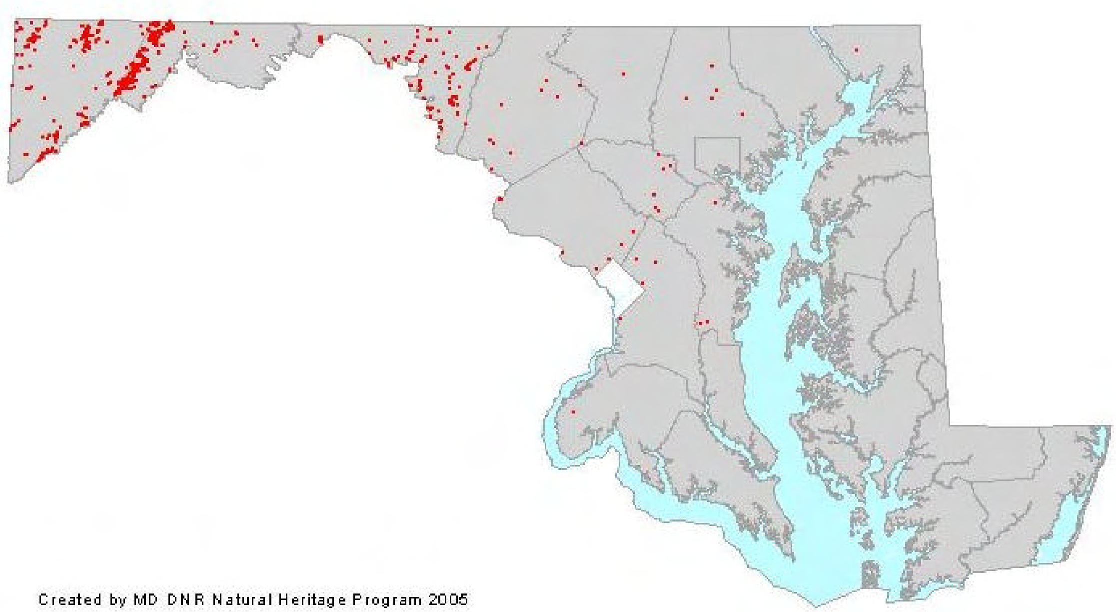
Location and Condition:

Nearly all of Maryland's caves are confined to the four westernmost counties, and most of these are located in Allegany and Washington Counties. The two most significant threats to caves are vandalism and groundwater pollution from development and agriculture. Many caves have suffered the effects of one or both of these. Over 90% of all caves are on private land and few cave systems are fully protected, especially when one considers that protection of the surrounding catchment basin or watershed is often as critical as securing the cave entrance.

Like caves, most of Maryland's springs occur in western Maryland but scattered springs also occur in the Piedmont and, to a lesser degree, the Coastal Plain. Nearly all mines occur in large coal seams in western Allegany and Garrett Counties. Much remains to be learned about the number, location and condition of springs and mines but, clearly, they face many of the same conservation issues as caves.

MD DNR NHP compiled information on 1,114 caves, mines and springs in Maryland, of which only 215 (19 %) are caves and springs. The majority of this key wildlife habitat is found on privately-owned land (93%). The others are owned by the federal government (2.3%), state government (3.3%), private conservation organizations (0.7%), various county/municipal agencies (0.6%), or are on lands with conservation easements (0.6%).

Figure 4.21 Location of Caves, Mines and Springs in Maryland (Sources: MD DNR MGS; UMD AEL; USGS NHD; USGS GNIS; MD DNR NHP)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Allegheny woodrat
Eastern small-footed myotis
Indiana bat
Southeastern myotis
Amphibians
Long-tailed salamander
Inverts: Beetles
A cave beetle
Inverts: Springtails
Crabtree cave springtail
Inverts: Spiders
Appalachian cave spider
Snivelys cave spider
Inverts: Freshwater Crustaceans
A harpacticoid copepod

Allegheny cave amphipod
An amphipod
An isopod
An isopod
An isopod
An isopod
An isopod
An isopod
Barrelville amphipod
Biggers' cave amphipod
Dearolf's cave amphipod
Franz's cave amphipod
Franz's cave isopod
Greenbrier cave amphipod
Pizzini's amphipod
Potomac amphipod
Price's cave isopod

Roundtop amphipod
Shenandoah cave amphipod
Tenuis amphipod
Tidewater amphipod
Inverts: Snails
Appalachian spring snail
Blue ridge spring snail
Inverts: Flatworms
A planarian
A planarian
A planarian
A planarian
Hoffmaster's cave planarian
Rare Natural Communities
N/A

In addition to the GCN species listed above, this key wildlife habitat supports a diversity of other wildlife species. No game species are found in this habitat type.

Threats:

a. Conversion to other land uses or habitat types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Human disturbance and other incompatible practices that result in habitat degradation
d. Invasive species that result in habitat degradation
e. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
f. Habitat degradation due to strip mining, logging, road construction and salt application, agriculture, overgrazing, and development of watershed areas
g. Pollution of groundwater from pesticides (such as dimlin), toxins, and nutrient overload
h. Hydrologic disturbances, siltation, groundwater flow alteration, and disturbances of recharge areas affecting water flow or quality
i. Fragmentation of habitat
j. Vegetation removal at upwellings resulting in loss of allochthonous input
k. Spelunker disturbances to caves and mines resulting in compaction of littoral zone

Conservation Actions:

a. Limit land use changes that may impact hydrology ***[Measure: # of acres protected from altered hydrology]***
b. Incorporate conservation actions into land planning efforts and public land management plans by local, state, and federal agencies ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
c. Delineate and protect watersheds for seeps, springs and caves with globally rare subterranean aquatic invertebrates ***[Measure: # of watershed areas identified and mapped; # of targeted landowners participating in conservation programs]***
d. Protect groundwater supply feeding springs inhabited by GCN species ***[Measure: average and minimum annual groundwater flow maintained at priority sites; water quality maintained at priority sites]***
e. Work with Bureau of Mines to protect mines supporting GCN species ***[Measure: # of joint cooperative projects implemented; # of mines protected]***
f. Limit access to minimize human disturbance ***[Measure: # of sites with limited access]***
g. Educate spelunkers about the value of these habitats and the impacts of disturbance to caves and mines supporting GCN species ***[Measure: # of educational materials developed and distributed]***
h. Protect known sites from future strip mining or development of surrounding forests *[Measure: # of sites protected]*
i. Install and maintain appropriate gates at entrances to caves and mines that support GCN species *[Measure: # of gates installed and maintained]*
j. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
k. Incorporate best management practices into land management plans *[# of development projects and other land management plans implementing BMPs]*
l. Add sites to Maryland Natural Areas Registry (MNAR) *[Measure: MNAR program developed; # of sites with landowners participating in MNAR]*
m. Use registry or acquisition to restore and protect groundwater aquifers *[Measure: # of acres conserved]*

n. Initiate measures to prevent pollution of first and second order streams by surrounding habitat with adequate buffers *[Measure: # of miles of adequate buffer established]*
o. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
p. Minimize or eliminate soil disturbance in estimated catchment basin *[Measure: # of catchment basins identified and mapped; # of acres with management plans that incorporate minimal or no soil disturbance]*
q. Avoid any degradation or alteration of spring areas *[Measure: # of springs protected]*
r. Conserve appropriate corridors for movement and dispersal of GCN species *[Measure: # of acres corridors conserved]*
s. Restore forest cover to deforested catchment basins *[Measure: # of acres restored]*
t. Maintain appropriate vegetation around springs *[Measure: # of sites with appropriate surrounding vegetation maintained]*

Inventory, Monitoring and Research Needs:

a. Establish a long-term habitat monitoring program *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
b. Initiate long-term monitoring studies of GCN species, especially bats and invertebrates *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
c. Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially bats and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
d. Conduct research on habitat use and requirements of GCN species, especially bats and invertebrates *[Measure: # of research projects conducted; # of research papers published]*
e. Conduct species surveys and determine distribution and abundance of GCN species *[Measure: # of surveys completed]*
f. Conduct research to determine movement patterns and dispersal of GCN species, especially bats and woodrats *[Measure: # of research projects conducted; # of research papers published]*
g. Conduct research to determine recharge areas to calculate how large an area is needed to protect GCN species *[Measure: # of research projects conducted; # of research papers published]*
h. Assess and monitor water quality *[Measure: # of monitoring studies conducted; water quality data analyzed and published]*

(22) Coastal Beaches, Dunes, and Mudflats

Description:

In Maryland, coastal beaches, dunes, and mudflats occur along the Atlantic Coast and lower portions of the Chesapeake Bay. These habitats are subject to extreme conditions associated with maritime environments such as salt spray, high winds, flooding, and shifting sands. Beaches are situated in front of primary dunes (foredune) above the mean high tide line and composed of unconsolidated sands and shells, which are constantly being shifted by winds and floods of storm surges and spring high tides. This dynamic disturbance regime severely limits vegetation to salt tolerant, succulent annuals such as American sea rocket and glassworts. In addition, broad overwashed flats may develop behind primary dunes when breaching occurs during storm surges. Extensive construction of high, artificial dunes along the Atlantic coast has reduced the extent of these habitats by increasing oceanside beach erosion and eliminating the disturbance regime that creates and maintains overwashed flats. Most dunes in maritime environments are dominated by grasses and dwarf shrubs well adapted to gradients of soil moisture and salt spray. Sand movement is also an important factor in shaping dune communities. Active dunes, where sand movement is greatest, tend to support grasses such as American beachgrass, beach panic grass, and bitter seabeach grass, whereas stabilized dunes support low growing shrubs such as beach heather. Steep, ocean-fronting dunes are usually colonized by linear, nearly monospecific stands of American beachgrass. The crest and back slopes of primary dunes have a slightly more diverse plant assemblage that may include sea oats, bitter seabeach grass, beach panic grass, seaside goldenrod, seaside spurge, and sanddune sandbur. A series of smaller secondary dunes spreads inward from the primary dune. These dunes are somewhat protected from salt spray and often dominated by beach panic grass.

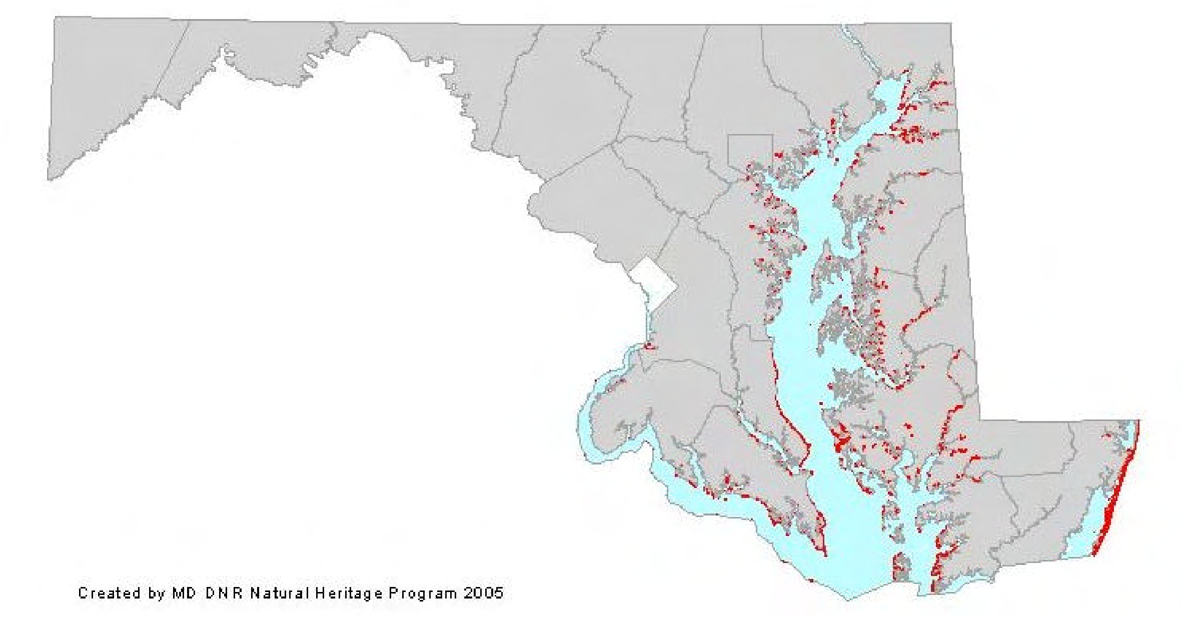
Small seasonally flooded grasslands in low swales between secondary dunes are commonly referred to as “interdunal swales.” Considered a rare natural community, interdunal swales are characterized by perched water tables and shallow seasonal flooding by rainfall. Although they are predominantely freshwater wetlands, periodic saltwater intrusion may occur in some swales during storm surges. Fluctuations in water levels and salinity vary between swales and greatly influence species composition. As water levels draw down late in the growing season, interdunal swales support a variety of grasses, sedges, rushes, and forbs.

Intertidal mudflats are widely distributed throughout the tidal portions of Maryland, but are most frequent and best developed along large freshwater tidal rivers. These habitats are subject to regular tidal flooding and exposure cycles twice a day. Substrates are variable depending on region ranging from fine-textured to moderately-coarse alluvium (i.e., unconsolidated sand, silt, clay, or gravel). The vegetation is notably sparse in these habitats, but is typically dominated by herbaceous species adapted to the flooding and exposure cycles. Many of these species seed bank or produce perennial rootstocks enabling them to maintain their viability during long periods of inundation. Intertidal mudflats are typically linear, developing as a narrow band between tidal waters and the edges of marshes, swamps, and even uplands that may abruptly border shorelines. Sparsely vegetated beds of low-growing rosette-leaved aquatics such as Eastern lilaeopsis, American waterwort, kidneyleaf mudplantain, Parker's pipewort, mudwort, and awl-leaf arrowhead are diagnostic of freshwater habitats. Patches of common threesquare, dotted smartweed, and common water willow are also common. In brackish systems, intertidal mudflats are characteristically devoid of vegetation although clumps of saltmarsh cordgrass may occasionally be found. During low tides, beds of seagrass such as Eurasian watermilfoil, eelgrass, and widgeon grass are commonly visible.

Location and Condition:

Coastal beaches and dunes are located in Worcester County on Fenwick and Assateague Islands. Assateague Island is under state and federal ownership (Assateague Island State Park and Assateague Island National Seashore) and remains the best example of these habitats despite frequent human use for recreation. The extensive development of Fenwick Island has destroyed much of the original dune system. In addition, the construction of high, artificial dunes and jetties along Fenwick Island has reduced the extent of these habitats by increasing oceanside beach erosion and eliminating the natural processes that create and maintain them. To offset this, large-scale beach replenishment projects are necessary to supplement the low levels of natural on-shore sand deposition. Intertidal mudflats are common along many of the coastal bays and tributaries of the Chesapeake Bay. The majority of these habitats are in good condition although sedimentation, runoff, boat wakes, and ditching of adjacent marshes remain a constant threat.

Figure 4.22 Location of Coastal Beaches, Dunes, and Mudflats in Maryland (Sources: MD DNR NHP; NPS Assateague Island National Seashore; USFWS NWI)



GCN Species, Rare Natural Communities, and Other Wildlife:

Mammals
Least shrew
Birds
American black duck
American oystercatcher
American peregrine falcon
Bald eagle
Black skimmer
Black tern
Black-bellied plover
Black-crowned night-heron
Boat-tailed grackle
Brant
Brown pelican
Common tern
Dunlin
Eastern meadowlark
Forster's tern
Glossy ibis
Grasshopper sparrow
Great blue heron

Great egret
Greater yellowlegs
Gull-billed tern
Harlequin duck
Laughing gull
Least tern
Little blue heron
Piping plover
Purple sandpiper
Red knot
Roseate tern
Royal tern
Ruddy turnstone
Sanderling
Sandwich tern
Semipalmated sandpiper
Short-billed Dowitcher
Snowy egret
Tricolored heron
Whimbrel
Willet

Wilson's plover
Wilson's snipe
Yellow-crowned night-heron
Reptiles
Loggerhead seaturtle
Northern diamond-backed terrapin
Inverts: Beetles
A lampyrid firefly
Ghost tiger beetle
Northeastern beach tiger beetle
White tiger beetle
Inverts: Marine Arthropods
Horseshoe crab
Rare Natural Communities
Maritime Dune Grasslands
Interdunal Swales
Intertidal Mud/Sand/Gravel Flats
Coastal Beaches and Overwash Flats

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: red fox, common raccoon, eastern cottontail, Canada goose, snow goose, brant, mallard, and American black duck. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Conversion to other land uses or habitat types that results in loss of habitat
b. Pesticide use and contamination that directly or indirectly affects GCN species
c. Human disturbance and other incompatible practices that result in habitat degradation
d. Invasive species that result in habitat degradation
e. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
f. Climate change, sea-level rise, and shoreline erosion that result in modification of natural processes
g. Inappropriate shoreline erosion control practices
h. Sedimentation
i. Oil spills
j. Fragmentation
k. Dune crossings, driving, and recreation on beaches that result in habitat degradation

Conservation Actions:

a. Develop and implement shore erosion control practices that are compatible with beach and dune maintenance ***[Measure: guidelines developed; # of sites with compatible management implemented]***
b. Ensure that land-use planning and zoning decisions are done in an appropriate manner to reduce impacts to these habitats ***[Measure: # of local planning and zoning processes incorporating wildlife focused habitat protection]***
c. Manage feral horse population on Assateague Island to reduce adverse impacts ***[Measure: % of population managed; # of acres with reduced adverse impacts]***
d. Restore functional dunes and native vegetation ***[Measure: # of acres restored]***
e. Incorporate conservation actions into land planning efforts and public land management plans by local, state, and federal agencies ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
f. Limit access and educate the public about the value of these habitats to minimize human disturbance ***[Measure: # of sites with limited access; # of educational materials developed and distributed]***
g. Develop and implement protocols to control invasive species in a manner compatible with GCN species *[Measure: # of protocols developed; # of sites with management implemented]*
h. Incorporate best management practices into land management plans *[Measure: # of development projects implementing BMPs]*
i. Restore tidal flows to marshes and create tidal open water flats *[Measure: # of acres restored]*
j. Utilize Coastal Bays Program to influence land use decisions and educate the public *[Measure: # of existing programs incorporated into land planning efforts; # of educational materials developed and distributed]*

k. Limit the use of pesticides such that GCN species and this habitat are not adversely affected *[Measure: # of sites with reduced quantity or frequency of pesticide use]*
l. Improve and maintain water quality *[Measure: # of sites with management implemented]*
m. Minimize risk of oil spills and respond immediately to contain spills when they occur *[Measure: # of protocols developed and evaluated for effectiveness; # of immediate responses]*

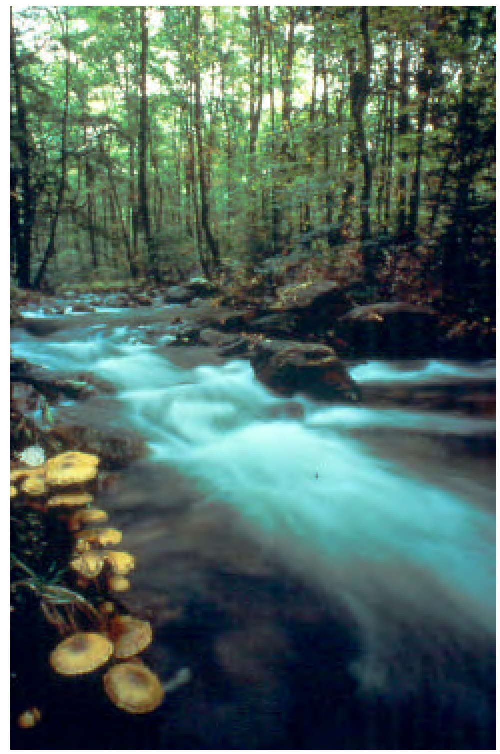
Inventory, Monitoring and Research Needs:

a. Conduct long-term monitoring studies of certain GCN species, including piping plover, least tern, and shorebirds *[Measure: # of monitoring programs established; # of monitoring programs conducted]*
b. Conduct inventories for certain GCN species, especially invertebrates *[Measure: # of inventories completed]*
c. Conduct research on movement patterns, dispersal and basic biology of certain GCN species *[Measure: # of research projects conducted; # research papers published]*
d. Conduct research on habitat requirements to gain a better understanding of threats in general and area sensitivity needs of certain GCN species *[Measure: # of research projects conducted; # research papers published; # of threats and conservation actions modified and re-prioritized based on models]*
e. Conduct monitoring of invasive species that affect GCN species and their habitat *[Measure: # of monitoring programs established; # of monitoring programs conducted]*

Stream and River Habitats

(23) Coldwater Streams

Description:

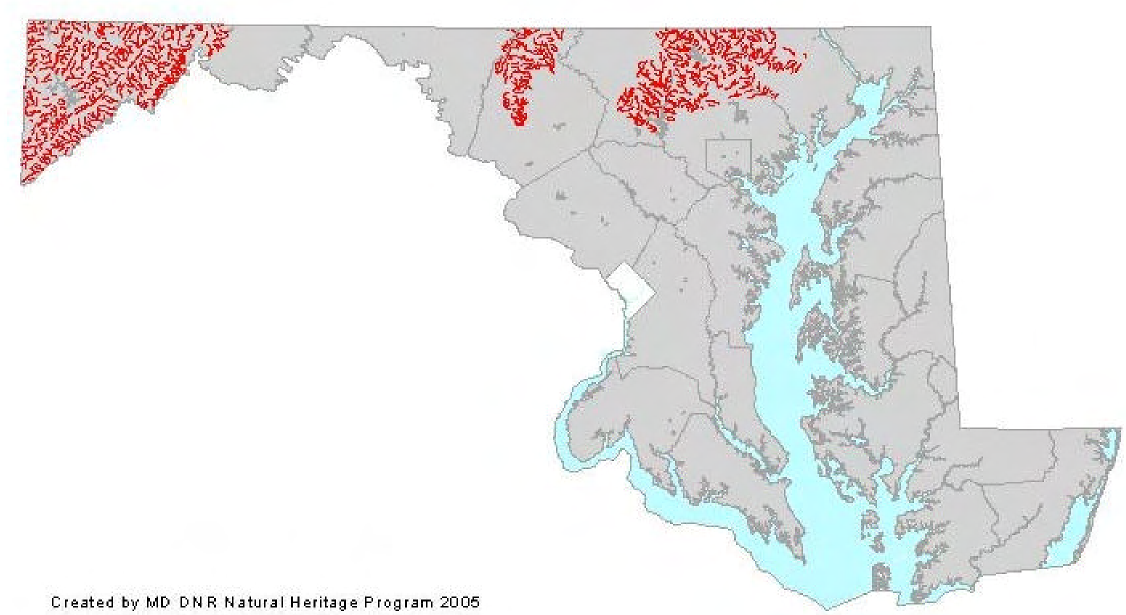


Coldwater streams comprise approximately 1500 miles of Maryland's freshwater streams and are unique in their form, function, and biota. They are most common in the Highlands physiographic province, particularly in the Youghiogheny drainage, but are also found in the Piedmont physiographic province within the Middle Potomac, Susquehanna, Gunpowder, and Patapsco drainages. Characterized by a maximum daily mean water temperature of less than 22?C and dissolved oxygen levels greater than 5 mg/L, these streams are typically found only in the headwater reaches of a watershed. Most are riffle-dominated, high gradient (>2%) streams with well-shaded riparian canopies allowing for mechanical aeration and regulation of water temperature. Compared to downstream cool- and warmwater streams, aquatic biodiversity and productivity are low, with few fish and benthic macroinvertebrate species, often occurring in low abundance. Brook trout, Maryland's only native trout species, are found in these streams along with introduced brown and rainbow trout. Common non-game species include mottled and Blue Ridge sculpin, tessellated darter, longnose dace, and creek chub. Stoneflies along with mayflies of the genera *Ephemerella*, *Epeorus*, *Stenonema*, and *Paraleptophlebia* often dominate the benthic macroinvertebrate community. In contrast to the low diversity of fish and benthic macroinvertebrate species, coldwater streams support the greatest diversity of aquatic and semi-aquatic salamanders in the State, including spring, seal, and mountain dusky salamanders.

Location and Condition:

Coldwater stream habitats have declined as a result of disturbance associated with agriculture and urban development. Although the historic extent of coldwater streams in Maryland is not known, this type of stream was likely more widespread. Based on a Combined Biotic Index (CBI) that uses fish and benthic macroinvertebrate communities as indicators of environmental quality, coldwater streams in Maryland are in fair condition, meaning that many of these streams are at least partially degraded. Of 143 sites sampled in coldwater streams from 2000-2004, 34% are considered to be severely degraded. Twenty-eight percent of sites sampled during this period are considered to be in good condition. A predictive model developed by MD DNR estimates that, on average, 33% of fish species have been lost from Maryland's coldwater systems. The decline of the brook trout, a GCN coldwater stream species, in Maryland occurs at relatively low levels (approximately 5%) of impervious surfaces in a watershed. Higher stream temperatures and increased sedimentation are likely explanations for the loss of fish species from coldwater streams.

Figure 4.23 Location of Coldwater Streams in Maryland (Source: MD DNR MBSS/Versar Inc.)



GCN Species and Other Wildlife:

Mammals
Southern water shrew
Reptiles
Common ribbonsnake
Queen snake
Wood turtle
Amphibians
Allegheny Mountain dusky salamander
Long-tailed salamander
Northern red salamander
Seal salamander
Fishes
Brook trout
Mottled sculpin

Redside dace
Silverjaw minnow
Inverts: Dragonflies & Damselflies
Arrowhead spiketail
Brown spiketail
Common sanddragon
Delta-spotted spiketail
Great spreadwing
Green-faced clubtail
Harpoon clubtail
Least clubtail
Midland clubtail
Mocha emerald
Northern pygmy clubtail

Ocellated darner
River jewelwing
Sable clubtail
Ski-tailed emerald
Southern pygmy clubtail
Spine-crowned clubtail
Superb jewelwing
Tiger spiketail
Turquoise bluet
Zebra clubtail
Inverts: Freshwater Crustaceans
An entocytherid ostracod
An entocytherid ostracod

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type:

common raccoon, mink, northern river otter, American beaver, muskrat, wood duck, eastern snapping turtle, brook trout, brown trout, rainbow trout, cutthroat trout, and white sucker. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species
g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Loss of headwater areas
k. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
l. Dumping
m. Development and land use, including roadways, that result in fragmentation and isolation
n. Deforestation that results in loss of forested watershed
o. Human recreation that results in disturbance/degradation
p. Point-source pollution
q. Incompatible timber harvesting that results in loss of coarse woody debris and increased water temperatures
r. Stream flow alteration from culvert placement
s. Erosion
t. Recreational use that results in degradation of habitat
u. Acid mine drainage
v. Roads, including maintenance, and ATVs
w. Degradation due to livestock grazing
x. Overabundance of deer as it impacts the regeneration of trees adjacent to streams

Conservation Actions:

a. **Restore and protect riparian buffers** ***[Measure: # of miles of buffers conserved]***
b. **Limit impervious surfaces in watersheds** ***[Measure: % of imperious surfaces within watershed]***
c. **Improve stormwater management** ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
d. **Work with watershed management plans to conserve streams and rivers** ***[Measure: # of watersheds with cooperative management projects]***
e. **Develop land management plans which incorporate conservation measures into the local planning processes** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***

f. **Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]***
g. Preserve land associated with streams *[Measure: # of acres conserved]*
h. Work with Maryland DOT to minimize use of road culverts or to design better systems to reduce stream alterations *[Measure: # of guidelines developed; # of new road plans with guidelines implemented]*
i. Establish passage at existing stream blockages or remove existing stream blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*
j. Minimize acid mine drainage and mitigate damages resulting from such drainage *[Measure: # of guidelines and protocols developed; # of sites with protocols implemented]*
k. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors]*
l. Work with Army Corps of Engineers and federal, state and county highways to reduce impacts and improve mitigation targeting *[Measure: # of guidelines developed; # of new road plans with guidelines implemented; # of mitigation projects implemented]*
m. Upgrade existing use classification through MDE process *[Measure: use classification upgraded]*
n. Develop and implement protocols to control deer populations to reduce browsing levels in riparian buffers *[Measure: # of protocols developed; # of sites with management implemented]*
o. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
p. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
q. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
r. Implement soil conservation *[Measure: # of projects implementing BMPs]*
s. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
t. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with mechanisms to minimize impacts]*
u. Reforestation of watersheds *[Measure: # of acres reforested]*
v. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
w. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*

Inventory, Monitoring and Research Needs:

a. Define the complete extent of distribution of coldwater stream habitats *[Measure: distribution of coldwater streams updated; habitat model developed and assessed]*
b. Assess coldwater stream habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
c. Initiate long-term monitoring studies of GCN species, including native brook trout, fishes, and amphibians *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
d. Conduct research on basic ecology, breeding parameters, and life histories of GCN species *[Measure: # of research projects conducted; # of research papers published]*
e. Conduct research on habitat use and requirements of GCN species *[Measure: # of research projects conducted; # of research papers published]*

f. Conduct species surveys and determine distribution and abundance of GCN species, including benthic macroinvertebrates and crayfish *[Measure: # of surveys completed]*
g. Conduct research to determine movement patterns and dispersal of GCN species, especially amphibians *[Measure: # of research projects conducted; # of research papers published]*
h. Reintroduce GCN species, such as brook trout, into suitable restored habitats *[Measure: # of sites with reintroduction implemented; # of viable populations established]*

(24) Limestone Streams

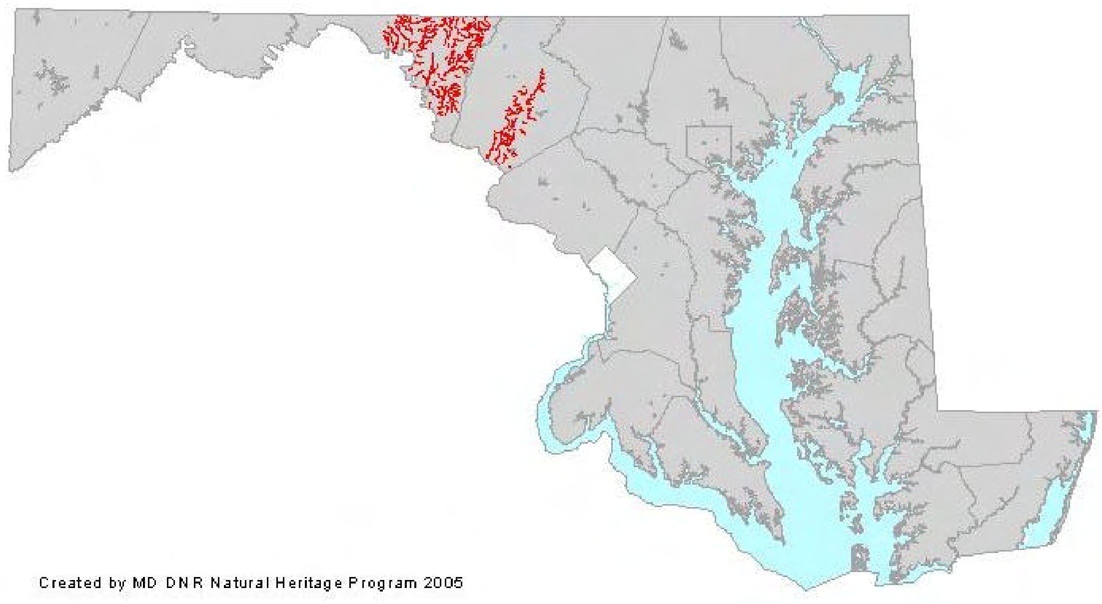
Description:

Limestone streams are strongly influenced by the underlying geology of the Ridge and Valley physiographic province of Maryland, resulting in systems that are physically and chemically distinct from freestone (non-limestone) streams. Fractures, cracks, and channels are abundant in limestone making springs and seeps common. This connectivity between groundwater and surface water serves to stabilize pH and water temperature. Limestone streams are also biologically unique. Plants, such as watercress and waterweed are abundant, especially near spring sources and groundwater seeps. Fish and benthic macroinvertebrate communities tend to exhibit low diversity, but maintain high abundance in response to the stable water chemistry. Common fish species include checkered sculpin, pearl dace, and spottail shiner. In contrast to the region's freestone streams, which are dominated by mayfly and stonefly taxa, the benthic macroinvertebrate communities of limestone streams tend to be dominated by crustaceans, like scuds and aquatic sow bugs. An estimated 480 miles of Maryland's streams are limestone systems.

Location and Condition:

The majority of Maryland's limestone streams are located in the Ridge and Valley physiographic province, a predominately agricultural area that is under increasing pressure from suburban development. Agricultural land use practices have altered many of these streams. Based on a Combined Biotic Index (CBI) that uses fish and benthic macroinvertebrate communities as indicators of environmental quality, the average condition of Limestone streams in Maryland is poor. Of 30 sites sampled in limestone streams from 2000 to 2004, 63% are severely degraded. The remaining 37% of sites sampled are moderately degraded. No sites sampled in limestone streams during the five-year period are considered to be in good condition. A predictive model developed by MD DNR estimates that, on average, 47% of fish species have been lost from Maryland's limestone stream habitats.

Figure 4.24 Location of Limestone Streams in Maryland (Source: MD DNR MBSS/Versar Inc.)



GCN Species and Other Wildlife:

Reptiles
Common ribbonsnake
Queen snake
Amphibians
Long-tailed salamander
Northern red salamander
Fishes
Brook trout
Checkered sculpin
Pearl dace
Inverts: Dragonflies & Damselflies
Great spreadwing
Least clubtail
Mocha emerald
Turquoise bluet
Inverts: Freshwater Crustaceans
An entocytherid ostracod
An entocytherid ostracod

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, American beaver, muskrat, wood duck, eastern snapping turtle, brook trout, brown trout, rainbow trout, smallmouth bass, redbreast sunfish, and bluegill. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species

g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Loss of headwater areas
k. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
l. Dumping
m. Development and land use, including roadways, that result in fragmentation and isolation
n. Deforestation that results in loss of forested watershed
o. Human recreation that results in disturbance/degradation
p. Point-source pollution
q. Groundwater withdrawal
r. Degradation of seepage wetlands
s. Strip mining and acid mine drainage
t. Sink hole pollution/disturbance as it impacts water quality in the stream
u. Development as it impacts water supply
v. Ground water contamination which ultimately contaminates surface water
w. Sewage treatments

Conservation Actions:

a. **Restore and protect riparian buffers** ***[Measure: # of miles of buffers conserved]***
b. **Limit groundwater withdrawals** ***[Measure: # of sites with reduced groundwater withdrawals]***
c. **Limit impervious surfaces in watersheds** ***[Measure: % of impervious surfaces within watershed]***
d. **Develop land management plans which incorporate conservation measures into the local planning processes** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
e. **Improve stormwater management** ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
f. **Work with watershed management plans to conserve streams and rivers** ***[Measure: # of watersheds with cooperative management projects]***
g. Work with Army Corps of Engineers and federal, state and county highways to reduce impacts and improve mitigation targeting *[Measure: # of guidelines developed; # of new road plans with guidelines implemented; # of mitigation projects implemented]*
h. Prevent degradation of seepage wetlands *[Measure: # of acres protected]*
i. Implement best management practices for livestock *grazing [Measure: # of projects implementing BMPs]*
j. Improve capacity for eliminating spills (i.e. TMDL) *[Measure: # of protocols developed]*
k. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
l. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*
m. Incorporate TMDL process *[Measure: # of processes incorporated into conservation actions]*
n. Describe and evaluate ground water withdrawals (MDE) *[Measure: # of groundwater withdrawal sites evaluated]*
o. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*

p. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
q. Implement soil conservation *[Measure: # of projects implementing BMPs]*
r. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
s. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
t. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with mechanisms to minimize impacts]*
u. Reforestation of watersheds *[Measure: # of acres reforested]*
v. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
w. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*
x. Control or limit the introduction of non-native species *[Measure: # of controls implemented]*

Inventory, Monitoring and Research Needs:

a. Define the complete extent of distribution of limestone stream habitats *[Measure: distribution of limestone stream habitat updated; habitat model developed and assessed]*
b. Assess limestone stream habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
c. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
d. Monitor existing GCN species populations, including checkered sculpin, so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring projects conducted]*
e. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
f. Reintroduce certain GCN species into suitable restored habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*
g. Monitor ecological integrity of hydrological systems *[Measure: # of monitoring studies established]*
h. Map hydrological systems *[Measure: # of maps developed]*

(25) Highland Streams

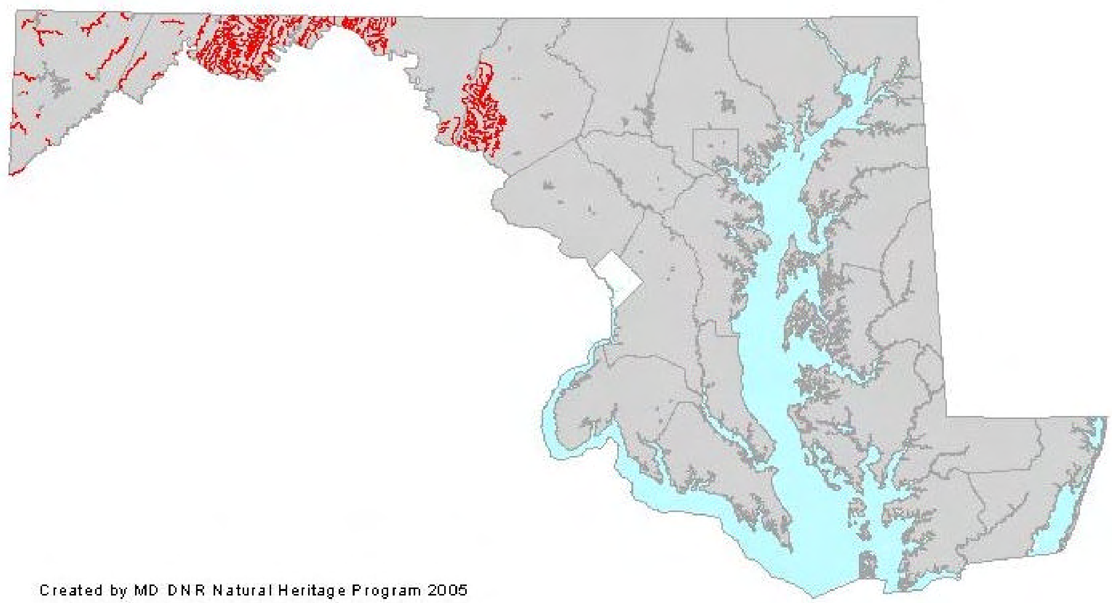
Description:

Highland streams flow through several physiographic regions, including the Appalachian Plateau, Valley and Ridge, Blue Ridge, and the western part of the Piedmont. They are typically high gradient systems (>4 %), ranging in elevation from 140 to 2800 feet. Substrate is dominated by gravel-cobble-boulder associations, and is interspersed with bedrock outcroppings. Because many of these streams fall within the rain shadow of the Appalachians, they receive the lowest annual rainfall amounts in the state. Consequently, stream flow in the summer is often markedly reduced for many highland streams. These systems are moderately productive but are home to several endemic fish species, including stonecat, striped shiner, and Johnny darter. These species are found only in the Youghiogheny river basin, which flows to the Mississippi river and ultimately to the Gulf of Mexico. Other common native fish species include mottled and Potomac sculpin. Stoneflies along with mayflies of the genera *Ephemerella*, *Epeorus*, *Stenonema*, and *Paraleptophlebia* often dominate the benthic macroinvertebrate community. Streamside trees and logs play an important role in shaping Highland stream channels and banks, creating pools and slow-water areas beneficial to aquatic species. Logs and leaf litter are also a primary source of organic matter forming the base of the food web in these streams. There are approximately 700 miles of Highland streams in Maryland

Location and Condition:

Based on a Combined Biotic Index (CBI) that uses fish and benthic macroinvertebrate communities as indicators of environmental quality, the average condition of highland streams in Maryland is fair, meaning that many of these streams are at least partially degraded. Of 86 sites sampled in highland streams from 2000-2004, 44% are severely degraded. Only 21% of the sites sampled in highland streams during the same five-year period are considered to be minimally impaired. A predictive model developed by MD DNR estimates that, on average, 31% of fish species have been lost from Maryland's highland stream habitats.

Figure 4.25 Location of Highland Streams in Maryland (Source: MD DNR MBSS/Versar Inc.)



GCN Species and Other Wildlife:

Reptiles
Common ribbonsnake
Eastern spiny softshell
Queen snake
Wood turtle
Amphibians
Allegheny Mountain dusky salamander
Long-tailed salamander
Northern red salamander
Seal salamander
Fishes
Brook trout
Cheat minnow
Comely shiner
Greenside darter
Johnny darter
Longnose sucker
Northern hogsucker
Silverjaw minnow

Striped shiner
Inverts: Dragonflies & Damselflies
Allegheny river cruiser
Arrowhead spiketail
Cobra clubtail
Cyrano darner
Delta-spotted spiketail
Great spreadwing
Green-faced clubtail
Harpoon clubtail
Laura's clubtail
Least clubtail
Midland clubtail
Mocha emerald
Northern pygmy clubtail
Ocellated darner
Rapids clubtail
River jewelwing
Sable clubtail

Ski-tailed emerald
Southern pygmy clubtail
Spine-crowned clubtail
Superb jewelwing
Turquoise bluet
Uhler's sundragon
Zebra clubtail
Inverts: Beetles
Appalachian Tiger Beetle
Inverts: Freshwater Crustaceans
An entocytherid ostracod
An entocytherid ostracod
Inverts: Freshwater Mussels
Atlantic spike
Brook floater
Creeper
Eastern lampmussel
Green floater
Triangle floater

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, northern river otter, American beaver, muskrat, wood duck, eastern snapping turtle, brook trout, brown trout, rainbow trout, and white sucker. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species
g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Loss of headwater areas
k. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
l. Dumping
m. Development and land use, including roadways, that result in fragmentation and isolation
n. Deforestation that results in loss of forested watershed
o. Human recreation that results in disturbance/degradation
p. Point-source pollution
q. Acid mine drainage
r. Incompatible timber harvest practices that result in loss of coarse woody debris and increased water temperatures
s. Livestock and grazing practices that degrade water quality
t. Stream channelization

Conservation Actions:

a. **Restore and protect riparian buffers** ***[Measure: # of miles of buffers conserved]***
b. **Minimize or eliminate stream channelization (e.g. culverts)** ***[Measure: # of culverts and other stream channelization sites mitigated or eliminated; # miles natural stream flow restored]***
c. **Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such** ***[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]***
d. **Improve stormwater management** ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
e. **Limit impervious surfaces in watersheds** ***[Measure: % of impervious surfaces within watershed]***
f. **Work with watershed management plans to conserve streams and rivers** ***[Measure: # of watersheds with cooperative management projects]***
g. **Minimize and mitigate acid mine drainage damage to streams** ***[Measure: # of guidelines and protocols developed; # of sites with protocols implemented]***
h. Implement best management practices for livestock grazing near streams *[Measure: # of projects implementing BMPs]*

i. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*
j. Develop land management plans which incorporate conservation measures into the local planning processes *[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]*
k. Work with Army Corps of Engineers and federal, state and county highways to reduce impacts and improve mitigation targeting *[Measure: # of guidelines developed; # of new road plans with guidelines implemented; # of mitigation projects implemented]*
l. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
m. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
n. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
o. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
p. Implement soil conservation *[Measure: # of projects implementing BMPs]*
q. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
r. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with mechanisms to minimize impacts]*
s. Reforestation of watersheds *[Measure: # of acres reforested]*
t. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
u. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*

Inventory, Monitoring and Research Needs:

a. Assess highland stream habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
b. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
c. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established;# of monitoring studies conducted]*
d. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
e. Reintroduce certain GCN species into suitable restored habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*

(26) Piedmont Streams

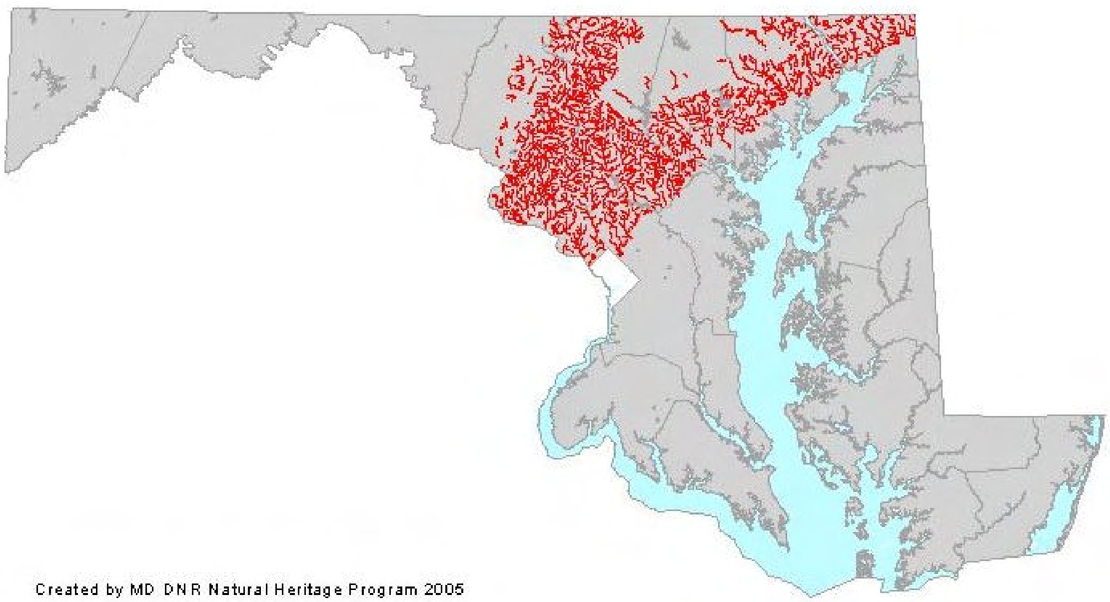
Description:

Piedmont streams, defined by their western boundary of the Catoctin Mountains in Frederick County to the eastern border at the fall line, are among the most biologically productive systems in the State. The physical and chemical nature of Piedmont streams is governed largely by the varying topography and geology of the Piedmont physiographic province. Streams along the eastern edge share similar physical characteristics with the neighboring Coastal Plain. Here, streams are typically low to moderate gradient (1-2%) with silt, sand, and gravel substrates common. Juxtaposition of these two physiographic provinces results in a mixing of aquatic biota, with several predominately Coastal Plain species commonly found within Piedmont streams draining this transition zone. Fish species common to these streams include tessellated darter, eastern blacknose dace, common shiner, and bluntnose minnow. High-gradient Piedmont streams are characterized by cobble-boulder substrates with bedrock outcrops common. Blue Ridge sculpin, brown trout, brook trout, and longnose dace are frequently encountered in these systems. Streamside trees and logs play an important role in shaping the stream channel and banks, creating pools and slow-water areas beneficial to many aquatic species. Logs and leaf litter are also a primary source of organic matter forming the base of the food web in these streams. River basins with Piedmont streams draining into Chesapeake Bay include Susquehanna, Elk, Bush, Gunpowder, Patapsco, the upper portion of the Patuxent River, and the eastern portion of the Potomac Washington Metro basins. There are approximately 2400 miles of Piedmont streams in Maryland.

Location and Condition:

Maryland's Piedmont physiographic province has been the center of urban and suburban development in the state. Stream degradation associated with urbanization has reduced biodiversity and biological health of many Piedmont streams draining urban centers. The overall condition of Piedmont streams on average is fair. Of 261 sites sampled in Piedmont streams from 2000-2004, 39% are severely degraded. Only 15% of the sites sampled in Piedmont streams are considered to be minimally impaired. A predictive model developed by MD DNR estimates that, on average, 32% of fish species have been lost from Maryland's Piedmont stream habitats.

Figure 4.26 Location of Piedmont Streams in Maryland (Source: MD DNR MBSS/Versar Inc.)



GCN Species and Other Wildlife:

Reptiles
Bog turtle
Common ribbonsnake
Queen snake
Spotted turtle
Wood turtle
Amphibians
Long-tailed salamander
Northern red salamander
Fishes
Bridle shiner
Brook trout
Comely shiner
Glassy darter
Greenside darter
Logperch
Maryland darter
Northern hogsucker
Rosyside dace
Shield darter

Silverjaw minnow
Warmouth
Inverts: Dragonflies & Damselflies
Allegheny river cruiser
Allegheny snaketail
Arrowhead spiketail
Brown spiketail
Cobra clubtail
Common sanddragon
Cyrano darner
Great spreadwing
Laura's clubtail
Least clubtail
Mocha emerald
Ocellated darner
Rapids clubtail
Royal river cruiser
Ski-tailed emerald
Tiger spiketail

Turquoise bluet
Inverts: Mayflies
Walker's tusked sprawler
Inverts: Beetles
A hydrophilid beetle
Inverts: Freshwater Crustaceans
A crayfish
A crayfish
An entocytherid ostracod
An entocytherid ostracod
Inverts: Freshwater Mussels
Alewife floater
Atlantic spike
Brook floater
Creeper
Eastern lampmussel
Green floater
Triangle floater
Yellow lance

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, American beaver, muskrat, wood duck, eastern snapping turtle, brown trout, brook trout, rainbow trout, smallmouth bass, largemouth bass, redbreast sunfish, bluegill, pumpkinseed, longear sunfish, white sucker, yellow bullhead, channel catfish, common carp, rock bass, black crappie, chain pickerel, walleye, golden redhorse, and fallfish. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Stream channelization
g. Non-native species
h. Nutrient enrichment
i. Pesticide/herbicide application that result in pollution or degradation of water quality
j. Stream blockages, including dams
k. Loss of headwater areas
l. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
m. Dumping
n. Development and land use, including roadways, that result in fragmentation and isolation
o. Deforestation that results in loss of forested watershed
p. Human recreation that results in disturbance/degradation
q. Point-source pollution
r. Surface mining that result in water quality degradation
s. Incompatible timber harvesting that result in water quality degradation
t. Livestock and grazing practices that result in water quality degradation
u. Urban sprawl/development

Conservation Actions:

a. Restore and protect riparian buffers ***[Measure: # of miles of buffers conserved]***
b. Limit impervious surfaces in watersheds ***[Measure: % of impervious surfaces within watershed]***
c. Improve stormwater management ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
d. Encourage reforestation within watershed ***[Measure: # of acres reforested]***
e. Work with watershed management plans to conserve streams and rivers ***[Measure: # of watersheds with cooperative management projects]***
f. Develop land management plans which incorporate conservation measures into the local planning processes ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
g. Implement best management practices for livestock grazing *[Measure: # of projects implementing BMPs]*

h. Cooperate with public on non-point source issues (IPMs) e.g. golf courses, agricultural lands, etc. *[Measure: # of sites with IMP practices implemented]*
i. Upgrade water treatment facilities – separate sewage from runoff (MDE, MES) *[Measure: # of sites with upgraded treatment]*
j. Implement low impact development retrofits *[Measure: # of sites with retrofits]*
k. Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]*
l. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*
m. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
n. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
o. Respond to toxic spills quickly and effectively *[Measure: # of protocols developed and evaluated for effectiveness]*
p. Work with Army Corps of Engineers and federal, state and county highways to reduce impacts and improve mitigation targeting *[Measure: # of guidelines developed; # of new road plans with guidelines implemented; # of mitigation projects implemented]*
q. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
r. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
s. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
t. Implement soil conservation *[Measure: # of projects implementing BMPs]*
u. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with mechanisms to minimize impacts]*
v. Reforestation of watersheds *[Measure: # of acres reforested]*
w. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
x. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*

Inventory, Monitoring and Research Needs:

a. Assess Piedmont stream habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
b. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
c. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
d. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
e. Reintroduce certain GCN species into suitable restored habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*

(27) Coastal Plain Streams

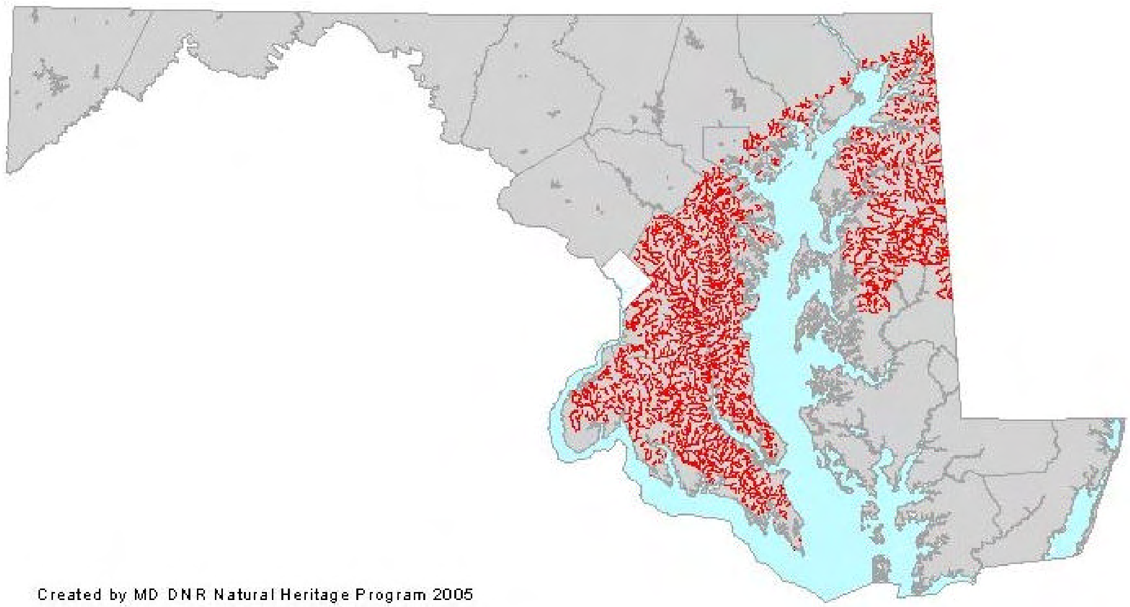
Description:

Maryland's coastal plain streams extend from the fall line eastward toward the Atlantic Ocean. These streams are typically low gradient (<1%) and found at elevations of less than 50' above sea level. Silt, sand, gravel, and small cobble are the dominant substrates. Most coastal plain streams contain only runs, glides and pools; however, gravel riffles are common in those streams draining the rolling hills on the western and upper eastern shore. Streams on the lower eastern shore are extremely sluggish with broad floodplains and braided channels. Because coastal plain streams lack stable substrates such as bedrock and boulders, wood and submerged aquatic vegetation are important channel features. Submerged logs and tree roots slow the flow of nutrients and sediment, provide cover for fishes and stream insects, and control stream bank erosion. Eastern mudminnow, golden shiner, creek chubsucker, and fallfish are common in these systems. These streams are also important habitat to the American eel from the juvenile to adult stage. The Chester, Choptank, Nanticoke/Wicomico, Pocomoke, Lower Potomac, Patapsco, Gunpowder, Elk, Lower Susquehanna, Bush, Ocean Coastal, Potomac Washington Metro, West Chesapeake, and Patuxent river basins all contain non-blackwater coastal plain streams, comprising approximately 2500 stream miles.

Location and Condition:

Based on a Combined Biotic Index (CBI) that uses fish and benthic macroinvertebrate communities as indicators of environmental quality, the average condition of Coastal Plain streams in Maryland is fair, meaning that many of these streams are at least partially degraded. Of 287 sites sampled in Coastal Plain streams from 2000-2004, 48% are severely degraded. Only 20% of the sites sampled in Coastal Plain streams are considered to be minimally impaired. A predictive model developed by MD DNR estimates that, on average, 54% of fish species have been lost from Maryland's Coastal Plain stream habitats.

Figure 4.27 Location of Coastal Plain Streams in Maryland (Source: MD DNR MBSS/Versar Inc.)



GCN Species and Other Wildlife:

Mammals	Rosyside dace	Sparkling jewelwing
Southeastern star-nosed mole	Shield darter	Tiger spiketail
Reptiles	Silverjaw minnow	Turquoise bluet
Common ribbonsnake	Swamp darter	Uhler's sundragon
Northern red-bellied turtle	Warmouth	**Inverts: Beetles**
Queen snake	American brook lamprey	Schwarz' diving beetle
Rainbow snake	Least brook lamprey	**Inverts: Freshwater Crustaceans**
Red-bellied watersnake	**Inverts: Dragonflies & Damselflies**	A crayfish
Spotted turtle	Allegheny snaketail	**Inverts: Freshwater Mussels**
Wood turtle	Arrowhead spiketail	Alewife floater
Fishes	Blackwater bluet	Atlantic spike
American shad	Brown spiketail	Creeper
Banded sunfish	Common sanddragon	Dwarf wedge mussel
Blackbanded sunfish	Cyrano darner	Eastern lampmussel
Bluespotted sunfish	Great spreadwing	Eastern pondmussel
Bridle shiner	Laura's clubtail	Northern lance
Brook trout	Least clubtail	Paper pondshell
Flier	Mocha emerald	Tidewater mucket
Glassy darter	Royal river cruiser	Triangle floater
Hickory shad	Russet-tipped clubtail	Yellow lampmussel
Ironcolor shiner	Sable clubtail	Yellow lance
Longnose gar	Selys' sunfly	
Mud sunfish		

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, northern river otter, American beaver, muskrat, mallard, American black duck, wood duck, eastern snapping turtle, largemouth bass, redbreast sunfish, bluegill, pumpkinseed, longear sunfish, white sucker, yellow bullhead, brown bullhead, channel catfish, common carp, yellow perch, white crappie, black crappie, white perch, and chain pickerel. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species
g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Loss of headwater areas
k. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
l. Dumping
m. Development and land use, including roadways, that result in fragmentation and isolation
n. Deforestation that results in loss of forested watershed
o. Human recreation that results in disturbance/degradation
p. Point-source pollution
q. Groundwater and stream water withdrawals
r. Liming practices for agriculture
s. Stream channelization
t. Livestock and grazing practices that result in water quality degradation
u. Inappropriate timber harvest practices that impact water quality or loss of coarse woody debris
v. Bank erosion
w. Sea-level rise

Conservation Actions:

a. Restore and protect riparian buffers ***[Measure: # of miles of buffers conserved]***
b. Limit impervious surfaces in watersheds ***[Measure: % of impervious surfaces within watershed]***
c. Improve stormwater management ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
d. Minimize stream channelization ***[Measure: # of stream channelization sites mitigated or eliminated; # miles natural stream flow restored]***

e. **Maintain and increase forest cover in watersheds** ***[Measure: # of acres protected; # of acres reforested]***
f. **Work with watershed management plans to conserve streams and rivers** ***[Measure: # of watersheds with cooperative management projects]***
g. **Develop land management plans which incorporate conservation measures into the local planning processes** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
h. **Improve sediment and erosion control practices** ***[Measure: # of protocols developed; # of sites with management implemented]***
i. Implement low impact developments, retrofits *[Measure: # of sites with retrofits]*
j. Implement best management practices for livestock grazing *[Measure: # of projects implementing BMPs]*
k. Restore ditch streams to natural meanders *[Measure: # of miles natural stream flow restored]*
l. Utilize Coastal Zone Management programs *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*
m. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*
n. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
o. Limit groundwater and stormwater withdrawals *[Measure: # of sites with reduced groundwater/stormwater withdrawals]*
p. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
q. Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of acres habitat managed for GCN species]*
r. Implement soil conservation *[Measure: # of projects implementing BMPs]*
s. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
t. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
u. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
v. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with mechanisms to minimize impacts]*
w. Reforestation of watersheds *[Measure: # of acres reforested]*
x. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
y. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*
z. Conserve and restore associated wetland areas *[Measure: # of acres conserved, # of acres restored]*

Inventory, Monitoring and Research Needs:

a. Assess Coastal Plain stream habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
b. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
c. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring studies conducted]*

d. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
e. Reintroduce certain GCN species, including freshwater mussels, into suitable habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*
f. Determine which watersheds are most suitable for reintroducing GCN fish species *[Measure: # of sites/watersheds evaluated for reintroduction]*

(28) Blackwater Streams

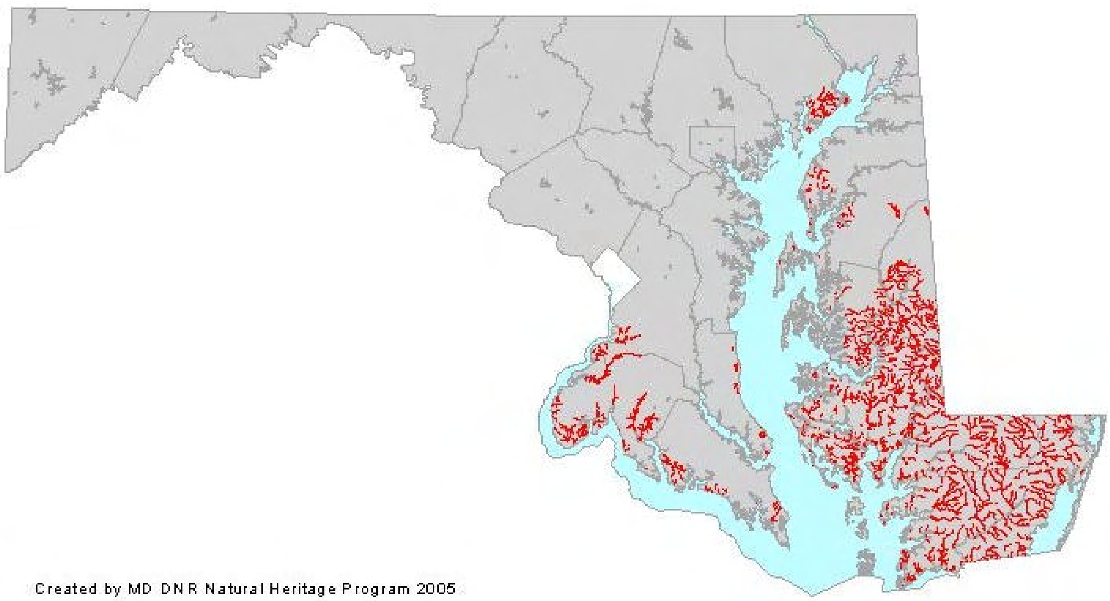
Description:

Blackwater streams are sluggish, low gradient (<1%) systems located within the Pocomoke and Nanticoke/Wicomico basins of Maryland's Coastal Plain physiographic province. They are characterized by low acidity, generally with pH levels less than 6, and dissolved organic carbon greater than 8 mg/L. In contrast to clearwater streams, dissolved oxygen levels are low (< 5mg/L) due to increased bacterial respiration from the decomposition of organic matter. Substrate consists primarily of silt, sand, and organic matter, with minor and isolated amounts of small gravel. Because of the lack of larger, more stable substrate, instream wood is of critical importance in defining hydrologic features and providing cover for the aquatic biota. Biodiversity in blackwater streams is typically low, and limited to only those organisms that are tolerant of the naturally acidic conditions. Common fishes include eastern mudminnow, pirate perch, creek chubsucker, tadpole madtom, and redfin pickerel. The benthic macroinvertebrate community is dominated by true fly, dragonfly, amphipod and isopod taxa. Blackwater systems comprise approximately 1200 miles of Maryland streams.

Location and Condition:

Centuries of intensive agricultural practices and stream channelization have reduced the extent of blackwater streams on Maryland's Coastal Plain. Based on geologic, soil, stream gradient, and elevation data in Maryland's Coastal Plain, approximately 1200 miles of streams are designated blackwater stream habitats. However, streamside logging, stream channelization, and agricultural liming practices have altered many of these stream miles such that these streams no longer possess the chemical properties (i.e., dissolved organic carbon >8 mg/L; pH < 6.0; dissolved oxygen <5 mg/L) attributed to blackwater habitats. Of the 142 sites sampled within the blackwater stream habitats, only 37 % are in true blackwater streams. The remaining 63% of the sites no longer maintain high concentrations of organic carbon, low dissolved oxygen, and low pH waters, criteria used by the MD DNR to define blackwater streams. Significantly lower forested land cover upstream of these sites than found above true blackwater sites likely contributes to lower organic carbon concentrations. A predictive model developed by MD DNR estimates that, on average, 47% of fish species have been lost from Maryland's blackwater stream habitats.

Figure 4.28 Location of Blackwater Streams in Maryland (Source: MD DNR MBSS/Versar Inc.)



GCN Species and Other Wildlife:

Mammals
Southeastern star-nosed mole
Reptiles
Common ribbonsnake
Northern red-bellied turtle
Red-bellied watersnake
Spotted turtle
Fishes
Banded sunfish
Blackbanded sunfish
Bluespotted sunfish
Bridle shiner
Flier

Glassy darter
Ironcolor shiner
Longnose gar
Mud sunfish
Silverjaw minnow
Swamp darter
Least brook lamprey
Inverts: Dragonflies & Damselflies
Blackwater bluet
Cyrano darner
Mocha emerald
Royal river cruiser

Russet-tipped clubtail
Sparkling jewelwing
Turquoise bluet
Inverts: Freshwater Mussels
Alewife floater
Dwarf wedge mussel
Eastern lampmussel
Eastern pondmussel
Northern lance

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, northern river otter, American beaver, muskrat, mallard, American black duck, wood duck, eastern snapping turtle, largemouth bass, bluegill, yellow bullhead, common carp, yellow perch, white crappie, black crappie, white perch, and chain pickerel. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Loss of headwater streams
g. Non-native species
h. Nutrient enrichment
i. Pesticide/herbicide application that result in pollution or degradation of water quality
j. Stream blockages, including dams
k. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
l. Dumping
m. Development and land use, including roadways, that result in fragmentation and isolation
n. Deforestation that results in loss of forested watershed
o. Human recreation that results in disturbance/degradation
p. Point-source pollution
q. Groundwater and stream water withdrawals
r. Liming practices that result in water quality degradation
s. Stream channelization
t. Incompatible timber harvest practices that impact water quality or result in the loss of coarse woody debris

Conservation Actions:

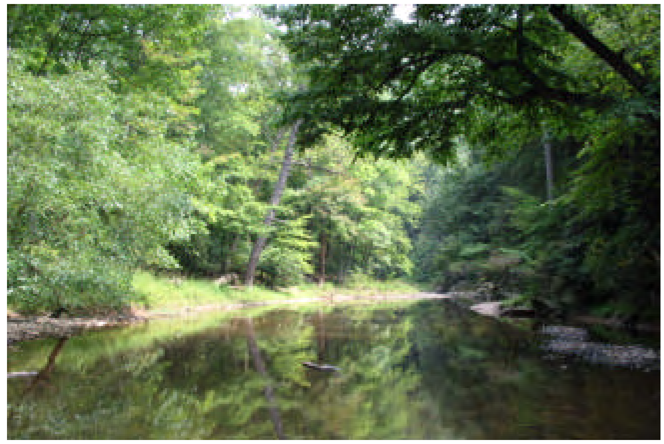
a. Restore and protect riparian buffers ***[Measure: # of miles of buffers conserved]***
b. Limit impervious surfaces in watersheds ***[Measure: % of impervious surfaces within watershed]***
c. Maintain and increase forest cover in watersheds ***[Measure: # of acres protected; # of acres reforested]***
d. Minimize stream channelization ***[Measure: # of stream channelization sites mitigated or eliminated; # miles natural stream flow restored]***
e. Improve stormwater management ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
f. Work with watershed management plans to conserve streams and rivers ***[Measure: # of watersheds with cooperative management projects]***
g. Develop land management plans which incorporate conservation measures into the local planning processes ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
h. Establish passage at existing stream blockages or remove blockages completely where appropriate ***[Measure: # of passages established; # of blockages removed]***
i. Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]*
j. Utilize Coastal Zone Management programs *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*

k. Implement best management practices for liming application *[Measure: # of projects implementing BMPs]*
l. Limit groundwater and surface water withdrawals *[Measure: # of sites with reduced groundwater/stormwater withdrawals]*
m. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
n. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
o. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
p. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
q. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
r. Implement soil conservation *[Measure: # of projects implementing BMPs]*
s. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with mechanisms to minimize impacts]*
t. Reforestation of watersheds *[Measure: # of acres reforested]*
u. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
v. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*
w. Conserve and restore associated wetland areas *[Measure: # of acres conserved, # of acres restored]*

Inventory, Monitoring and Research Needs:

a. Define the complete extent of distribution of blackwater stream habitats *[Measure: distribution of blackwater streams updated; habitat model developed and assessed]*
b. Assess blackwater stream habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
c. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
d. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
e. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
f. Reintroduce certain GCN species into suitable habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*

(29) Highland Rivers



Description:

Large Highland rivers in Maryland are located in the western portion of the state in the Youghiogheny and Potomac River basins. Highland rivers consist of riffle/run and pool habitat sequences with substrate ranging from large boulders to sand and silt. The energy base for these systems includes large woody debris and leaf litter, as well as primary production by periphyton, phytoplankton, and aquatic macrophytes. Game fish species common to Highland rivers include smallmouth bass, chain pickerel, and walleye. Tiger muskellunge, northern pike, walleye, brown trout, rainbow trout, and cutthroat trout are gamefish stocked in Highland rivers. Non-game species common in these systems include American eel, redbreast sunfish, rockbass, Potomac sculpin, Northern hogsucker, and stonecat. There are approximately 130 miles of Highland riverine habitat in Maryland.

Location and Condition:

Degradation and loss of species associated with highland and coldwater tributaries have ultimately affected the downstream conditions of Maryland's highland riverine habitats. Highland rivers serve as receiving waters for effluents from industrial sources and municipal sewage treatment plants. The damming of highland rivers for drinking water reservoirs and hydroelectric power generation has altered these habitats considerably, often reducing available habitats for many GCN fish and mussel species. Although these rivers provide excellent recreational opportunities, the introduction of non-native gamefish has been extensive and has altered the natural community composition of these habitats.

Figure 4.29 Location of Highland Rivers in Maryland (Sources: MD DNR MBSS/Versar Inc.; MD DNR NHP)

GCN Species and Other Wildlife:

Birds	Silverjaw minnow	Rusty snaketail
Bald eagle	Stonecat	Spine-crowned clubtail
Common loon	Striped shiner	Splendid clubtail
Horned grebe	Warmouth	Stygian shadowdragon
Reptiles	**Inverts: Dragonflies & Damselflies**	**Inverts: Mayflies**
Eastern spiny softshell	A snaketail	Walker's tusked sprawler
Northern red-bellied turtle	Allegheny river cruiser	**Inverts: Freshwater Mussels**
Spotted turtle	Cobra clubtail	Alewife floater
Amphibians	Cyrano darner	Atlantic spike
Common mudpuppy	Eastern ringtail	Brook floater
Eastern hellbender	Elusive clubtail	Creeper
Fishes	Green-faced clubtail	Eastern lampmussel
Cheat minnow	Laura's clubtail	Green floater
Comely shiner	Least clubtail	Paper pondshell
Greenside darter	Midland clubtail	Tidewater mucket
Johnny darter	Ocellated darner	Triangle floater
Longnose sucker	Rapids clubtail	Yellow lampmussel
Northern hogsucker		

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, northern river otter, American beaver, muskrat, Canada goose, mallard, American black duck, wood duck, ring-necked duck, common merganser, hooded merganser, eastern snapping turtle, brook trout, brown trout, rainbow trout, cutthroat trout, smallmouth bass, largemouth bass, rock bass, redbreast sunfish, bluegill, pumpkinseed, longear sunfish, white sucker, yellow bullhead, brown bullhead, channel catfish, common carp, yellow perch, black crappie, walleye, muskellunge, fallfish, golden redhorse, and shorthead redhorse. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species
g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
k. Dumping
l. Development and land use, including roadways, that result in fragmentation and isolation
m. Deforestation that results in loss of forested watershed
n. Human recreation that results in disturbance/degradation
o. Point-source pollution
p. Acid mine drainage
q. Hydroelectric power generation
r. Incompatible timber harvest practices that impact water quality

Conservation Actions:

a. Restore and protect riparian buffers ***[Measure: # of miles of buffers conserved]***
b. Limit impervious surfaces in watersheds ***[Measure: % of impervious surfaces within watershed]***
c. Improve stormwater management ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
d. Work with watershed management plans to conserve streams and rivers ***[Measure: # of watersheds with cooperative management projects]***
e. Develop land management plans which incorporate conservation measures into the local planning processes ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
f. Minimize and mitigate acid mine drainage damage to rivers *[Measure: # of guidelines and protocols developed; # of sites with protocols implemented]*
g. Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]*
h. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*

i. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
j. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
k. Implement soil conservation *[Measure: # of projects implementing BMPs]*
l. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
m. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
n. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
o. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with comments/input to minimize impacts]*
p. Reforestation of watersheds *[Measure: # of acres reforested]*
q. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
r. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*

Inventory, Monitoring and Research Needs:

1. Assess highland river habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
2. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
3. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
4. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
5. Reintroduce certain GCN species into suitable habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*

(30) Piedmont Rivers

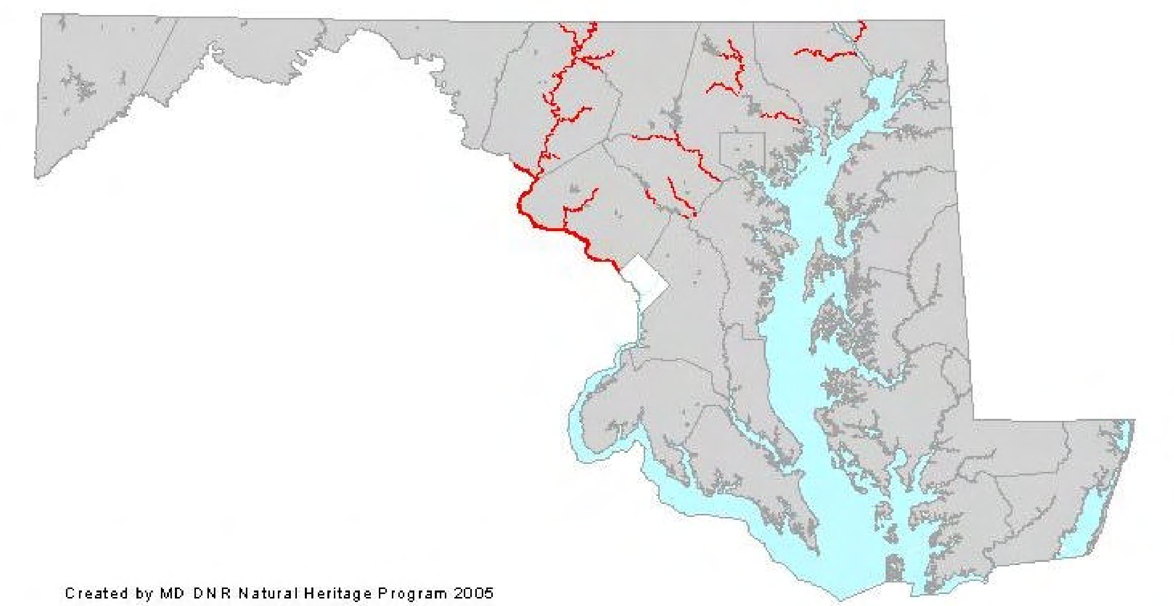
Description:

Large rivers of the Piedmont physiographic province are transition habitats between headwater streams and tidal portions of Chesapeake Bay. Physically, Piedmont rivers consist of large riffle/run and pool sequences with substrate ranging from large boulders to sand and silt. As transition zones between upland habitats and lowlands of the Coastal Plain, Piedmont rivers are home to a diverse aquatic fauna, often consisting of a mixture of piedmont and lowland species. Chemical, physical, and hydrologic stability typical of large Piedmont rivers also contribute to high species diversity. Fish species common to Piedmont rivers include American eel, river chub, spottail shiner, common shiner, white sucker, smallmouth bass, largemouth bass, pumpkinseed, redbreast sunfish, bluegill, rockbass, and margined madtom. Piedmont rivers provide spawning habitat to many migratory fish species of Chesapeake Bay such as blueback herring, alewife, white perch, yellow perch, striped bass, and several species of shad. Piedmont rivers also serve as wintering habitats for migratory waterfowl. Although logs and leaf litter continue to play a large role in the food base of these systems, open tree canopies allow for the growth of periphyton, phytoplankton, and aquatic macrophytes providing additional sources of energy to the food chain. Connectivity between river channels and the adjacent floodplain is important for the movement and exchange of organic matter in these systems. Floodplains also provide refugia for aquatic species during periods of high flows. Piedmont riverine habitat can be found in portions of the Susquehanna, Elk, Bush, Gunpowder, Patapsco, the upper portion of the Patuxent River, and the eastern portion of the Potomac Washington Metro basins. There are approximately 240 miles of Piedmont riverine habitat in these basins.

Location and Condition:

Piedmont rivers are located in highly urbanized portions of Maryland. Stressors associated with urbanization have had negative affects on these habitats. Combined sewer overflows (CSOs) designed to carry domestic, commercial, and industrial wastewater often deliver untreated sewage to Piedmont rivers during storm flows. These outflows can reduce biological health of these habitats. As with highland rivers, Piedmont rivers have been impounded for drinking water reservoirs and for hydroelectric power generation. Impoundments have reduced the available habitat for several GCN fish and mussel species and also reduced upstream access to spawning grounds by many migratory fishes. Degradation of Piedmont and coldwater tributaries has negatively affected downstream Piedmont rivers.

Figure 4.30 Location of Piedmont Rivers in Maryland (Source: MD DNR MBSS/Versar Inc.; MD DNR NHP)



GCN Species and Other Wildlife:

Birds
Bald eagle
Common loon
Horned grebe
Reptiles
Northern map turtle
Northern red-bellied turtle
Rainbow snake
Spotted turtle
Wood turtle
Amphibians
Eastern hellbender
Fishes
American shad
Bowfin
Bridle shiner
Comely shiner
Greenside darter
Hickory shad
Logperch
Northern hogsucker

Shield darter
Silverjaw minnow
Trout-perch
Warmouth
White catfish
Inverts: Dragonflies & Damselflies
Allegheny river cruiser
Allegheny snaketail
Big bluet
Cobra clubtail
Common sanddragon
Cyrano darner
Eastern ringtail
Elusive clubtail
Laura's clubtail
Least clubtail
Midland clubtail
Ocellated darner
Rapids clubtail
Riverine clubtail
Robust baskettail

Royal river cruiser
Russet-tipped clubtail
Rusty snaketail
Skillet clubtail
Smoky rubyspot
Spine-crowned clubtail
Splendid clubtail
Stygian shadowdragon
Inverts: Freshwater Mussels
Alewife floater
Atlantic spike
Brook floater
Creeper
Dwarf wedge mussel
Eastern lampmussel
Green floater
Paper pondshell
Tidewater mucket
Triangle floater
Yellow lampmussel
Yellow lance

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, American beaver, muskrat, Canada goose, mallard, wood duck, ring-necked duck, common merganser, hooded merganser, eastern snapping turtle, smallmouth bass, largemouth bass, redbreast sunfish, bluegill, pumpkinseed, longear sunfish, white sucker, yellow bullhead, channel catfish, common carp, yellow perch, black crappie, chain pickerel, walleye, muskellunge, fallfish, golden redhorse, shorthead redhorse, rock bass, green sunfish, and brown bullhead. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species
g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
k. Dumping
l. Development and land use, including roadways, that result in fragmentation and isolation
m. Deforestation that results in loss of forested watershed
n. Human recreation that results in disturbance/degradation
o. Point-source pollution
p. Incompatible timber harvest practices that impact water quality
q. Hydroelectric power generation

Conservation Actions:

a. Restore and protect riparian buffers ***[Measure: # of miles of buffers conserved]***
b. Limit impervious surfaces in watersheds ***[Measure: % of impervious surfaces within watershed]***
c. Improve stormwater management ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
d. Develop land management plans which incorporate conservation measures into the local planning processes ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
e. Work with watershed management plans to conserve streams and rivers ***[Measure: # of watersheds with cooperative management projects]***
f. Enhance point-source pollution control ***[Measure: # of protocols implemented to control point-source pollution; # of miles protected by implementation]***

g. Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]*
h. Work with Army Corps of Engineers and federal, state and county highways to reduce impacts and improve mitigation targeting *[Measure: # of guidelines developed; # of new road plans with guidelines implemented; # of mitigation projects implemented]*
i. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
j. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*
k. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
l. Implement soil conservation *[Measure: # of projects implementing BMPs]*
m. Work with power companies to address thermal pollution from hydroelectric power generation *[Measure: # of guidelines developed; # of projects implemented; # of miles protected by implementation of guidelines]*
n. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
o. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
p. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
q. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with comments/input to minimize impacts]*
r. Reforestation of watersheds *[Measure: # of acres reforested]*
s. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
t. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*

Inventory, Monitoring and Research Needs:

a. Assess Piedmont river habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
b. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
c. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
d. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
e. Reintroduce certain GCN species into suitable habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*
f. Develop a Maryland Biological River Survey *[Measure: development of Maryland Biological River Survey]*

(31) Coastal Plain Rivers

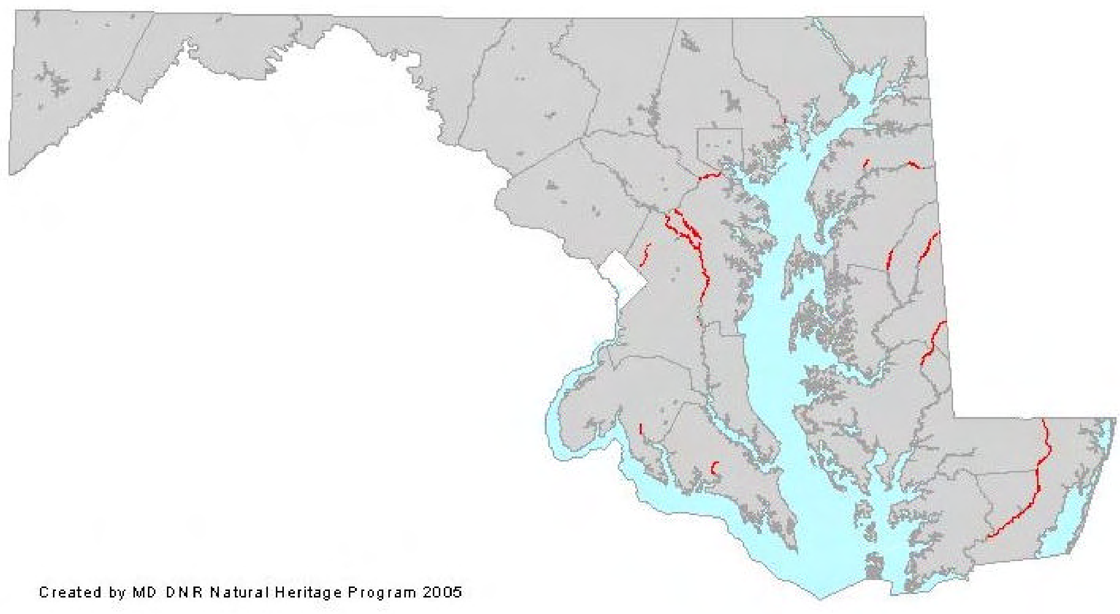
Description:

Large Coastal Plain rivers consist of predominately pool/glide habitat with sand and silt substrates. Large woody debris is an important element in structuring pool habitat and serves as an important source of coarse organic matter to riverine food webs. Open tree canopies allow for the growth of periphyton, phytoplankton, and aquatic macrophytes. These primary producers also form the base of energy flow within these systems. Connectivity between river channels and the adjacent floodplain is important for the movement and exchange of organic matter in Coastal Plain river systems. Floodplains provide refugia for aquatic species during periods of high flows, and refugia for prey species from main channel fish predators. Extensive pool habitat common in Coastal Plain rivers is home to many large predator fish species typically uncommon in headwater Coastal Plain streams. Fish species common to Coastal Plain rivers include largemouth bass, chain pickerel, pumpkinseed, redbreast sunfish, black crappie, bluegill, fallfish, shorthead redhorse, longnose gar, and warmouth. Coastal Plain rivers also provide spawning habitat to many migratory fish species of Chesapeake Bay such as blueback herring, alewife, white perch, yellow perch, American shad, and hickory shad. Sandy substrates of Coastal Plain rivers support a diverse community of freshwater mussels (Unionidae); many of which are rare, threatened, or endangered in Maryland. Many of these riverine fish and mussel species are favorite prey items of river otter and muskrat. Coastal Plain rivers also serve as wintering habitats for migratory waterfowl. Coastal Plain riverine habitat can be found in portions of the Elk, Chester, Choptank, Nanticoke, Lower Potomac, Patuxent, Pocomoke, and Wicomico river basins. Coastal Plain riverine habitat comprises approximately 100 stream miles within these basins.

Location and Condition:

Degradation and loss of species associated with Coastal Plain and blackwater tributaries have ultimately affected the downstream conditions of Maryland's Coastal Plain riverine habitats. Maryland Coastal Plain rivers are located in predominately agricultural watersheds. Nutrient enrichment and sedimentation associated with agricultural land use practices have reduced habitat quality and quantity available to many GCN fish and mussel species. Stream blockages have also reduced upstream access to spawing habitats by migratory fishes.

Figure 4.31 Location of Coastal Plain Rivers in Maryland (Source: MD DNR MBSS/Versar Inc.; MD DNR NHP)



GCN Species and Other Wildlife:

Mammals
Southeastern star-nosed mole
Birds
American black duck
Bald eagle
Common loon
Horned grebe
Reptiles
Northern red-bellied turtle
Rainbow snake
Red-bellied watersnake
Spotted turtle
Wood turtle
Fishes
American shad
Bluespotted sunfish

Bowfin
Bridle shiner
Comely shiner
Hickory shad
Logperch
Longnose gar
Stripeback darter
Warmouth
White catfish
Inverts: Dragonflies & Damselflies
Allegheny snaketail
Big bluet
Common sanddragon
Cyrano darner
Laura's clubtail

Piedmont clubtail
Royal river cruiser
Russet-tipped clubtail
Smoky rubyspot
Inverts: Freshwater Mussels
Alewife floater
Atlantic spike
Creeper
Eastern lampmussel
Eastern pondmussel
Northern lance
Paper pondshell
Tidewater mucket
Yellow lampmussel
Yellow lance

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: common raccoon, mink, northern river otter, American beaver, muskrat, Canada goose, mallard, American black duck, wood duck, ring-necked duck, hooded merganser, snapping turtle, largemouth bass, bluegill, pumpkinseed, redbreast sunfish, channel catfish, white catfish, yellow bullhead, brown bullhead, common carp, white perch, yellow perch, chain pickerel, striped bass, blueback herring, and alewife. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Urban land use and impervious surface that result in chemical and hydrologic changes
b. Sedimentation
c. Removal or degradation of riparian buffers
d. Atmospheric deposition
e. Fragmentation, degradation, and loss of habitats
f. Non-native species
g. Nutrient enrichment
h. Pesticide/herbicide application that result in pollution or degradation of water quality
i. Stream blockages, including dams
j. Lack of scientific understanding of appropriate habitat requirements and management for all GCN species
k. Dumping
l. Development and land use, including roadways, that result in fragmentation and isolation
m. Deforestation that results in loss of forested watershed
n. Human recreation that results in disturbance/degradation
o. Point-source pollution
p. Incompatible timber harvest practices that impact water quality
q. Oil and chemical spills
r. Excessive human recreational use that results in habitat degradation

Conservation Actions:

a. Maintain and increase forest cover in watersheds ***[Measure: # of acres protected; # of acres reforested]***
b. Restore and protect riparian buffers ***[Measure: # of miles of buffers conserved]***
c. Limit impervious surfaces in watersheds ***[Measure: % of impervious surfaces within watershed]***
d. Improve stormwater management ***[Measure: # of stormwater control guidelines developed; # of guidelines incorporated into local, state, and federal agency plans]***
e. Work with watershed management plans to conserve streams and rivers ***[Measure: # of watersheds with cooperative management projects]***
f. Develop land management plans which incorporate conservation measures into the local planning processes ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
g. Develop habitat buffer guidelines for use by foresters and land managers and work with them to implement such *[Measure: # of guidelines developed; # of sites with cooperative management projects; # of miles of habitat managed for GCN species]*
h. Utilize Coastal Zone Management programs *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*
i. Establish passage at existing stream blockages or remove blockages completely where appropriate *[Measure: # of passages established; # of blockages removed]*

j. Preserve and enhance connectivity of critical habitats *[Measure: # of existing watersheds connected by new corridors established]*
k. Work with Army Corps of Engineers and federal, state and county highways to reduce impacts and improve mitigation targeting *[Measure: # of guidelines developed; # of new road plans with guidelines implemented; # of mitigation projects implemented]*
l. Respond to oil and chemical spills quickly and effectively *[Measure: # of protocols developed and evaluated for effectiveness; # of immediate responses]*
m. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
n. Implement best management practices for nutrient and pesticide application *[Measure: # of projects implementing BMPs]*
o. Implement soil conservation *[Measure: # of projects implementing BMPs]*
p. Educate the public regarding necessary conservation of streams and rivers and their GCN species *[Measure: # of educational materials developed and distributed]*
q. Reduce trash dumping and fishing line dumping by educating the public *[Measure: # of educational materials developed and distributed]*
r. Work with Maryland DOT to improve transportation planning for new roads to minimize impacts to habitat *[Measure: # of new road plans with comments/input to minimize impacts]*
s. Reforestation of watersheds *[Measure: # of acres reforested]*
t. Limit recreational activities to protect resources *[Measure: # of sites with limited access]*
u. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of cooperative projects implemented]*

Inventory, Monitoring and Research Needs:

a. Assess Coastal Plain river habitat condition and prioritize for conservation *[Measure: # of assessments completed; # of conservation actions modified and re-prioritized based on assessment]*
b. Survey unexplored areas with potential GCN species habitats *[Measure: # of surveys completed]*
c. Monitor existing GCN species populations so that widespread declines can be detected *[Measure: # of monitoring studies established; # of monitoring studies conducted]*
d. Develop more complete understanding of GCN species habitat requirements, life history, minimum viable population size, distribution, abundance, ecology, demographics and recruitment *[Measure: # of research projects conducted; # of research papers published]*
e. Reintroduce certain GCN species into suitable habitats where appropriate *[Measure: # of sites with reintroduction implemented; # of viable populations established]*
f. Periodically monitor for the presence of spawning migratory fish *[Measure: # of surveys completed]*

Estuarine and Marine Habitats

(32) Oligohaline Estuaries (including Tidal Freshwater)

Description:

This habitat is defined as Maryland waters whose depth is influenced by the position of the moon (tidal) that normally range from 0 to 5 parts per thousand salinity. It includes more than 1000 miles of tidally influenced streams, as well as a significant portion of the Potomac River, the Susquehanna River below Conowingo Dam, and a section of every other tributary of size that enters Chesapeake Bay. It also includes typically small segments of tributaries that drain into the Coastal Bays section of Maryland. Bottom sediments in this key wildlife habitat vary from large boulders and outcrops of bedrock near the limit of tidal influence (few instances) to sands, silts and clays that often form relatively hard bottom. Water depths in this zone range from 0 to over 30 meters, with the shallowest areas exposed to air at low tide. Critical features created by plants and animals include submerged aquatic vegetation (SAV) beds in shallow, lower velocity areas and American oyster beds in salinities approaching 5 ppt. Because of the relatively shallow water, the input of nutrients, and frequent flushing from tide changes, primary productivity in this habitat is among the richest in the world, and there is an intimate connection between tidal wetlands and nearby waters. Its position in the watershed makes this habitat a critical link between fresh and estuarine waters. This interface is likely an important area for nutrient cycling, however, this habitat is poorly monitored and understood. The tidal fresh/oligohaline habitat is also critical spawning and larval nursery habitat for both anadromous fish species and their prey.

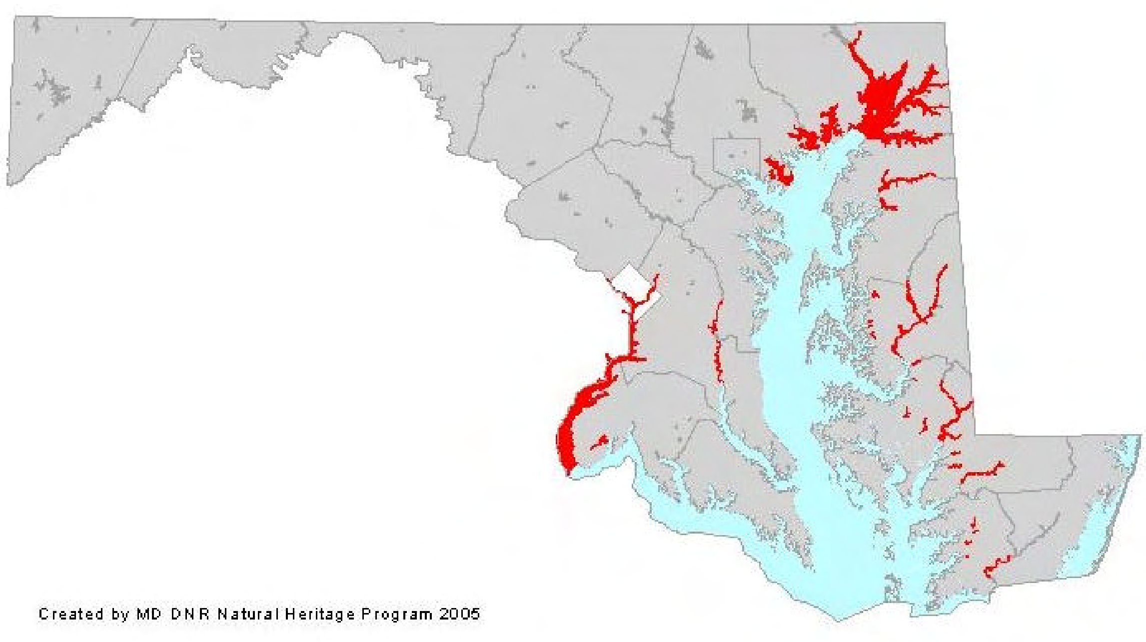
The location of oligohaline estuaries varies with local geography, tidal stage, weather patterns (e.g., rainfall amounts, drought), season and year. The dynamic nature of the habitat shifts its distribution and abundance at any given time, allowing it to shift over various substrates and water depths. Water depths are generally shallow, from intertidal to tens of feet. The spatial extent of low salinity estuaries increases with large rainfall events (e.g., hurricanes) but may be restricted far upriver in tributaries during low-flow or drought years.

Subtidal benthic habitats of low-salinity estuaries may include SAV beds and unvegetated mud, silt and/or sandy bottoms. Plant life may consist of SAV and macroalgae, with characteristic species including redhead grass, slender pondweed, naiads, sago pondweed, horned pondweed, wild celery, water stargrass and muskgrass. Exotic species such as curly pondweed, spiny naiad, hydrilla and Eurasian watermilfoil may also be present. The distribution and abundance of flora varies with water clarity, nutrient loads and other factors. SAV levels are historically low in Maryland, while macroalgae levels can rise suddenly with algal blooms due to nutrient enrichment.

Location and Condition:

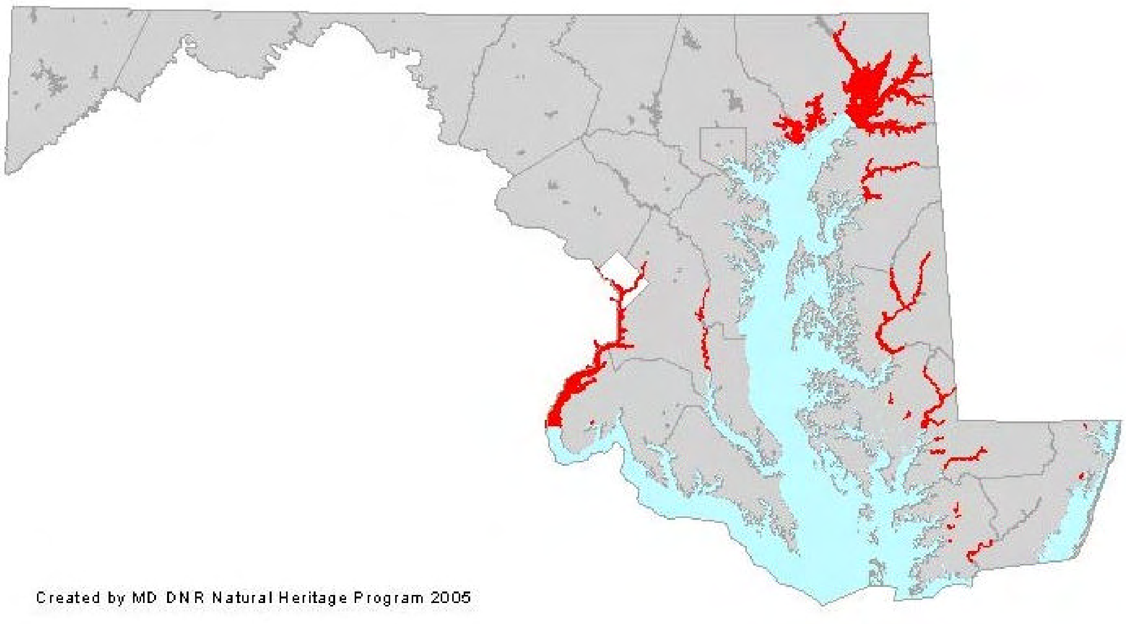
This habitat can be found in the upper estuaries of Chesapeake Bay, generally north of Baltimore in Kent and Harford Counties and on the Potomac River in upper Charles County south of the District of Columbia. The tidal portions of major freshwater Coastal Plain rivers are also included (Figures 4.32a and 4.32b). The Chesapeake Bay was listed as an "impaired water body" under the Clean Water Act due to excess nutrients and sediments (USGS 2004). Sources of the Bay's poor water quality include agriculture, urbanization, industry, and wastewater treatment. Pollutant loads from agricultural lands and point source nutrient loads from urban/suburban lands have generally declined due to management actions. On a pound-per-pound basis, taking into account point and nonpoint sources, urban/suburban areas deliver the most nutrient pollution to the Bay (CBP 2004a). MD DNR reported an improvement in water clarity in the upper bay area and an increase in SAV coverage and diversity, compared to the significant decline of 2003. The Potomac, however, show a significant increase in phosphorus and nitrogen concentrations. The overall water quality index still remains bellow the 40% reduction called for by the Chesapeake Bay Agreement of 2000.

Figure 4.32a Location of Oligohaline Estuaries in Maryland – Average Surface Salinities, 1997-1999 (Source: MD DNR RAS; MD DNR NHP)



In the Coastal Bays, oligohaline estuaries are limited to the upstream creeks of the coastal watershed. In comparison to the Chesapeake Bay, the Coastal Bays are in much better condition due to the higher flushing rate and the smaller and less developed watershed. However, increased nutrients (nitrogen and phosphorus) have led to poor water quality and degraded ecosystem health in the Coastal Bays. Tributaries generally show poor to very degraded water quality due to high nutrient inputs (Wazniak et al. 2004).

Figure 4.32b Location of Oligohaline Estuaries in Maryland – Average Bottom Salinities, 1997-1999 (Source: MD DNR RAS; MD DNR NHP)



GCN Species and Other Wildlife:

Birds
American black duck
Bald eagle
Brown pelican
Canvasback
Common loon
Common tern
Forster's tern

Horned grebe
Laughing gull
Least tern
Pied-billed grebe
Red-throated loon
Ruddy duck
Reptiles
Northern diamond-backed terrapin

Fishes
American shad
Atlantic sturgeon
Hickory shad
Longnose gar
Shortnose sturgeon
White catfish

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: Canada goose, mallard, American black duck, wood duck, gadwall, blue-winged teal, green-winged teal, northern pintail, American widgeon, northern shoveler, ring-necked duck, canvasback, redhead, greater scaup, lesser scaup, bufflehead, hooded merganser, ruddy duck, eastern snapping turtle, largemouth bass, smallmouth bass, striped bass, channel catfish, white catfish, chain pickerel, American eel, white perch, yellow perch, spot, common carp, Atlantic croaker, alewife, brown bullhead, yellow bullhead, bluegill, black crappie, white crappie, and pumpkinseed. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Threats:

a. Development, agriculture, and environmental contaminants that result in habitat degradation
b. Oil and chemical spills
c. Lack of scientific understanding of appropriate habitat requirements and management of all GCN species
d. Human activities & recreation that result in habitat degradation
e. Invasive non-native species (including ballast water release)
f. Pollution, including metaloids, changes in pH, and thermal and toxic discharges, nutrients (especially nitrogen and phosphorus), and sedimentation that result in water quality degradation
g. Dredge spoil dumping
h. Loss of submerged aquatic vegetation
i. Hydrologic and ground water alterations that result in changes in salinity

Conservation Actions:

a. Reestablish and conserve SAV (submerged aquatic vegetation) beds in areas where they formerly occurred and where water quality has improved since their disappearance ***[Measure: # of acres SAV restored]***
b. Develop land management plans which incorporate conservation measures into the local planning processes ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
c. Initiate measures to protect, maintain, and improve all species habitats and populations through coordinated efforts with various programs, especially the Chesapeake Bay Program ***[Measure: # of joint cooperative projects implemented]***
d. Implement BMPs to reduce non-point source impacts and erosion control measures and promote the protection and preservation/restoration of aquatic/riparian communities ***[Measure: # of projects implementing BMPs]***
e. Utilize Coastal Zone Management programs ***[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]***
f. Improve water quality by reducing deleterious contaminant concentrations and upgrading wastewater treatment plants ***[Measure: # of guidelines and protocols developed; # of sites with protocols implemented]***
g. Maintain buffer zones to block siltation, pesticide, and fertilizer runoff to wetlands and develop regional strategies to reduce and restrict the flow of pesticides and other toxic contaminants into aquatic systems *[Measure: # of acres of buffers protected]*
h. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of joint cooperative projects implemented]*
i. Improve and promote education and public outreach efforts *[Measure: # of educational materials developed and disseminated]*
j. Develop watershed management plans that review the totality of inputs and outputs of aquatic systems to preserve ecosystem functions *[Measure: # of plans incorporating input/output model and recommended guidelines]*
k. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
l. Establish policies that reduce oil spill likelihood (e.g., vessel mandates) *[Measure: # of policies developed and implemented]*

m. Utilize the Chesapeake Bay Critical Area Program *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*
n. Work with NGOs, including Chesapeake Bay Foundation and the Alliance for the Chesapeake Bay *[Measure: # of joint cooperative projects implemented]*
o. Implement compatible shore-erosion techniques *[Measure: # of sites with compatible techniques implemented]*
p. Increase the number of pumpout stations *[Measure: # of pumpout stations added]*
q. Respond to oil and chemical spills quickly and effectively *[Measure: # of protocols developed and evaluated for effectiveness; # of immediate responses]*
r. Limit boating activity to protect SAV beds *[Measure: # of sites with limited access]*
s. Encourage citizens to donate to the Chesapeake Bay and Endangered Species Fund *[Measure: # of educational materials developed and distributed]*

Inventory, Monitoring and Research Needs:

a. Conduct quantitative surveys identifying all populations, habitats, and critical resources, followed by long-term research on population trends and assessments of mortality factors *[Measure: # of surveys completed]*
b. Establish coordinated habitat and population monitoring programs on a regional level using standardized surveying techniques designed to have minimal impacts on populations *[Measure: # of monitoring programs established; # of standardized protocols developed and implemented; # of conservation partners implementing standardized protocols]*
c. Develop monitoring programs to accompany all management activities for the purpose of assessing effectiveness of techniques *[Measure: # of monitoring programs established; # of monitoring programs conducted]*
d. Monitor effects of environmental contaminants *[Measure: # of monitoring studies conducted]*
e. Identify sources of aquatic contaminants and reduce their presence *[Measure: # sources identified; # of mitigation protocols developed and implemented]*
f. Conduct research on movements, mortality rates, causes of mortality, and feeding habitat of GCN species *[Measure: # of research projects conducted; # of research papers published]*
g. Conduct quantitative surveys on distribution, demographics, recruitment, and reproductive ecology, thoroughly document known populations of GCN species *[Measure: # of surveys conducted]*
h. Implement research recommendations in approved fishery management plans *[Measure: # of research projects conducted; # of research papers published]*
i. Conduct monitoring of benthic invertebrates *[Measure: # of monitoring programs established; # of monitoring programs conducted]*

(33) Mesohaline Estuaries

Description:

This habitat is defined as Chesapeake Bay and Coastal Bays tidal waters that normally range from 5 to 18 parts per thousand salinity. It includes a significant portion of the mainstem Chesapeake Bay, the lower Potomac River, eastern shore embayments, and much of the Maryland Coastal Bays area. Bottom sediments in this key wildlife habitat typically vary from hard-packed sands and clays to soft, mayonnaise-like silt in the deepest areas. Gravel beds do exist, however, in some well-flushed shallow areas. Critical shallow water features created by plants and animals include submerged aquatic vegetation (SAV) beds and American oyster beds. Because of the connection with upstream, high productivity habitat, animal and plant biomass is quite high. In addition, juvenile anadromous fish, summer migrants (e.g., weakfish, menhaden, bluefish), and developing blue crabs move into the estuary and bring additional biomass.

The location of the mesohaline salinity range within the Chesapeake Bay varies with local geography, tidal stage, weather patterns (e.g., rainfall amounts, drought), season and year. The dynamic nature of the habitat shifts its location and abundance at any given time, allowing it to move over various substrates and water depths. The large size of Chesapeake Bay and its open connection with the Atlantic Ocean creates a large mesohaline area as compared to the smaller and significantly more enclosed Coastal Bays, where mesohaline estuaries are typically limited to creek mouths. Water depths are generally shallow, from subtidal to tens of feet.

Subtidal benthic habitats of mid-salinity estuaries may include SAV beds, clam and oyster beds, and bare mud, silt and/or sandy bottoms. Plant life may consist of SAV and macroalgae, including widgeon grass, eelgrass, sago pondweed, wild celery and sea lettuce. The distribution and abundance of flora varies with water clarity, nutrient loads and other factors.

Location and Condition:

This habitat can be found generally in the middle estuaries of Chesapeake Bay and the Coastal Bays; however, the location of these mid-salinity estuaries varies with local geography, tidal stage, weather patterns (e.g., rainfall amounts, drought), season and year. The majority of Maryland's portion of the open waters of Chesapeake Bay is mesohaline, as are most of the eastern tributary estuaries. In the Coastal Bays, mesohaline waters tend to be located at creek mouths. Chesapeake Bay is listed as an "impaired water body" due to excess nutrients and sediments (USGS 2004). The condition of the Coastal Bays varies, with Sinepuxent and Chincoteague Bays having “good” water quality ratings, Assawoman and Isle of Wight Bays rated as “fair,” Newport Bay as “poor” and St. Martin River classified as “very poor” (Wazniak et al. 2004).

Figure 4.33a Location of Mesohaline Estuaries in Maryland – Average Surface Salinities, 1997-1999 (Source: MD DNR RAS; MD DNR NHP)

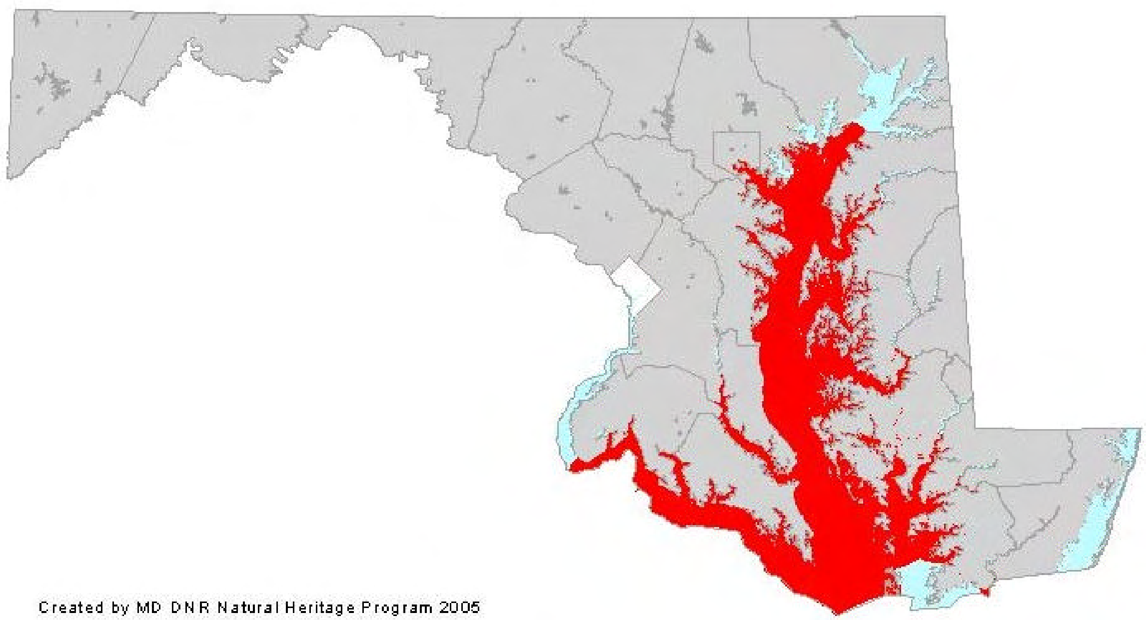
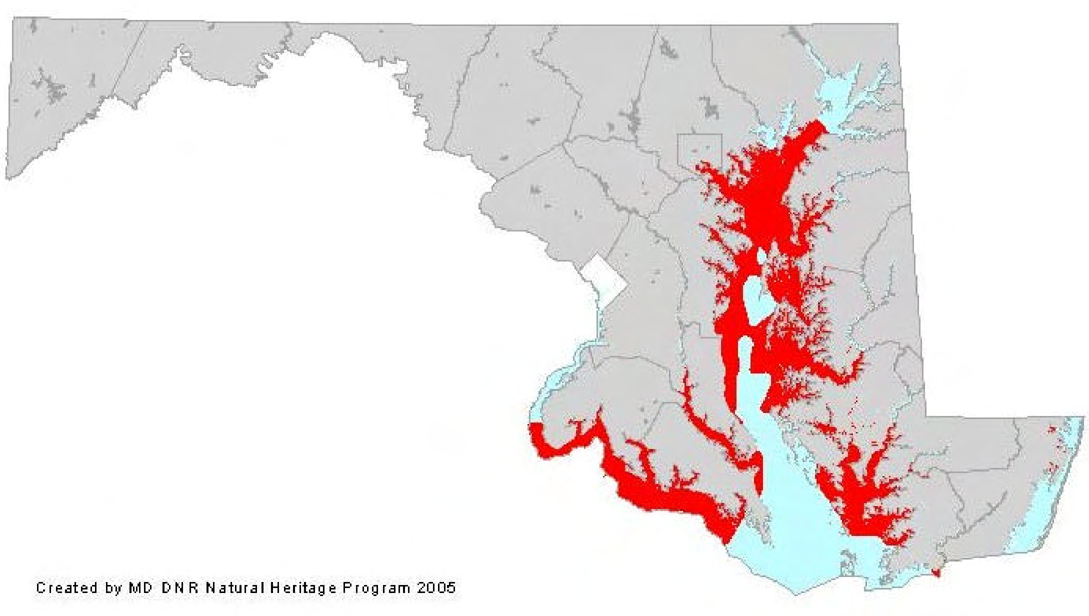


Figure 4.33b Location of Mesohaline Estuaries in Maryland – Average Bottom Salinities, 1997-1999 (Source: MD DNR RAS; MD DNR NHP)



GCN Species and Other Wildlife:

Birds	Horned grebe	Green seaturtle
American black duck	Laughing gull	Kemp's ridley seaturtle
Bald eagle	Least tern	Leatherback seaturtle
Black skimmer	Northern gannet	Loggerhead seaturtle
Black tern	Pied-billed grebe	Northern diamond-backed terrapin
Brant	Red-throated loon	**Fishes**
Brown pelican	Roseate tern	American shad
Canvasback	Royal tern	Atlantic sturgeon
Common loon	Ruddy duck	Hickory shad
Common tern	Sandwich tern	Shortnose sturgeon
Forster's tern	**Reptiles**	**Inverts: Marine Arthropods**
Gull-billed tern	Atlantic hawksbill seaturtle	Horseshoe crab

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: Canada goose, mallard, American black duck, wood duck, gadwall, blue-winged teal, green-winged teal, northern pintail, American widgeon, northern shoveler, ring-necked duck, canvasback, redhead, greater scaup, lesser scaup, black scoter, white-winged scoter, surf scoter, long-tailed duck, common goldeneye, bufflehead, red-breasted merganser, hooded merganser, ruddy duck, eastern snapping turtle, northern diamond-backed terrapin, striped bass, bluefish, white catfish, black drum, American eel, summer flounder, Spanish mackerel, white perch, spotted seatrout, weakfish, spot, Atlantic croaker, kingfishes, sheepshead, northern puffer, alewife, oyster toadfish, blue crab, American oyster, soft-shell clam, and razor clam. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

Numerous species of zooplankton and phytoplankton provide biomass to the water column and form the base of the food chain. Mesohaline estuaries are highly productive nurseries and zooplankton commonly consist of larvae of amphipods, isopods, copepods, hydromedusae, crabs, and fish (USACE 2002). Benthic fauna include blue crab, shrimp, soft shell clams, razor clams, horseshoe crabs, and oysters. Oyster reefs and shipwrecks may provide localized relief and a hard substrate for epibenthic organisms, although the abundance of oyster reefs has declined dramatically.

Seventy species of fish spend a portion of their life cycle in the mesohaline estuaries of Chesapeake Bay (USACE 2002). Some fish utilize mesohaline estuaries for spawning, while others use the habitat as juvenile nursery areas. Species such as hogchoker are resident estuarine species, but anadromous species such as herring, shad, sturgeon and striped bass are found seasonally. Menhaden, bluefish, striped bass, black drum, summer flounder, and common eel are characteristic commercially valuable species. Loggerhead seaturtles forage in the estuaries during warmer summer months and northern diamondback terrapin are resident reptiles, breeding in adjacent coastal habitats.

Mesohaline estuaries also support a high diversity of waterbirds and waterfowl. These waters provide foraging habitat for hundreds of avian species, including numerous GCN species such as common loon, horned grebe, least tern, brown pelican, and many species of herons and egrets. Bald eagle and osprey rely on near shore waters for foraging areas, as well. The estuaries are migratory staging sites for many species, such as loons, northern gannet, canvasback and Canada goose, and year-round habitat for others (e.g., American black duck). Estuaries in the lower Potomac River and the mouth of the Choptank River host thousands of migrating and overwintering waterfowl such as bufflehead, canvasback, both scaup species, and common goldeneye. Up to 50,000 waterfowl overwinter on the lower Potomac's estuaries, and over 59,000 waterfowl stopover or winter at Eastern Neck NWR in Queen Anne's County (Chipley et al. 2003).

Threats:

a. Development, agriculture, and environmental contaminants that result in habitat degradation
b. Oil and chemical spills
c. Lack of scientific understanding of appropriate habitat requirements and management of all GCN species
d. Human activities & recreation that result in habitat degradation
e. Invasive non-native species (including ballast water release)
f. Pollution, including metaloids, changes in pH, and thermal and toxic discharges, nutrients (especially nitrogen and phosphorus), and sedimentation that result in water quality degradation
g. Dredge spoil dumping
h. Loss of submerged aquatic vegetation
i. Loss of oxygen
j. Oyster reef extraction that results in habitat loss
k. Dredges and scrapes (commercial uses) that impact SAV and bottom sediments
l. Hydrologic and ground water alterations that result in changes in salinity

Conservation Actions:

a. **Reestablish and conserve SAV (submerged aquatic vegetation) beds in areas where they formerly occurred and where water quality has improved since their disappearance** ***[Measure: # of acres SAV restored]***
b. **Develop land management plans which incorporate conservation measures into the local planning processes** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
c. **Initiate measures to protect, maintain, and improve all species habitats and populations through coordinated efforts with various programs, especially the Chesapeake Bay Program** ***[Measure: # of joint cooperative projects implemented]***
d. **Implement BMPs to reduce non-point source impacts and erosion control measures and promote the protection and preservation/restoration of aquatic/riparian communities** ***[Measure: # of projects implementing BMPs]***

e. **Improve water quality by reducing deleterious contaminant concentrations and upgrading wastewater treatment plants** ***[Measure: # of guidelines and protocols developed; # of sites with protocols implemented]***
f. **Utilize Coastal Zone Management programs** ***[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]***
g. Maintain buffer zones to block siltation, pesticide, and fertilizer runoff to wetlands and develop regional strategies to reduce and restrict the flow of pesticides and other toxic contaminants into aquatic systems *[Measure: # of acres of buffers protected]*
h. Develop watershed management plans that review the totality of inputs and outputs of aquatic systems to preserve ecosystem functions *[Measure: # of plans incorporating input/output model and recommended guidelines]*
i. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of joint cooperative projects implemented]*
j. Improve and promote education and public outreach efforts *[Measure: # of educational materials developed and disseminated]*
k. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
l. Establish policies that reduce oil spill likelihood (e.g., vessel mandates) *[Measure: # of policies developed and implemented]*
m. Utilize the Coastal Bays Program *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*
n. Utilize the Chesapeake Bay Critical Area Program *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*
o. Work with NGOs, including Chesapeake Bay Foundation and the Alliance for the Chesapeake Bay *[Measure: # of joint cooperative projects implemented]*
p. Implement compatible shore-erosion techniques *[Measure: # of sites with compatible techniques implemented]*
q. Increase the number of pumpout stations *[Measure: # of pumpout stations added]*
r. Respond to oil and chemical spills quickly and effectively *[Measure: # of protocols developed and evaluated for effectiveness; # of immediate responses]*
s. Limit boating activity to protect SAV beds *[Measure: # of sites with limited access]*
t. Implement required management actions in approved fishery management plans *[Measure: # of actions implemented]*
u. Encourage citizens to donate to the Chesapeake Bay and Endangered Species Fund *[Measure: # of educational materials developed and distributed]*

Inventory, Monitoring and Research Needs:

a. Conduct quantitative surveys identifying all populations, habitats, and critical resources, followed by long-term research on population trends and assessments of mortality factors *[Measure: # of surveys completed]*
b. Establish coordinated habitat and population monitoring programs on a regional level using standardized surveying techniques designed to have minimal impacts on populations *[Measure: # of monitoring programs established; # of standardized protocols developed and implemented; # of conservation partners implementing standardized protocols]*
c. Develop monitoring programs to accompany all management activities for the purpose of assessing effectiveness of techniques *[Measure: # of monitoring programs established; # of monitoring programs conducted]*
d. Monitor effects of environmental contaminants *[Measure: # of monitoring studies conducted]*

e. Identify sources of aquatic contaminants and reduce their presence *[Measure: # sources identified; # of mitigation protocols developed and implemented]*
f. Conduct research on movements, mortality rates, causes of mortality, and feeding habitat of GCN species *[Measure: # of research projects conducted; # of research papers published]*
g. Determine the effects of dredging on GCN species *[Measure: # of research projects conducted; # of research papers published]*
h. Conduct quantitative surveys on distribution, demographics, recruitment, and reproductive ecology, thoroughly document known populations of GCN species *[Measure: # of surveys completed]*
i. Conduct SAV monitoring *[Measure: # of surveys completed]*
j. Implement research recommendations in approved fishery management plans *[Measure: # of research projects conducted; # of research papers published]*
k. Conduct research on abundance, distribution, and food web dynamics of important organisms to add information to ecosystem models *[Measure: # of research projects conducted; # of research papers published]*

(34) Polyhaline Estuaries

Description:

This habitat is defined as tidal waters of the Chesapeake Bay and Coastal Bays that normally range from 18 to 30 parts per thousand salinity. Bottom sediments in this key wildlife habitat typically vary from hard-packed sands and clays to soft, mayonnaise-like silt in the deeper troughs. Depths in this habitat range from tidally exposed to more than 40 meters. Critical shallow water features created by plants and animals include submerged aquatic vegetation (SAV) beds and American oyster beds. Because of the connection with the upper estuary zones, animal and plant biomass is quite high. In addition, juvenile anadromous fish, summer migrants (e.g., weakfish, menhaden, bluefish), and developing blue crabs move into the estuary and bring additional biomass.

The location of the polyhaline salinity range within the Chesapeake Bay varies with local geography, tidal stage, weather patterns (e.g., rainfall amounts, drought), season and year. The dynamic nature of the habitat shifts its location and abundance at any given time, allowing it to move over various substrates and water depths. High salinity estuaries generally are found in the lower portion of estuaries, closest to marine waters.

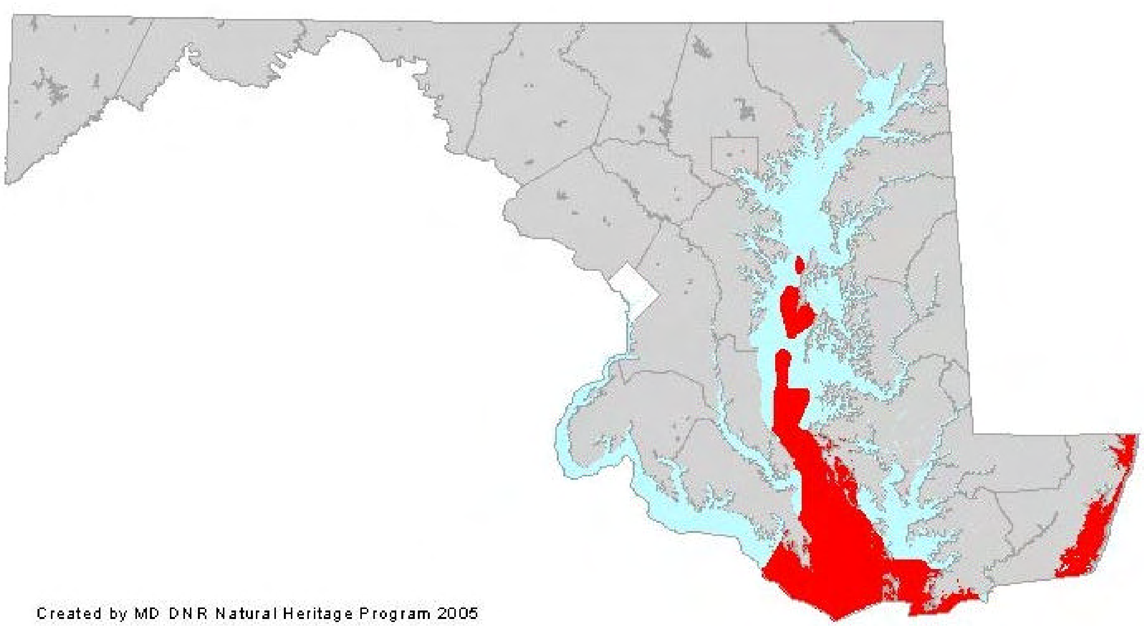
Subtidal benthic habitats of polyhaline estuaries may include SAV beds, clam and oyster beds, and unvegetated mud, silt and/or sandy bottoms. Plant life may consist of SAV and macroalgae (seaweed), with widgeon grass, eelgrass, and sea lettuce as characteristic species. The distribution and abundance of flora varies with water clarity, nutrient loads and other factors.

Location and Condition:

This habitat can be found in the lower estuaries and open waters of Chesapeake Bay and the Coastal Bays. The location of polyhaline estuaries varies with local geography, tidal stage, weather patterns (e.g., rainfall amounts, drought), season and year. At the surface, typical polyhaline distribution in Chesapeake Bay is limited to Virginia, with only occasional extension into the open waters of Maryland. Polyhaline distribution at the bottom of the Chesapeake Bay extends much farther northward (Figures 4.34a and 4.34b). The Chesapeake Bay was listed as an "impaired water body" under the Clean Water Act due to excess nutrients and sediments (USGS 2004).

Figure 4.34a Location of Polyhaline Estuaries in Maryland – Average Surface Salinities, 1997-1999 (Source: MD DNR RAS; MD DNR NHP)

Figure 4.34b Location of Polyhaline Estuaries in Maryland – Average Bottom Salinities, 1997-1999 (Source: MD DNR RAS; MD DNR NHP)



The open coastal bays have good to excellent condition compared to Chesapeake Bay (Wazniak et al. 2004). Sinepuxent and Chincoteague Bays have a "good " overall water quality index ranking of .85 and .74, due to lack of development and regular flushing. Isle of Wight and Assawoman Bays have "fair" conditions with ranks of .53 and .33, while Newport

Bay and St. Martin River have the "poor" rankings of .35 and .33 due to very low values for water quality, living resources, and habitat indicators.

GCN Species and Other Wildlife:

Mammals	Gull-billed tern	Kemp's ridley seaturtle
Humpback whale	Horned grebe	Leatherback seaturtle
Birds	Laughing gull	Loggerhead seaturtle
American black duck	Least tern	Northern diamond-backed terrapin
Bald eagle	Northern gannet	**Fishes**
Black skimmer	Red-throated loon	American shad
Black tern	Roseate tern	Atlantic sturgeon
Brant	Royal tern	Hickory shad
Brown pelican	Ruddy duck	Shortnose sturgeon
Canvasback	Sandwich tern	**Inverts: Marine Arthropods**
Common loon	**Reptiles**	Horseshoe crab
Common tern	Atlantic hawksbill seaturtle	
Forster's tern	Green seaturtle	

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: Canada goose, snow goose, brant, mallard, American black duck, wood duck, gadwall, blue-winged teal, green-winged teal, northern pintail, American widgeon, northern shoveler, ring-necked duck, canvasback, redhead, greater scaup, lesser scaup, black scoter, white-winged scoter, surf scoter, long-tailed duck, common goldeneye, bufflehead, red-breasted merganser, hooded merganser, eastern snapping turtle, northern diamond-backed terrapin, black sea bass, striped bass, bluefish, black drum, American eel, summer flounder, Spanish mackerel, scup, spotted seatrout, tautog, weakfish, spot, hickory shad, Atlantic croaker, kingfishes, Florida pompano, sheepshead, northern puffer, cunner, alewife, oyster toadfish, pollock, hake, king mackerel, spiny dogfish, smooth dogfish, gray triggerfish, blue crab, American oyster, hardshell clam, and razor clam. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

The Coastal Bays support over 140 species of finfish and 120 species of benthic and epibenthic invertebrates (Wazniak et al. 2004). Estuarine-dependent species such as summer flounder, bluefish, spot, weakfish, tautog, and black sea bass are commercially valuable, while recreational anglers target croaker and striped bass in addition to many of the commercially valuable species.

Polyhaline estuaries also support a high diversity of waterbirds and waterfowl. These waters provide foraging habitat for many avian species, including numerous GCN species such as least tern, black skimmer, brown pelican, and many species of herons and egrets. The estuaries are overwintering and migratory staging sites for species, such as loons, grebes, and brant, and year-round habitat for others (e.g., American black duck).

Threats:

a. Development, agriculture, and environmental contaminants that result in habitat degradation
b. Oil and chemical spills
c. Lack of scientific understanding of appropriate habitat requirements and management of all GCN species
d. Human activities & recreation that result in habitat degradation
e. Invasive non-native species (including ballast water release)
f. Pollution, including metaloids, changes in pH, and thermal and toxic discharges, nutrients (especially nitrogen and phosphorus), and sedimentation that result in water quality degradation
g. Dredge spoil dumping
h. Loss of submerged aquatic vegetation
i. Loss of oxygen
j. Oyster reef extraction that results in habitat loss
k. Dredges and scrapes (commercial uses) that impact SAV and bottom sediments
l. Hydrologic and ground water alterations that result in changes in salinity

Conservation Actions:

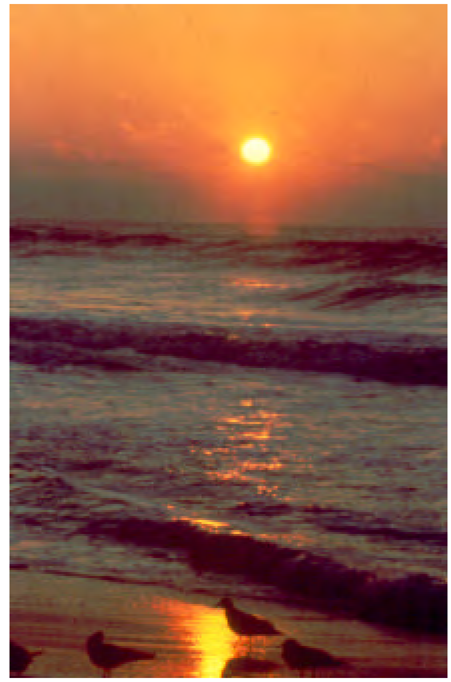
a. **Initiate measures to protect, maintain, and improve all species habitats and populations through coordinated efforts with various programs, especially the Chesapeake Bay Program** ***[Measure: # of joint cooperative projects implemented]***
b. **Develop land management plans which incorporate conservation measures into the local planning processes** ***[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]***
c. **Implement BMPs to reduce non-point source impacts and erosion control measures and promote the protection and preservation/restoration of aquatic/riparian communities** ***[Measure: # of projects implementing BMPs]***
d. **Reestablish and conserve SAV (submerged aquatic vegetation) beds in areas where they formerly occurred and where water quality has improved since their disappearance** ***[Measure: # of acres SAV restored]***
e. **Improve water quality by reducing deleterious contaminant concentrations and upgrading wastewater treatment plants** ***[Measure: # of guidelines and protocols developed; # of sites with protocols implemented]***
f. **Utilize Coastal Zone Management programs** ***[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]***
g. **Utilize the Coastal Bays Program** ***[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]***
h. Maintain buffer zones to reduce siltation, pesticide, and fertilizer runoff to wetlands and develop regional strategies to reduce and restrict the flow of pesticides and other toxic contaminants into aquatic systems *[Measure: # of acres of buffers protected]*
i. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of joint cooperative projects implemented]*
j. Improve and promote education and public outreach efforts *[Measure: # of educational materials developed and disseminated]*

k. Develop watershed management plans that review the totality of inputs and outputs of aquatic systems to preserve ecosystem functions *[Measure: # of plans incorporating input/output model and recommended guidelines]*
l. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*
m. Establish policies that reduce oil spill likelihood (e.g., vessel mandates) *[Measure: # of policies developed and implemented]*
n. Utilize the Chesapeake Bay Critical Area Program *[Measure: # of local, state, and federal agency programs incorporating wildlife focused habitat management actions]*
o. Work with NGOs, including Chesapeake Bay Foundation and the Alliance for the Chesapeake Bay *[Measure: # of joint cooperative projects implemented]*
p. Implement compatible shore-erosion control techniques *[Measure: # of sites with compatible techniques implemented]*
q. Increase the number of pumpout stations *[Measure: # of pumpout stations added]*
r. Respond to oil and chemical spills quickly and effectively *[Measure: # of protocols developed and evaluated for effectiveness; # of immediate responses]*
s. Limit boating activity to protect SAV beds *[Measure: # of sites with limited access]*
v. Implement required management actions in approved fishery management plans *[Measure: # of actions implemented]*
t. Encourage citizens to donate to the Chesapeake Bay and Endangered Species Fund *[Measure: # of educational materials developed and distributed]*

Inventory, Monitoring and Research Needs:

a. Conduct quantitative surveys identifying all populations, habitats, and critical resources, followed by long-term research on population trends and assessments of mortality factors *[Measure: # of surveys completed]*
b. Establish coordinated habitat and population monitoring programs on a regional level using standardized surveying techniques designed to have minimal impacts on populations *[Measure: # of monitoring programs established; # of standardized protocols developed and implemented; # of conservation partners implementing standardized protocols]*
c. Develop monitoring programs to accompany all management activities for the purpose of assessing effectiveness of techniques *[Measure: # of monitoring programs established]*
d. Monitor effects of environmental contaminants *[Measure: # of monitoring studies conducted]*
e. Identify sources of aquatic contaminants and reduce their presence *[Measure: # sources identified; # of mitigation protocols developed and implemented]*
f. Conduct research on movements, mortality rates, causes of mortality, and feeding habitat of GCN species *[Measure: # of research projects conducted; # of research papers published]*
g. Determine the effects of dredging on GCN species *[Measure: # of research projects conducted; # of research papers published]*
h. Conduct quantitative surveys on distribution, demographics, recruitment, and reproductive ecology, thoroughly document known populations of GCN species *[Measure: # of surveys completed]*
i. Conduct SAV monitoring *[Measure: # of surveys completed]*
l. Implement research recommendations in approved fishery management plans *[Measure: # of research projects conducted; # of research papers published]*
j. Conduct research on abundance, distribution, and food web dynamics of important organisms to add information to ecosystem models *[Measure: # of research projects conducted; # of research papers published]*

(35) Ocean



Description:

The Atlantic Ocean consists of benthic, pelagic and surface water habitats. This community is defined as open marine waters (salinity exceeding 30 ppt) and includes all substrate types: unconsolidated sands, muds and gravels; rock; reef; and aquatic beds (Cowardin et al. 1979). Water depths range from zero at the coastline to thousands of feet in international waters; Maryland's marine waters are less than seventy feet deep, however. Bottom topography is generally gently sloping away from the shoreline, with occasional shoals, sand waves or shipwrecks providing local topography.

Marine habitats are typically high energy, with waves and currents mixing waters of varying temperatures, salinities and nutrient levels. Lunar tides alter the water levels in the nearshore region and generate currents at inlets, where marine waters are diluted with estuarine waters. Longshore currents transport sediment and zooplankton along nearshore margins, creating a dynamic habitat that is continually changing. Along the Mid-Atlantic coast, open ocean vegetative associations are limited to phytoplankton and macroalgae.

Location and Condition:

Oceanic habitat is found from the shorelines of Fenwick Island and Assateague Island seaward for three miles (the jurisdiction for state waters), covering approximately 96 square miles. No oceanic waters are impaired and there is only one point source of pollution: the wastewater discharge for Ocean City (MD DNR 2000b).

However, of Maryland's 35 key wildlife habitats, this one is least likely to afford significant conservation of the species found within it through conservation of the habitat. Most species are highly migratory and conservation of oceanic species is best achieved through better regulation of commercial and recreational fisheries at the state, national and international levels.

Figure 4.35 Location of Ocean in Maryland (Source: MD DNR NHP)

GCN Species and Other Wildlife:

Mammals
Blue whale
Fin whale
Harbor porpoise
Humpback whale
Northern right whale
Sei whale
Sperm whale
Birds
Black skimmer
Black tern
Brant
Brown pelican

Common loon
Common tern
Forster's tern
Harlequin duck
Horned grebe
Laughing gull
Least tern
Northern gannet
Red-throated loon
Roseate tern
Royal tern
Sandwich tern
Reptiles

Atlantic hawksbill seaturtle
Green seaturtle
Kemp's ridley seaturtle
Leatherback seaturtle
Loggerhead seaturtle
Fishes
American shad
Atlantic sturgeon
Hickory shad
Shortnose sturgeon
Inverts: Marine Arthropods
Horseshoe crab

In addition to the GCN species listed above, this key wildlife habitat supports a wide diversity of wildlife species. The following game species are found in this habitat type: brant, common eider, king eider, black scoter, white-winged scoter, surf scoter, long-tailed duck, common goldeneye, red-breasted merganser, black sea bass, striped bass, bluefish, black drum, American eel, summer flounder, Spanish mackerel, scup, spotted seatrout, tautog, weakfish, Atlantic croaker, kingfishes, Florida pompano, northern puffer, cunner, alewife, pollock, hake, king mackerel, spiny dogfish, smooth dogfish, gray triggerfish, dolphin, white marlin, wahoo, albacore, bluefin tuna, skipjack tuna, blue shark, dusky shark, requiem shark, shortfin mako, yellowfin tuna, blue crab, and American lobster. Management plans and conservation programs for these game species are currently being implemented by MD DNR, USFWS, and many other partners.

The water column hosts a high number of pelagic species, some of which are resident (e.g.,flounder) while others are migratory and are found only seasonally (e.g., whales, tuna, sharks). Commercially and recreationally valuable fisheries also contribute to the biodiversity of marine waters; Spanish mackerel, scup, spiny dogfish, bluefin tuna, monkfish, swordfish, Atlantic blue and white marlin, and Atlantic sailfish all attract commercial fishermen and anglers to Maryland's coast.

The ocean provides foraging habitat for many seabirds and waterfowl such as red-throated loon, northern gannet, shearwaters, storm-petrels, alcids, scoters, gulls, and terns.

Benthic fauna found in Maryland's marine waters are diverse – from worms and mollusks to crustaceans and bottom-dwelling fish. Channel whelk, lightning whelk, knobbed whelk, and horseshoe crabs are predators on other benthic organisms.

Threats:

a. Development and environmental contaminants that result in habitat degradation
b. Dredges and scrapes (commercial uses) that impact bottom sediments
c. Oil and chemical spills
d. Lack of scientific understanding of appropriate habitat requirements and management of all GCN species
e. Human activities & excessive recreational use that results in habitat degradation
f. Invasive non-native species (including ballast water release)
g. Acoustic disturbance
h. Sand mining

Conservation Actions:

a. Reduce recreational impacts by educating the public about these impacts and ways to minimize them ***[Measure: # of educational materials developed and distributed]***
b. Reduce presence of aquatic contaminants ***[Measure: # of guidelines developed; # of guidelines implemented]***
c. Establish policies that reduce oil spill likelihood (e.g., vessel mandates) ***[Measure: # of policies developed and implemented]***
d. Develop land management plans which incorporate conservation measures into the local planning processes *[Measure: # of local, state, and federal agency plans incorporating wildlife focused habitat management actions]*
e. Implement recommendations in the 2005 Maryland Coastal Bays Management Plan *[Measure: # of recommendations implemented]*
f. Implement required management actions in approved fishery management plans *[Measure: # of actions implemented]*
g. Coordinate conservation efforts between various interest groups and across states boundaries, including state agencies *[Measure: # of joint cooperative projects implemented]*

h. Improve and promote education and public outreach efforts *[Measure: # of educational materials developed and disseminated]*
i. Ensure sand mining activity is limited to areas of least impact *[Measure: # of sites identified and protected from sand mining activities]*
j. Respond to oil and chemical spills quickly and effectively *[Measure: # of protocols developed and evaluated for effectiveness; # of immediate responses]*
k. Develop and implement protocols to control invasive species *[Measure: # of protocols developed; # of sites with management implemented]*

Inventory, Monitoring and Research Needs:

a. Identify sources of aquatic contaminants *[Measure: # of sources identified]*
b. Determine indicators of ecologically significant areas *[Measure: # of research studies conducted; # of research papers published; # of indicators identified]*
c. Conduct long-term monitoring program for priority GCN species and/or indicators of ecologically significant areas *[Measure: # of monitoring programs developed; # of monitoring programs conducted]*
d. Conduct research to define predator-prey interactions and ecosystem relationships among organisms within this habitat *[Measure: # of research studies conducted; # of research papers published; # of indicators identified]*

Chapter 5: Monitoring

This chapter presents the various aspects of **Element #5**, including Maryland's strategy for the development of an effective monitoring framework for GCN species and key wildlife habitats and a description of the adaptive assessment strategy to measure the effectiveness of the identified conservation actions to conserve wildlife diversity in Maryland. Appendix 5 provides an inventory of the existing monitoring programs and projects in Maryland.

Monitoring, Evaluation and Adaptive Management

It is impractical and very inefficient to have individual and separate monitoring actions for each of the 502 GCN species. It is more practical to develop an effective monitoring framework or strategy that monitors the *status* and *condition* of species and habitats, conservation action effectiveness, and finally the incorporation of new information and adaptive responsiveness of this plan. This is one of the overarching conservation strategies identified in Chapter 4: "Develop programs and strategies to monitor key wildlife habitats and the effectiveness of conservation actions."

The long-term successful implementation of Maryland's WDCP will, as a minimum, prevent more GCN species from becoming increasingly rare and endangered, prevent key wildlife habitats from being degraded and irreparably lost, and minimize or eliminate threats to both. A critical measure of success will also include the reversal of population trends such that rare species will become more abundant and degraded key wildlife habitats will become restored and vital components of our natural landscape. These are long-term outcomes of the success of this WDCP, recognizing the many external factors that might limit implementation. Another important measure of the effectiveness and adaptability of this WDCP is the frequency and degree of use and integration of the WDCP targets into the programs and operations of MD DNR's many programs, as well as those of its partners and stakeholders. Therefore, Maryland's monitoring framework and adaptive assessment strategy will focus on evaluating the long-term progress towards these broad objectives.

Table 5.1 summarizes a preliminary list of overall evaluation objectives and potential performance outcomes and measures to monitor the success of the WDCP and its numerous actions designed to conserve Maryland's species and habitats in greatest need of conservation. It draws upon existing monitoring mechanisms and programs already in place (e.g., ACJV, multiple migratory bird plans, watershed plans), and it outlines how the objectives could be measured throughout implementation by MD DNR and its partners.

Table 5.1 Preliminary evaluation objectives and potential performance outcomes and measures to assess the success of the WDCP conservation measures.

Objective	Strategies / Actions	Measures of Outcomes
Key Wildlife Habitat Conservation	Conservation Actions, and Inventory, Monitoring & Research Projects	Acres/stream miles Key Wildlife Habitat conserved
		Acres/stream miles Key Wildlife Habitat restored or enhanced
GCN Species Conservation	Conservation Actions, and Inventory, Monitoring & Research Projects	GCN species occurrences with targeted stewardship implemented
		Species removed from State T&E list
		Species added to State T&E list
		GCN species with lowered conservation status rank (e.g., S2 changed to S4)
		Species removed from GCN list
		Species added to GCN list
Biological Assessment	Threats assessment	Threats assessment updated
	Status, trends, limiting factor assessment	GCN species with status, trends and limiting factors assessed
	Population and habitat objectives	GCN population and key wildlife habitat objectives determined/updated
		State population and habitat objectives determined/updated
Research	Applied research projects	Research projects completed
		Research papers/reports published
		Adaptive mgmt applied based on findings
Conservation Design	Conservation planning projects	Core network of conservation lands identified
		Conservation plans written or revised
		Key wildlife habitats with GIS data updated
	Conservation tools	New GIS decision support tools developed
		Existing GIS decision support tools updated
		Predictive distribution models updated
		New predictive distribution models created
Monitoring and Evaluation	Monitoring programs	Existing monitoring programs utilized or modified to meet WDCP evaluation needs
		New monitoring programs developed
Information Management	Web-based data	Internet data pages developed
	Outcome tracking product	Outcome tracking data entered and available electronically
	Specific information products	Natural Heritage Database updated
		MD DNR databases/GIS layers updated
		New databases/GIS layers developed
		Data disseminated
Project Funding	Federal grants	Projects funded
		Dollars allocated
	State Wildlife Grants and other state grants	Projects funded
		Dollars allocated

Objective	Strategies / Actions	Measures of Outcomes
	Other funding programs	Projects funded
		Dollars allocated
Partner Outreach	Outreach plan	Plan completed or updated
	Web site	Internet pages created or updated
	Partner meetings and presentations	Meetings with and presentations to NGOs, field units of federal agencies, ecosystem teams and others
Public Outreach & Education	Outreach Plan implemented	Objectives met through appropriate outreach techniques
	Objective-based Educational products, meetings and events	Products produced (e.g., website, website frequent updates, periodic workshops and symposia and resulting publications. Other materials such as: maps and information packets)
Implementation effectiveness	Partners and stakeholders adopting WDCP targets (GCN species and key wildlife habitats) in their plans/programs	# partner/stakeholder plans using WDCP targets and implementing identified actions
		# plans revised within MD DNR and externally with GCN species, key wildlife habitats and actions used and accomplished
	Extent to which MD DNR can implement	% projects funded and completed

In addition to focusing on the measures for long-term progress toward the WDCP's overarching goals, the short-term outcomes of specific conservation actions for habitats, taxa groups, and species will be monitored, as appropriate. The outcomes of some of these activities will be much easier to track than others. Therefore, given the need to work within our limited time and funding, an early accomplishment will be to develop a prioritization scheme for tracking the detailed outcomes outlined in Chapter 4. Once a process for tracking the most important performance measures has been implemented, the remaining performance measures may be included, as funding allows.

Monitoring Framework: Monitoring GCN species and Key Wildlife Habitats

The first two objectives listed in Table 5.1 involve monitoring of GCN species and their key wildlife habitats. Chapter 4 identifies numerous priority monitoring needs for GCN species and key wildlife habitat status and condition. Maryland is fortunate to have an extensive monitoring system (**Element 5**) already in place, with hundreds of state, federal, local and grass-roots monitoring projects and programs. Appendices 1a and 5 list many of the existing plans and programs that have been developed by local, state, regional, national, or international partners that may include monitoring GCN species or their habitat components in Maryland. Many of the monitoring conservation actions identified in Chapter 4 were developed with these existing monitoring actions/plans in mind, as potentially providing the majority of the WDCP monitoring framework. Wherever possible this WDCP recommends and supports the full implementation of partners' plans (e.g., USFWS, ASMFC, PIF BCR, TNC, PARC, BCI), especially those that have recommended or identified standardized monitoring actions and protocols for regional and/or national consistency. These existing monitoring efforts will be utilized as mechanisms to achieve WDCP conservation actions and implementation partnerships wherever applicable at the local, state, regional and national levels. Many of Maryland's monitoring efforts will be coordinated at these levels, through existing networks, such as USFWS Region 5 Migratory Bird Plans, PARC, and PIF, to ensure monitoring at the proper scale.

Within each key wildlife habitat, the most appropriate level of monitoring, whether it is at the species, guild, taxa, habitat or community level, will be identified to best monitor that "system" at the relevant ecological scale. Implementation of this WDCP also involves monitoring at a variety of geographic scales, including local, state, regional, national, and international, according to the suitability and recommendation of relevant partners' plans and programs. For example, the PARC recommends herpetofaunal monitoring with standardized protocols for the northeast and southeast regions, similar to USFWS and Partners In Flight BCRs and other regional, national and international bird conservation plans. As a result, Maryland's monitoring strategy will use the standardized regional protocols for reptile and amphibian monitoring in order to place Maryland's populations in the appropriate context. Other standardized monitoring protocols, such as those of the Breeding Bird Survey, International Shorebird Survey, North American Bat Conservation Partnership Strategic Plan, and American Fisheries Society, will be utilized wherever appropriate so that Maryland's data will be compatible with regional and national conservation efforts.

The MD DNR Monitoring and Non-Tidal Assessment Division (MANTA) has three interactive programs (Atmospheric Deposition, Ecological Assessments, and Monitoring) that assess the status and trends of biological communities in the state's non-tidal, freshwater rivers and streams (http://www.dnr.state.md.us/streams/pubs/pub_list.html). As a result, MD DNR already has a mechanism to monitor freshwater aquatic communities. The MBSS conducts comprehensive biological and chemical monitoring of freshwater streams and rivers throughout the state and publishes reports on their health (e.g., Boward et al. 1999), allowing MD DNR to monitor GCN species that occur in those environments. The MD DNR NHP tracks hundreds of species and natural communities, maintaining a detailed database on their abundance and distribution and providing MD DNR with an existing mechanism to monitor the status and trends of many GCN species and key wildlife habitats. Monitoring programs for certain species and taxa groups, such as puritan and northeastern beach tiger beetles, bog turtle, marshbirds, and colonial waterbirds, are ongoing, as are other monitoring programs within WHS, including mid-winter waterfowl surveys.

Implementation of the WDCP strategy will rely heavily on the existing monitoring projects and programs conducted by MD DNR partners. Dozens of community groups of volunteers participate in watershed-based water quality and stream monitoring, and the Maryland Water Monitoring Council serves as an umbrella organization for 14 of these groups. The MBSS program has created a guidance manual to educate volunteer stream monitors, creating a standardized system for data gathering (MD DNR 2000a). Appendix 5 shows the intensive and extensive level of ongoing monitoring efforts for water quality and stream and river habitats.

The USFWS, U.S. EPA, USGS, NPS, National Oceanic and Atmospheric Administration (NOAA) and Department of Defense (U.S. Army, U.S. Navy, U.S. Army Corps of Engineers) also monitor various fish and wildlife resources and their habitats in Maryland. The USFWS monitors migratory bird populations, federal endangered species, non-native invasive species such as nutria, wildlife on its several National Wildlife Refuges in Maryland, and the Chesapeake Bay ecosystem in cooperation with its partners like EPA. The USGS has a research center at Patuxent with long-term monitoring programs for amphibians, birds, wildlife diseases, and water quality and quantity parameters. NPS monitors the habitats and wildlife resources of Assateague Island National Seashore, Chesapeake & Ohio Canal National Historical Park, and other NPS properties in the state. NOAA assesses the status and trends of many fisheries resources and the habitats at the Chesapeake Bay National Estuarine Research Reserve. The U.S. Army monitors fish, wildlife, and submerged aquatic vegetation habitats at its Aberdeen Proving Ground. The U.S. Army Corps of Engineers has comprehensive ecological monitoring programs for its island restoration projects in the Chesapeake Bay. The U.S. Navy monitors birds at Patuxent Naval Air Station, Bloodsworth Island, Indian Head, and other naval properties. Several of these federal partners also work with MD DNR and others to protect and monitor the resources of the Chesapeake Bay. By coordinating with these federal partners and others, MD DNR can better implement the WDCP's monitoring framework.

Chesapeake Bay may be one of the most monitored ecosystems in the country, with a wide range of state, federal, local, regional, academic and non-governmental research and monitoring programs. Recent water quality and habitat quality monitoring data for Chesapeake Bay, the Coastal Bays and estuarine tributaries (monthly and continuous data) are available online through the state's Eyes on the Bay Monitoring Program (http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm). The Chesapeake Bay Monitoring Program, a part of the regional Chesapeake 2000 agreement, has several ecological components, which are detailed at http://www.dnr.state.md.us/bay/monitoring/index.html. The CBP maintains a clearinghouse of monitoring data on Chesapeake Bay's physical, chemical and living resources at http://www.chesapeakebay.net/monprgms.htm. Bay Program partners track more than 100 indicators of restoration progress and Bay watershed health; 89 of these use monitoring and tracking data, and the rest rely on computer modeling (CBP 2004a). The Alliance for Chesapeake Bay's Citizen Monitoring Program is a regional network of trained volunteers who track the condition of waters draining into Chesapeake Bay using weekly water quality tests throughout Maryland, Pennsylvania and Virginia (http://www.alliancechesbay.org/project.cfm?vid=87). By cooperating in such programs, MD DNR can maximize not only the monitoring data gathered but community involvement as well. Key wildlife habitats that can be monitored through this network of existing programs in Chesapeake Bay include Oligohaline Estuaries, Mesohaline Estuaries and Polyhaline Estuaries, and GCN species include shortnose sturgeon, Atlantic sturgeon, seaturtles, Northern diamond-backed terrapin, horseshoe crab, waterfowl, shorebirds, and many others.

In 2000, MD DNR was awarded a five-year grant from the EPA to create an integrated, comprehensive coastal monitoring program as part of the National Coastal Assessment initiative (also known as Coastal 2000). The objectives of the Maryland Coastal 2000 program are to assess the physical, chemical, and biological condition of the state's coastal waters using a standardized collection of environmental indicators and rank the relative importance of several stressors on these resources (http://www.dnr.state.md.us/coastalbays/water_quality/nca.html). The first year of monitoring (2000-2001) utilized 54 estuarine sites for water quality, benthic community, sediment chemistry and sediment toxicity monitoring and 20 sites for fish sampling. In the second year (2002) the program was expanded to include 124 monitoring sites. Not only can the estuarine key habitats take advantage of this existing monitoring program, but the Tidal Marsh, Tidal Shrub Wetland, and Ocean key habitats can as well.

The Comprehensive Conservation and Management Plan (CCMP) for Maryland's Coastal Bays (MD DNR 1999) formulated a detailed monitoring strategy for the Coastal Bays that builds on 70 existing monitoring projects or programs in the estuaries and their watersheds. Part of the strategy is a comprehensive Eutrophication Monitoring Plan that incorporates landscape parameters (e.g. nutrient and chemical application rates, implementation of best management practices), stressors, and the responses of biological indicator species within the bays. The Maryland Coastal Bays Program, which is within MD DNR, is the lead implementation agency for the CCMP and its monitoring program. The existing monitoring programs for Maryland's coastal bays and Chesapeake Bay are integral to the WDCP's monitoring framework for key estuarine habitats and GCN species.

Although Maryland's aquatic habitats have extensive monitoring programs already in existence, such programs are not as numerous or robust for terrestrial habitats. MD DNR has ongoing GIS-based efforts related to forest fragmentation. The Strategic Forest Lands Assessment (SFLA) summarizes the distribution of the state's forested land base and the socioeconomic characteristics of the state's forest resources (MD DNR 1999b). This includes ownership, vulnerability to conversion, and spatial distribution of existing conservation efforts. MD DNR's Green Infrastructure Assessment (GIA) uses GIS technology to identify large, ecologically valuable forests and wetlands, as well as a network of connecting corridors, for targeted, coordinated conservation and restoration at the state and local levels (MD DNR 1999b). A GIS analysis of forest loss, especially within the Green Infrastructure, between 1997 and 2000 has already been completed (Weber and Aviram 2002). MD DNR has also developed a monitoring program for species and natural communities located within the recently acquired Chesapeake Forest on the lower Eastern Shore. Further use and development of various GIS tools, as well as on the ground programs, will be critical in the implementation, evaluation and adaptive management of this WDCP.

As stated in Chapter 4, a first iteration of the GIS layers that represent the distribution of Maryland's key wildlife habitats were developed as one of the steps in the process of creating the WDCP. These layers were developed using over ten different existing data sources, and the accuracy of these key wildlife habitat data layers varies greatly, ranging from field-verified locations to predictive models. Many will need additional ground-truthing and other quality control measures and refinements to increase their accuracy. However, they can serve as a starting point or baseline measure from which to begin assessing the overall level of "conservation ownership" status. Table 5.2 shows the acreages of each key wildlife habitat in Maryland and the breakdown of ownership, provided in percentages. Insufficient data were available for Forested Seepage Wetlands to develop an acceptable GIS layer for this key wildlife habitat.

Table 5.2 Acreages and Ownership Status of Maryland's Key Wildlife Habitats.

		OWNERSHIP OF TERRESTRIAL HABITATS (percent)					
KEY WILDLIFE HABITAT	**Total Ac**	**Federal**	**State**	**Local**	**NGO**	**Easement**	**Private**
Old Growth Forests	1,679	0.4	94.9				4.7
Early Successional Forests	116,531	1.4	20.0	1.6	0.2	1.1	75.6
Maritime Forests and Shrublands	1,612	92.5	6.3				1.2
Loblolly Pine - Oak Forests	394,545	1.8	12.2	0.6	1.3	1.1	82.9
Mesic Deciduous Forests	1,282,923	0.1	1.5	0.3		0.1	98.0
Dry Oak - Pine Forests	323,203	2.8	17.3	6.9	0.4	1.0	71.5
Northern Conifer - Hardwood Forests	70,059	1.6	26.8	1.6	0.6	0.5	68.9
Floodplain Forests	212,339	5.7	8.9	3.2	2.1	1.0	79.1
Upland Depressional Swamps	59,664	1.0	11.7	0.5	2.3	0.8	83.7
Carolina Bays	175		25.1		25.2		49.7
Vernal Pools	12,466	2.8	6.4	0.7	1.1	1.1	87.9
Forested Seepage Wetlands	unknown						
Bog and Fen Wetland Complexes	6,136	0.7	11.9	0.6	11.8	0.8	74.1
Nontidal Shrub Wetlands	14,842	3.6	11.2	4.4	2.5	1.8	76.4
Tidal Shrub Wetlands	7,034	5.4	9.8	3.0	1.7	3.5	76.6
Nontidal Emergent Wetlands	18,463	9.0	7.7	4.9	1.4	1.8	75.2
Tidal Marshes	211,098	12.6	28.4	0.6	1.3	2.6	54.5
Grasslands	241,671	4.8	3.3	1.3	0.3	1.5	88.9
Barrens and Dry Glades	6,921	3.1	33.8	23.4	2.1		37.6
Cliffs and Rock Outcrops	19,723	3.6	37.5	6.6	2.7		49.6
Caves, Mines, and Springs (number of locations)	1,114	2.3	3.3	0.6	0.7	0.6	92.5
Coastal Beaches, Dunes, and Mudflats	8,600	14.7	70.9	0.1		0.4	13.9

If monitoring programs do not currently exist for a GCN species or taxa group, either the monitoring actions for closely-related species occupying those same habitats may serve as surrogates or the need for new monitoring actions have been identified (Chapter 4). Within the next two years, important new monitoring needs will be reviewed and prioritized, and alternatives for implementing new monitoring conservation actions will be developed to benefit the overall key wildlife habitat, community, and/or assemblage, including many of the other GCN species, in order to maximize limited resources and maintain practicality and efficiency. In cases where not enough information exists to monitor a GCN species or key wildlife habitat, or monitoring protocols have not yet been developed, this need is documented and followed by a research action or other conservation action to address that information need (Chapter 4). This is true for some taxa groups, such as small mammals and invertebrate groups, for which standardized protocols need to be developed and for taxa where baseline data do not exist to form the basis of a monitoring protocol. In these cases, these overarching taxa research or data needs are described in Chapter 3 under the appropriate taxa and may also be included, as appropriate, as specific Inventory, Monitoring and Research or Conservation Actions in Chapter 4 for associated key wildlife habitats.

In summary, the Conservation Actions and Inventory, Monitoring and Research sections discussed in Chapter 4 for each key wildlife habitat recommends numerous monitoring efforts, whether it be at the species, guild, taxa, or habitat or community level. The most current scientific information and expert opinion were used along with peer review, public and partner stakeholder workshop/web-site feedback, and coordination with partners to maximize effectiveness. Existing monitoring and survey systems (Appendix 5) will be utilized as the foundation from which to gain partner and stakeholder input and to identify appropriate, high priority new programs that could be developed, assuming the availablilty of sufficient funding.

Adaptive Assessment Strategy – Monitoring Effectiveness of Conservation Actions

Maryland's assessment strategy (**Element 5**) involves a long-term commitment to the success of the WDCP. Species populations that have been declining for decades may take decades to reverse and therefore decades before the results of conservation actions can be fully realized. Therefore, an effective assessment strategy incorporates the concept that many conservation actions involve different temporal scales; both short-term conservation actions (e.g., research projects), as well as the long-term strategies are necessary to effect adequate conservation of GCN species and key wildlife habitats. Furthermore, differing geographic scales need to be taken into account as well. For example, direct habitat conservation usually occurs at small geographic scales (e.g., a parcel of land is acquired); however, many GCN species still have large populations such that numerous individual conservation actions would need to occur before changes in overall population status would be detectable.

The assessment will initially rely on the results and reports from the numerous ongoing monitoring programs that are discussed above, such as the MBSS, CBP, Coastal Bays Program, and ASMFC, and in Appendix 5. Within the next two years, select results from various research and conservation activities, as outlined in Chapter 4, will be managed in an "outcome tracking" database, which will be designed and developed for this purpose. This will increase the efficiency of synthesizing and analyzing the necessary information. It is important to note that the MD DNR NHP already monitors the status and trends of the rarest terrestrial and freshwater GCN species. This commitment alone already accounts for an assessment of 60% of all GCN species. Status and trend data for additional species can be tracked by adapting the existing NHP database or by developing additional data systems, as needed, to include data on the status of all GCN species, research and survey results, and ongoing inventory and monitoring projects.

As funding allows, additional web-based data entry and/or retrieval systems could be developed for MD DNR staff, researchers, and other partners, allowing data to be more easily shared and distributed. These electronic information management mechanisms may be linked with the USGS National Biological Information Infrastructure (NBII) network and with other regional and national partners' temporal and spatial monitoring efforts (e.g., NatureServe's Central Data Systems) to facilitate information sharing at the regional and national levels.

Ongoing adaptive management to guide the commitment of limited resources will be accomplished by periodic database review and analysis to track the implementation and success of WDCP objectives, strategies, and outcomes (for more on this process, see Chapter 6). Accomplishment measures may include assessing the acres/stream miles of habitat protected or improved through various means (i.e., acquisition by or donation to a conservation-oriented agency or organization, conservation easements, restoration or enhancement), research to fill data gaps, monitoring programs, information management, funding of conservation projects, and outreach to partners and the public. Specific conservation actions may be re-prioritized based on this periodic review of the implementation status. As funding permits, new data will be collected, compiled, and entered into the appropriate databases for regular monitoring and assessment of GCN species and key wildlife habitat resources.

Specific proposed criteria to evaluate the ongoing success of the WDCP conservation actions are measurable to be most effective in evaluating the performance of actions collectively. Criteria for the measurement of successful outcomes related to long-term goals may include the following subset of outcomes provided in Table 5.1:

1. A net increase in the acreage/stream miles of key wildlife habitat conserved through acquisition, easement, restoration, enhancement and/or creation.
2. The long-term reduction in the number of GCN species across the full array of wildlife.
3. A net increase in scientific knowledge of GCN species and key wildlife habitats.
4. Successful funding of the highest priority conservation projects.
5. Successful completion of the highest priority conservation projects.
6. An increase in partner and public involvement in achieving the conservation of wildlife diversity in Maryland.
7. The reduction or removal of threats to GCN species and key wildlife habitats through avoidance, minimization and mitigation measures.

The MD DNR NHP will coordinate a bi-annual review of the current status of the rarest GCN species. Database information and other input, including an evaluation of the most current scientific information and coordination with scientific experts, will guide decisions on potential changes needed in either conservation status ranks (i.e., S-ranks) or in the legal state protection status. Recommendations will be compiled for review and broader input by other agencies and the public.

In addition to these measurable criteria, the ability of the conservation actions to effectively address the needs of the fish and wildlife resources of Maryland will be monitored qualitatively. An improvement in the coordination of similar monitoring projects conducted by disparate sources would be one such qualitative measure. Coordination of all the avian monitoring projects, for example, through regional resources such as the ACJV Plan and BCRs, would enhance the efficiency of each project. This would lead to a qualitative improvement towards successfully implementing the WDCP goals and objectives for avifauna. Other qualitative measures for monitoring success may include the increased involvement of MD DNR in other statewide or regional conservation initiatives and the incorporation of MD DNR developed wildlife-focused habitat management guidelines into existing land use and planning efforts. By utilizing both quantitative and qualitative success criteria, the MD DNR will be responsive to the diverse nature, scope, and scale of the WDCP conservation actions. MD DNR will, with its partners, periodically review and reevaluate conservation actions and employ adaptive measures to keep the WDCP a dynamic process on track with the specific, current needs of Maryland's GCN species and their key wildlife habitats.

This chapter provided information pertinent to **Element #5** regarding the establishment of a monitoring framework. It presented an overview of some of the more extensive monitoring programs currently in place within Maryland and listed specific objectives and timelines for expanding MD DNR’s capacity to measure and track outcomes. Monitoring the progress of implementation and the success of conservation actions and of research and survey efforts will be critical for the necessary review and revision of the WDCP (**Element #6**), as discussed in the next chapter.

Chapter 6: Plan Implementation, Revision, and Coordination

This Chapter presents information that pertains primarily to the final three required Elements of the Plan:

1. Maryland's review and revision of WDCP within the 10-year implementation cycle (**Element #6**);
2. A description of the coordination with federal, state, and local agencies, and Indian tribes, that will be used throughout the implementation, review, and revision phases of this WDCP (**Element #7**); and
3. A description of the broad public participation that will be used throughout the implementation, review, and revision phases of this WDCP (**Element #8**).

Appendix 6a describes the WDCP development plan and process schedule. Appendix 6b lists over 300 partner and stakeholder groups that were invited to participate in the development of the WDCP (**Element #8**). Appendix 6c provides the details of coordination with federal, state, and local agencies and Indian Tribes during the development of the WDCP (**Element #7**). Appendix 6d outlines the public participation process, and Appendix 6e summarizes the outreach techniques used to maintain partner, stakeholder, and public involvement during the development of the WDCP (**Element #8**).

Plan Review and Revision

Many government plans end up collecting dust, unread and unremembered after the initial energy of plan development is spent. WDCP is designed and expected to be a living document. During the plan's implementation, MD DNR will review, evaluate and update progress on conservation actions, research, surveys, and monitoring on a periodic basis, most likely annually or as projects are completed. This will provide information for dissemination to internal and external partners. An outcome of the adaptive assessment strategy (**Element 5**) described in Chapter 5, the results of these reviews may frequently indicate that minor modifications in conservations actions are required. However, if the results indicate that a major change may be required due to significant changes in the status or condition of GCN species or key wildlife habitats, such as those affecting an entire guild, taxa group, or key wildlife habitat, a revision of the WDCP would be warranted. MD DNR WHS is the responsible party for implementing the review and evaluation process (**Element 6**).

In addition to the ongoing input into databases and GIS datasets and the evaluative reviews described above for adaptive assessment of conservation progress, MD DNR will work with its Wildlife Diversity Advisory Committee (WDAC) to perform a general overview and review of the WDCP in 2010. WDAC is a panel created by MD DNR and consisting of nine members who represent various aspects of the scientific and conservation community in Maryland. This review will assess the overarching threats and will look for any new landscape-scale or significant local issues that need to be addressed. It may also make recommendations to modify the overarching conservation actions or the specific actions provided in Chapter 4 within the appropriate key wildlife habitats based on these newly evaluated threats. At any time throughout the implementation cycle that significant changes to WDCP are warranted, MD DNR will seek broader input and comment from other agencies and the public, as described later in this chapter.

MD DNR will coordinate and complete a comprehensive revision of this WDCP by October 2015 (**Element 6**). To adequately prepare for this 10-year revision, periodic scientific reviews will have been performed to allow for re-evaluation of the status of species, habitats, and their threats, as well as the effectiveness of the actions to date. The results of these meetings and scientific updates will be incorporated into future reviews and revisions of this document, as appropriate. Committing to such significant coordination efforts indicates that MD DNR will continue to involve its many conservation partners and interested stakeholders in the WDCP progress. This will help ensure that the WDCP will be a living, dynamic document and that each revision includes the most current scientific and administrative information for the key conservation partners in the state and institutionalizes these important coordination and revision efforts.

In the interim, MD DNR will utilize both short and long-term iterative, existing mechanisms and processes with built-in review and evaluation to maximize opportunities for both internal and external implementation. Each division and program has a set operational timeframe for program evaluation and reporting. For example, the existing USFWS process requires annual reporting and review with 5-year AFA work plans and evaluations. The WHS, as well as most other MD DNR agency programs, have annual reporting requirements from their granting federal or other funding source. Annual or project-end results that indicate any changes or new information, including information from periodic review by the technical experts, will be assessed for adaptive management purposes and eventual plan revision.

An important outcome of this plan will result from the GCN species, key wildlife habitats, and priority conservation strategies being actively integrated into the revision processes of MD DNR’s plans and of its many partners’ plans and programs. This integration effort alone produces the ripple effect for conservation efforts across the state, providing a consistent and unified approach for conservation of Maryland’s wildlife and habitats. Incorporation of GCN species and key wildlife habitats across all MD DNR programs and plans will provide a focus for conservation targets for land acquisition and other conservation efforts. Integration of these GCN species and key wildlife habitats into the plans and programs of local, state and federal partner agencies will facilitate implementation of these actions by both private and public partners.

With the completion of annual progress reports to the USFWS Federal Aid office, an iterative, adaptive process will include the incorporation of the results of research, monitoring and survey efforts that provide for refinement of the priorities and actions of this plan. Each revision of this WDCP document and the planning documents of conservation partners should reciprocally integrate the updates of partners’ plans.

Coordination with Federal, State and Local Agencies and Indian Tribes

The MD DNR took the lead in coordinating Maryland's WDCP, beginning its process in early 2003 as information on the SWG and WCRP requirements and guidelines became available. Appendix 6b lists more than 300 stakeholders and partners that were contacted and invited to workshops during this effort. Development of the WDCP was coordinated with key federal, state and local agencies and Indian tribes (**Element 7**) as described in Appendix 6c.

Many of the programs presented in this WDCP (Appendices 4b and 5) are ongoing, and the coordination among various governmental agencies that is necessary for them to be successful will continue. As new projects related to specific actions within this WDCP are implemented, agency partners will be solicited for input and feedback via electronic correspondence and phone conversations, invited to meetings and workshops, and requested to provide review of draft versions of reports and articles, as appropriate. Key federal partners include, but are not limited to, the U.S. Fish and Wildlife Service (Chesapeake Bay Field Office, National Wildlife Refuge Offices, Fishery Resources Office, and Federal Aid); USGS; NPS; NRCS; U.S. EPA; USDA; National Oceanic and Atmospheric Administration; and the Department of Defense. To enhance implementation and coordination, it is anticipated that many federal partners will begin to incorporate the conservation of GCN species and key wildlife habitat conservation targets into their programs and plans, as appropriate.

Similarly, the coordination necessary for the successful implementation of ongoing state and local level projects will continue. As new projects related to specific actions within this WDCP are implemented, state and local agency partners will be solicited for input and feedback via electronic correspondence and phone conversations, invited to meetings and workshops, and requested to provide review of draft versions of reports and articles, as appropriate. MD DNR's key partner agencies at the state level include, but are not limited to, Department of the Environment, Department of Agriculture, Department of Planning, Department of Transportation (SHA), University of Maryland and major state universities, and the Maryland National Guard. Key partners at the local government level include the planning and zoning agencies within each of Maryland's 23 counties, as well as Baltimore City. Coordination at the local level includes contact with county staff related to environmental protection and resource management. Maryland has more than 150 municipalities and coordination at this level is frequently accomplished through the county agencies or via the Department of Planning. The Maryland-National Capital Park and Planning Commission is also a regional-level agency that develops and operates public park systems and provides land use planning for the great majority of both Montgomery and Prince Georges Counties.

There are no federally recognized Indian tribes in Maryland today. Non-federally recognized Indian tribes and communities include the Piscataway-Conoy Confederacy in La Plata, Maryland, with the American Indian Cultural Center of Cedarville Band in Waldorf, Maryland. They were contacted, invited to participate in the WDCP process, and invited to review the draft material on the website.

The MD DNR WHS will continue to lead in monitoring the progress of the WDCP implementation, and will communicate this information with the network of agency partners involved in the development of the plan. Periodic interagency informational and input meetings will be held, as warranted, to continue coordination efforts with these agencies in the implementation, review and revision of the WDCP.

Broad Public Participation

In addition to the coordination with key federal, state and local agencies and Indian tribes, MD DNR utilized an assortment of outreach techniques (Appendix 6e) to encourage broad public participation in every stage of WDCP development (**Element 8**). Appendix 6d provides detailed information on the public participation process used to engage all interested members of the public.

For the purposes of this WDCP effort, the "public" was categorized into 3 external tiers:

Tier 1: private/NGO partners and collaborators with a significant role/program
Tier 2: interested NGO's and individuals with a more limited role/program
Tier 3: the general public

The WDCP mailing list was compiled using numerous sources as an initial stage in the development of this WDCP. The list includes about 500 Tier 1 and Tier 2 entities, of which roughly 300 are partner and stakeholder groups (Appendix 6b) and the remaining 200 are individual partners and stakeholders, including researchers, educators, and experts, as well as citizens that are more actively involved and interested in some aspect of wildlife conservation. One of the primary sources of this list was the Maryland Teaming With Wildlife Coalition's list of member participants. The WDCP mailing list was compiled to contact and invite a large portion of Maryland's "affected" public to workshops. During the implementation phase of the WDCP, this mailing list will be updated and kept current as new NGO's form, as existing organizations change their contact information, and as partnerships with additional individuals develop. Because it is a dynamic list, it will continue to be used to invite stakeholders to future workshops that will be held in conjunction with major reviews and revisions of the WDCP.

As is outlined in Appendix 6e for the development of the WDCP, MD DNR will continue to focus its public participation efforts at those stakeholders and partners within Tier 1, while at the same time providing an appropriate level of participation and input opportunities to Tier 2 groups/citizens and the general public (Tier 3). Information about the implementation of the WDCP, including project reports, monitoring results, and review cycles will be shared with partners and the public through various means, such as updates to the MD DNR website, articles, and press releases (Appendix 6e). Inclusion of updates in partner (Appendix 6b) newsletters and outreach efforts will also be encouraged. As in the development process for the WDCP, stakeholders will be invited to provide input and feedback on future plan revisions.

Some of the Tier 1 NGO partners that are involved currently in assisting or implementing conservation actions and research, monitoring, and survey projects with MD DNR NHP include TNC, NatureServe, National Audubon Society, Environmental Defense, and the Maryland Ornithological Society. Numerous other organizations are currently assisting other MD DNR units with implementation of a wide array of conservation and monitoring programs (Appendices 4b and 5).

Some public participants belong to groups that, while having limited staff/capacity to provide scientific data that is directly applicable to the implementation of the WDCP, have a potential role in outreach, general input, and advocacy for the implementation and continued adaptive management of the WDCP (Tier 2). The remainder of Maryland's citizens (Tier 3), while not as actively or directly involved, will benefit from the implementation of the WDCP as related to recreational, quality of life, and economic benefits from effective statewide wildlife diversity conservation.

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Acronyms and Abbreviations

ACJV	Atlantic Coast Joint Venture
AFA	Application for Federal Assistance
AFS	American Fisheries Society
AP	Allegheny Plateau
ASMFC	Atlantic States Marine Fisheries Council
ATV	All Terrain Vehicle
AWRC	Anacostia Watershed Restoration Committee
BEST	Biomonitoring of Environmental Status and Trends
BCC	Birds of Conservation Concern
BCC-NE	Birds of Conservation Concern for Region 5 - Northeast
BCI	Bat Conservation International
BCR	Bird Conservation Regions
BLM	Bureau of Land Management
BLP	Bleiker Life Preserver
CAPS	Cooperative Agricultural Pest Survey
CBE	Committee for a Better Environment
CBP	Chesapeake Bay Program
CCMP	Comprehensive Conservation and Management Plan
CELCP	Coastal and Estuarine Land Conservation Plan
CITES	Convention on International Trade in Endangered Species
COMAR	Code Of Maryland Regulations
CPO	Citizen Participation by Objective
CREP	Conservation Reserve Enhancement Program
DAF	Depleted Anadromous Fish
DOI	Department of Interior
DNR	Department of Natural Resources
EAC	Environmental Advisory Committee
ELI	Environmental Law Institute
EO	Element Occurrences
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
FEMA	Federal Emergency Management Act
FIDS	Forest Interior Dwelling Species
FMP	Fishery Management Plan
FOMA	Friends of Mt. Aventine
FWRS	Fish and Wildlife Reference Service
GAP	Gap Analysis Program
GCN	Greatest Conservation Need
GIA	Green Infrastructure Assessment
GIS	Geographic Information System
HUC	Hydrologic Unit Code

IAFWA	International Association of Fish and Wildlife Agencies
IBA	Important Bird Areas
ICPRB	Interstate Commission on the Potomac River Basin
IUCN	International Union for the Conservation of Nature
LCP	Lower Coastal Plain
LTER	Long-term Ecological Research
MAFMC	Mid-Atlantic Fishery Management Council
MANTA	Monitoring and Non Tidal Assessment Division
MANEM	Mid-Atlantic / New England / Maritimes
MBSS	Maryland Biological Stream Survey
MD	Maryland
MDA	Maryland Department of Agriculture
MDE	MD Department of Environment
MDHS	Maryland’s Herpetological Society
MDN-GAP	Mid-Atlantic Gap Analysis Program
MDOT	Maryland Department of Transportation
MDP	Maryland Department of Planning
MERLIN	Maryland's Environmental Resources and Land Information Network
MGS	Maryland Geological Survey
MOS	Maryland Ornithological Society
MNBMCN	Migratory Nongame Birds of Management Concern in the Northeast
NABCI	North American Bird Conservation Initiative
NALCP	North American Landbird Conservation Plan
NASA	National Aeronautic and Space Adminstration
NASWG	North American Shorebird Working Group
NAWCA	North American Wetland Conservation Act
NAWCP	North American Waterbird Conservation Plan
NAWMP	North American Waterfowl Management Plan
NAWQA	National Water Quality Assessment
NBII	National Biological Information Infrastructure
NCDC	National Climate and Data Center
NCTC	National Conservation Training Center
NED	National Elevation Dataset
NEES & WDTC	Northeast Endangered Species and Wildlife Diversity Technical Committee
NE PARC	Northeast Partners in Amphibian and Reptile Conservation
NE_Reg	Northeast Regional Species of Concern
NGO	Non-governmental Organizations
NHD	National Hydrography Dataset
NHP	Natural Heritage Program
NLCD	National Land Cover Data
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRI	National Resources Inventory

NRCS	Natural Resource Conservation Service
NS	National Seashore
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
ORV	Off Road Vehicle
PAI	Potentially Affected Interests
PARC	Partners in Amphibian and Reptile Conservation
PD	Piedmont
PIF	Partners in Flight
RAS	Resource Assessment Service
RESI	Regional Economics Studies Institute
RV	Ridge and Valley
QC	Quality Control
SAMBI	South Atlantic Migratory Bird Initiative
SAS	Sensitive Aquatic Species
SAV	Submerged Aquatic Vegetation
SE PARC	Southeast Partners in Amphibian and Reptile Conservation
SHA	State Highway Authority
STATSGO	USDA Soil Conservation Service generalized soils data
SWG	State Wildlife Grant
TCI	Terwilliger Consulting, Inc.
TIO	Total Industrial Output
TNC	The Nature Conservancy
TWW	Teaming With Wildlife
UCP	Upper Coastal Plain
UMD AEL	University of Maryland Appalachian Environmental Lab
UMES	University of Maryland Eastern Shore
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USGS GNIS	USGS Geographic Names Information Center
USFWS	United States Fish and Wildlife Service
WCRP	Wildlife Conservation and Restoration Program
WDAC	Wildlife Diversity Advisory Committee
WDCP	Wildlife Diversity Conservation Plan
WHS NHP	Wildlife and Heritage Services Natural Heritage Program
WMA	Wildlife Management Area

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Appendix 1a. Data Sources and Resources

This appendix lists the information sources that were researched, compiled, and reviewed in order to best determine and present the status of the full array of wildlife and its conservation in Maryland (**Element #1**). A wide diversity of literature and programs was consulted and compiled through extensive research and coordination efforts. Some of these sources are included in the References section of this document, and the remaining sources are provided here as a resource for users and implementing parties of this document as well as for future revisions. Sources include published and unpublished data, reports, and correspondence from existing conservation programs and are listed in alphabetical order.

Table 1a.1. World Wide Web Information Resources Used in the Preparation of the WDCP.

Aberdeen Proving Ground, U.S. Army	http://www.apg.army.mil/apghome/sites/local/
Adkins Arboretum	http://www.adkinsarboretum.org
Alliance for the Chesapeake Bay	http://www.acb-online.org
America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation, Recommendations for a New Ocean Policy, Pew Oceans Commission 2003	http://www.pewoceans.org/oceans/index.asp
American Bird Conservancy	http://www.abcbirds.org/
American Birding Association	http://www.americanbirding.org/
American Chestnut Land Trust	http://www.acltweb.org/
American Fisheries Society	http://www.fisheries.org/html/index.shtml
Anacostia Watershed Society	http://anacostiaws.org
Animal and Plant Health Inspection Service (APHIS), USDA	http://www.aphis.usda.gov/
Anne Arundel County Volunteer Water Quality Monitoring Program	http://yosemite.epa.gov/water/volmon.nsf/0/2943e16f6b6f3b 9b8525671d006c4585?OpenDocument
Annual Chester River Watershed Snapshot, Chester Riverkeeper – Chester River Association	http://www.chesterriverassociation.org
Appalachian Clean Streams Initiative, USGS	http://mine-drainage.usgs.gov/archive/osm.html
Assateague Coastal Trust	http://www.actforbays.org/
Assateague Coastkeeper (Coastal Bays health), Assateague Coastal Trust	http://www.actforbays.org
Assateague Island geomorphology, National Park Service	http://www.nps.gov
Assateague Island National Seashore	http://www.nps.gov/asis/index.htm

Assessing The Relative Habitat Value Of Restored Versus Natural Coastal Marshes And Islands To Migratory Birds In Chesapeake Bay, USGS Patuxent Wildlife Research Center	http://www.pwrc.usgs.gov/staff/fieldstations/PWRCchar.cfm
Assessment of Spring Recreational Finfish Harvest in the Choptank River, Maryland DNR	http://www.dnr.state.md.us/fisheries
Association of Biodiversity Information	http://www.abi.org
Atlantic Seaduck Study: Movements, Habitat Use, and Feeding Ecology of Seaducks in Chesapeake Bay and Other Atlantic Coastal Areas (satellite tracking), USGS Patuxent Wildlife Research Center	http://www.pwrc.usgs.gov/resshow/perry/scoters/default.htm
Atlantic States Marine Fisheries Commission	http://www.asmfc.org/
Atmospheric deposition (rainfall and nitrogen) at Assateague Island NS, National Park Service	http://www2.nature.nps.gov/air/index.cfm
Audubon Maryland -- D.C.	http://www.audubonmddc.org/
Audubon Naturalist Society	http://www.audubonnaturalist.org/
Baltimore Ecosystem Study	http://www.beslter.org/
Baltimore Ecosystem Study – Long-term Ecological Research (LTER) project, Institute of Ecosystem Studies, National Science Foundation, U.S. Forest Service	http://www.fs.fed.us/ne/global/research/blter.html
Bat Conservation International	http://www.batcon.org/
Bay, Plain and Piedmont: A Landscape History of the Chesapeake Heartland …	http://www.chesapeakebay.net/pubs/gateways/plainandpiedmont/
Beach Water Quality Sampling Program, Worcester County	http://www.earth911.org/waterquality/default.asp?beach_id=2088&cluster=24
Biomonitoring of Environmental Status and Trends (BEST) Program (measure and assess ecological impacts of contaminants), USGS Patuxent Wildlife Research Center	http://water.usgs.gov/eap/env_data.html
Bird Banding Laboratory (banding and recovery monitoring, U.S. and Canada), USGS Patuxent Wildlife Research Center	http://www.pwrc.usgs.gov/bbl
Bird Counts, Chesapeake Bay Environmental Center	http://www.cbec-wtna.org
Bird Source, National Audubon Society & Cornell Lab of Ornithology	http://www.birds.cornell.edu

Bird-a-Thon, Irvine Nature Center	http://www.explorenature.org
Blackwater NWR	http://www.fws.gov/blackwater/
Breeding Bird Survey (U.S. and Canada), USGS Patuxent Wildlife Research Center	http://www.mbr-pwrc.usgs.gov/bbs/bbs.html
Breeding Bird Survey, Maryland Ornithological Society	http://www.mdbirds.org/sitemap.html
Bush River Watershed Management Plan, Harford County, Center for Watershed Protection (2003)	http://www.cwp.org/ws_services.htm
Butterfly Count (western Montgomery Co.), Audubon Naturalist Society	http://www.audubonnaturalist.org
Center for Watershed Protection	http://www.cwp.org/
Central Appalachian Forest Ecoregional Plan, The Nature Conservancy, Thorne et al. (2001)	http://nature.org
Chesapeake 2000: A Watershed Partnership Agreement, Chesapeake Bay Program (2000)	http://www.chesapeakebay.net
Chesapeake Bay Acid Rain Foundation	http://www.chesapeakebay.org
Chesapeake Bay Commission	http://www.chesbay.state.va.us
Chesapeake Bay Ecosystem Program, USGS	http://md.water.usgs.gov
Chesapeake Bay Environmental Center	http://www.wildfowltrust.org/about.htm
Chesapeake Bay Foundation	http://www.cbf.org
Chesapeake Bay Gateways Network	http://www.baygateways.net/
Chesapeake Bay Monitoring Program, Ecosystem Processes Component, Maryland DNR	http://www.dnr.state.md.us/bay/monitoring
Chesapeake Bay National Estuarine Research Reserve	http://www.nerrs.noaa.gov/ChesapeakeBayMD/welcome.html
Chesapeake Bay Program	http://www.chesapeakebay.net/
Chesapeake Bay Remote Sensing Program (chlorophyll), University of Maryland Center for Environmental Science, Maryland SeaGrant	http://www.mdsg.umd.edu/CB/remote_sensing.html
Chesapeake Bay Winter Dredge Survey (blue crab), Maryland DNR, Virginia Institute of Marine Sciences	http://www.vims.edu/research
Chesapeake Biological Laboratory	http://www.cbl.umces.edu/Research/ecologists/index.htm
Chesapeake Marshlands National Wildlife Refuge Complex – Draft Environmental Assessment and Comprehensive Conservation Plan	http://www.friendsofblackwater.org/ccp.html
Chester River Association	http://www.chesterriverassociation.org/

Choptank River Basin Overview, Choptank River Tributary Strategies Team, MD DNR (2003f)	http://www.dnr.state.md.us/bay/tribstrat/choptank/chop_whats_new.html
Christmas Bird Count, Audubon Society	http://www.audubon.org/bird/cbc/biblio.html
Christmas Bird Count, Audubon Society	http://www.audubon.org/bird/cbc/biblio.html
Coastal America	http://www.coastalamerica.gov
Coastal Bays Program	http://www.mdcoastalbays.org/
Coastal Bays Water Quality Monitoring Program, Maryland DNR	http://www.dnr.state.md.us/coastalbays/water_quality
Coastal LIDAR (high resolution elevation data), Maryland DNR	http://www.dnr.state.md.us/sw_index_flash.asp
Coastal States Organization	http://www.coastalstates.org/
Coastal Zone Management Program	http://www.ocrm.nos.noaa.gov/czm/
Cooperative Agricultural Pest Survey (CAPS), USDA/APHIS	http://www.caes.state.ct.us/CAPS/CAPS.htm
Cornell Lab of Ornithology	http://www.birds.cornell.edu/
Corsica River Watershed Restoration Action Strategy, Town of Centreville 2004	http://www.dnr.state.md.us/watersheds/surf/proj/cr_char.html
Critical Area Commission for Chesapeake Bay and Atlantic Coastal Bays	http://www.dnr.state.md.us/criticalarea/aboutthecommission.html
Defenders of Wildlife	http://www.defenders.org/
Description of the Ecoregions of the United States, U.S. Forest Service, Bailey (1995)	http://www.fs.fed.us/institute/ecoregions/ecoreg1_home.html
Diamondback Terrapin Project (sightings, tag/release; Assateague Is.) Assateague Coastal Trust	http://www.actforbays.org/index.html
Ducks Unlimited	http://www.ducks.org/
Eastern Neck NWR	http://easternneck.fws.gov/
Eastern Shore Land Conservancy	http://www.eslc.org
Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems, NatureServe, Comer et al. (2003)	http://www.natureserve.org/publications/usEcologicalsystems.jsp
Endangered Invertebrates: the case for greater attention to invertebrate conservation, Hoffman Black et al. (2004)	http://www.umich.edu/~esupdate/marapr2001/hoffman.htm
EPA	http://www.epa.gov/region03/index.htm
Eyes on the Bay Program	http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm
Fish Health/Disease Program,	http://www.dnr.state.md.us/sw_index_flash.asp

Maryland DNR	
Fish Monitoring Program (Otter Point Creek), Otter Point Creek – Anita C. Leight Estuary Center	http://www.dnr.state.md.us/baylinks/3.html
Fish population surveys, Trout Unlimited	http://www.tu.org/site/pp.asp?c=7dJEKTNuFmG&b=275410
FishBase	http://www.fishbase.org/search.cfm
Fisheries Statistics & Economics program, NOAA-NMFS	http://www.st.nmfs.gov/st1/fus/fus95
FISHMAP (Fishery Independent Sampling and Habitat Mapping), Maryland DNR	http://www.dnr.state.md.us/fisheries/education/flounder/flounder.html
Forest Inventory & Analysis Program, USFS	http://fia.fs.fed.us/
Forest Inventory Analysis, USDA/U.S. Forest Service	http://www.fs.fed.us
Freshwater Ecoregions of North America: A Conservation Assessment, World Wildlife Fund, Abell et al. (2000)	http://www.worldwildlife.org/science/ecoregions/delineation.cfm
Friends of Blackwater NWR	http://www.Friendsofblackwater.org
Friends of Sligo Creek	http://fosc.org/fosc.htm
Friends of the Potomac	http://wwww.potomacfriends.org
From the Mountains to the Sea: The State of Maryland's Freshwater Streams, MD DNR, EPA, Boward et al. (1999)	http://www.epa.gov/maia/html/md-streams.html
Georges Creek Watershed Restoration Action Strategies Plan, Georges Creek watershed partners, WRAS Steering Committee (2002)	http://dnrweb.dnr.state.md.us/download/bays/gcr_strategy.pdf
Governor's Office of Smart Growth	http://www.smartgrowth.state.md.us/
Grassland Birds of North America, Distribution and Trends of Breeding and Wintering Populations, USGS Patuxent Wildlife Research Center	http://www.pwrc.usgs.gov/biodiversity
Great Herring Bay Stream and Shore Survey, Maryland Save Our Streams	http://www.sidwell.edu/~env/sos.html
GreenPrint Program	http://www.dnr.state.md.us/education/growfromhere/LESSON4/ GREENPRINT/INDEX.HTM
Herpetology Monitoring Program (Otter Point Creek), Otter Point Creek – Anita C. Leight Estuary Center	http://www.dnr.state.md.us/baylinks/3.html
Herring Run Watershed Association	http://www.herringrun.org

Index of Watershed Indicators: An Overview, Environmental Protection Agency (2002)	http://www.epa.gov/iwi/iwi-overview.pdf
International Association of Fish and Wildlife Agencies (IAFWA)	http://www.iafwa.org/
Investigation of Anadromous Alosids in Chesapeake Bay, Maryland DNR	http://www.dnr.state.md.us/sw_index_flash.asp
Investigation of Maryland's Atlantic Ocean and Coastal Bay Finfish Stocks, Maryland DNR	http://www.dnr.state.md.us/sw_index_flash.asp
Investigation of Yellow Perch Stocks in Maryland, Maryland DNR	http://www.dnr.state.md.us/fisheries/recreational/articles/ypmgmnt.html
Irvine Nature Center	http://www.explorenature.org
Isle of Wight Bay Watershed Restoration Action Strategy, Worcester County 2002	http://dnrweb.dnr.state.md.us/download/bays/iow_strategy.pdf
Jones Falls Watershed Association	http://www.jonesfalls.org
LANDSAT Remote Sensing (land use/land cover), NASA, U.S. Geological Survey	http://www.usgs.gov
Liberty Reservoir Watershed Restoration Action Strategy with Carroll County, MD delete, Carroll County (2002)	http://www.dnr.state.md.us/watersheds/surf/proj/libres_sca.html
LIDAR Topographic Surveys, Assateague Island, USGS, National Park Service	http://www.usgs.gov
Little Patuxent River Watershed Restoration Action Strategy, Howard County, Howard County (2002)	http://www.dnr.state.md.us/watersheds/surf/proj/lpat_sca.html
Low Impact Development (LID) Center	http://www.lowimpactdevelopment.org/
Lower Eastern Shore Basin Overview, Lower Eastern Shore Tributary Strategies Team, MD DNR (2003g)	http://www.dnr.state.md.us/bay/tribstrat/low_east/low_east_shore.html
Lower Monocacy River Watershed Restoration Action Strategy, Frederick County (2004)	http://www.dnr.state.md.us/watersheds/surf/proj/lmon_char.html
Lower Patuxent River in Calvert County Watershed Restoration Action Strategy, Calvert County, Center for Watershed Protection (2004)	http://www.cwp.org
Lower Potomac River Basin Overview, Lower Potomac River Tributary Strategies Team, MD DNR (2003e)	http://www.dnr.state.md.us/bay/tribstrat/low_pot/low_pot.html

Lower Western Shore Basin Overview, Lower Western Tributary Strategies Team, MD DNR (2003h)	http://www.dnr.state.md.us/bay/tribstrat/low_west/lws_about.html
Magothy River Association	http://www.magothyriver.org/Who_We_Are.html
Manokin River Watershed Restoration Action Strategy, Somerset County 2002	http://dnrweb.dnr.state.md.us/download/bays/man_strategy.pdf
Marine Mammal and Sea Turtle Stranding Response program, Maryland DNR	http://www.dnr.state.md.us/fisheries/recreational/articles/marinemammal.html
Marine species strandings at Assateague Island NS, National Park Service	http://www.nps.gov
Maryland Anacostia River Basin Study (gamefish, stream barriers, benthos, water quality), Maryland DNR	http://www.dnr.state.md.us/streams/pubs/ea01-3_anacostia.pdf
Maryland Biological Stream Survey	http://www.dnr.state.md.us/streams/mbss/index.html
Maryland Biological Stream Survey (MBSS), Maryland DNR	http://www.dnr.state.md.us/streams/mbss/2002_pts.html
Maryland Bowhunter Survey, Maryland DNR	http://www.dnr.state.md.us/wildlife/gpar/index.asp
Maryland Breeding Bird Atlas 2002-2006, USGS Patuxent Wildlife Research Center	http://www.pwrc.usgs.gov/bba
Maryland Coastal Bays Ecosystem Health Assessment 2004	http://www.mdcoastalbays.org/publications2.php?subaction=showfull &id=1106242148&archive=&start_from=&ucat=24&
Maryland Coastal Program	http://www.dnr.state.md.us/bay/czm/
Maryland Coverts Project	http://www.naturalresources.umd.edu/Covert_Project.html
Maryland Dept. of Agriculture	http://www.mda.state.md.us/
Maryland Dept. of Environment	http://www.mde.state.md.us/
Maryland Dept. of Natural Resources	http://www.dnr.state.md.us/sw_index_flash.asp
Maryland Dept. of Planning	http://www.mdp.state.md.us/
Maryland Dept. of Transportation/State Highway Administration	http://www.mdot.state.md.us/
Maryland Farm Bureau	http://www.mdfarmbureau.com
Maryland Forests	http://mdforests.org
Maryland Geological Survey	http://www.mgs.md.gov/index.html
Maryland Ornithological Society	http://www.mdbirds.org/
Maryland Save Our Streams	http://www.towson.edu/gwc/gunpowder/Stream%20data%20and%20 monitoring%20sites.htm
Maryland SeaGrant	http://www.mdsg.umd.edu/
Maryland State Parks and Forests	http://www.dnr.state.md.us/mdmap.html

Maryland State Wetland Conservation Plan	http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/wetland_conservation/index.asp
Maryland Stream Waders	http://www.dnr.state.md.us/streams/mbss/mbss_volun.html
Maryland Trawl Survey, Maryland DNR	http://www.dnr.state.md.us/fisheries/education/crab/bluecrabfacts.html
Maryland Water Monitoring Council	http://www.mgs.md.gov/mwmc/
Maryland's Coastal Bays Ecosystem Health Assessment 2004, MD DNR (2004e)	http://www.dnr.state.md.us/coastalbays/sob_2004.html
Mast survey, Maryland DNR	http://www.dnr.state.md.us/wildlife/bbtfappendc.html
MD DNR Environmental Design Program	http://www.dnr.state.md.us/ed
MD DNR Natural Heritage Program	http://www.dnr.state.md.us/wildlife/nhpintro.asp
MD DNR Surf your Watershed	http://www.dnr.state.md.us/watersheds/surf/index.html
MD DNR Tributary Strategies	http://www.dnr.state.md.us/bay/tribstrat/wshd_orgs.html
MD DNR Wildlife and Heritage Service	http://www.dnr.state.md.us/wildlife/index.asp
MERLIN	http://www.mdmerlin.net/index.html
Mid-Atlantic / New England / Maritimes (MANEM) Waterbird Conservation Plan	http://www.fws.gov/birds/waterbirds/manem/habitat%20profiles.htm
Mid-Atlantic Fishery Management Council	http://www.mafmc.org/mid-atlantic/mafmc.htm
Middle Potomac River Basin Overview, Middle Potomac River Tributary Strategies Team, MD DNR (2003b)	http://www.dnr.state.md.us/bay/tribstrat/mid_pot/mid_pot.html
Midwinter Waterfowl Survey (Chesapeake Bay area), Maryland DNR, USFWS	http://www.dnr.state.md.us/dnrnews/pressrelease2005/030205.html
Montgomery County Stream Team	http://www.montgomerycountymd.gov/mc/services/dep/ education/streamteam.htm
Multi-Resolution Land Characteristics (land cover), EPA	http://www.epa.gov/mrlc
Mute Swan Aerial Surveys, Maryland DNR	http://www.dnr.state.md.us/wildlife/msfinalstrat.html
Nanticoke Watershed Alliance	http://www.nanticokeriver.org
National Aquarium in Baltimore	http://aqua.org/teachandlearn.html
National Audubon Society	http://www.audubon.org/
National Biological Information Infrastructure (NBII)	http://www.nbii.gov/

National Coastal Assessment (aka Coastal 2000) Maryland DNR, EPA	http://www.dnr.state.md.us/coastalbays/water_quality/coastal_2000.html
National Fish Habitat Initiative	http://www.fishhabitat.org
National Marine Fisheries Service	http://www.nmfs.noaa.gov/
National Ocean Service Cooperative Oxford Laboratory	http://www.chbr.noaa.gov/CooperativeOxfordLaboratory2.html
National Resources Inventory (NRI), USDA/Natural Resources Conservation Service	http://www.nrcs.usda.gov/technical/NRI
National Water Quality Assessment (NAWQA) Program USGS	http://water.usgs.gov/nawqa
National Wetlands Mitigation Action Plan	http://www.mitigationactionplan.gov/
National Wetlands Inventory Program, USFWS	http://www.personal.psu.edu/users/k/x/kxr246/5221/Project%203/project3.htm
National Wild Turkey Federation	http://www.nwtf.org/
National Wildlife Federation	http://www.nwf.org/
Native American Fish & Wildlife Society	http://www.nafws.org/
Natural Heritage Program Database (monitors non-game, endangered and rare species, habitats), Maryland DNR	http://www.dnr.state.md.us/wildlife/nhpdo.asp
Natural Resources Conservation Service	http://www.md.nrcs.usda.gov/
NatureServe	http://www.natureserve.org/
NOAA Restoration Center Programs, (oil spill and contaminant release response and restoration), NOAA	http://www.dnr.state.md.us/wildlife/mcc.asp
North American Butterfly Association	http://www.naba.org/
North Atlantic Right Whale Consortium	www.rightwhaleweb.org/
Northeast Midwest Institute	http://www.nemw.org/
Operation Clearwater (microbial water quality monitoring, Severn River), Severn River Association	http://www.severnriver.org/clear.htm
Otter Point Creek – Anita C. Leight Estuary Center	http://www.otterpointcreek.org/
Oyster population status and trends, Maryland DNR	http://www.dnr.state.md.us/coastalbays/publications/Chapter8.4.pdf
Partners in Flight	http://www.partnersinflight.org/
Patapsco / Back River Basin Overview, Patapsco-Back River Tributary Strategies Team, MD DNR (2003d)	http://www.dnr.state.md.us/bay/tribstrat/patapsco/pat_back.html
Patuxent Research Refuge, USFWS	http://www.fws.gov/patuxent/

Patuxent River Basin Overview, Patuxent River Tributary Strategies Team, MD DNR (2003c)	http://www.dnr.state.md.us/bay/tribstrat/patuxent/patuxent.html
Patuxent River Policy Plan, Patuxent River Commission 1997	http://www.mdp.state.md.us/info/patxattach/PPP-update-Q&A.pdf
Pickering Creek Audubon Center	http://www.pickeringcreek.org
Poplar Island Restoration project monitoring (water quality, fish, wildlife, SAV, ichthyoplankton, etc.), U.S. Army Corps of Engineers	http://www.nab.usace.army.mil/projects/Maryland/PoplarIsland
Potomac River Association	http://www.p-r-a.org
Potomac Riverkeeper	http://potomacriverkeeper.org
Potomac Watershed Partnership	http://potomacwatershed.net
Prince Georges County Stream Team	http://www.co.pg.md.us/government/agencyindex/der/ppd/ community/stream_teams.asp
Proceedings of the Marsh Bird Monitoring Workshop, USFWS, Ribic et al. (1999)	http://www.fws.gov
Project Owlnet, Adkins Arboretum	http://www.projectowlnet.org
Resident and Migratory Juvenile Finfish Recruitment Survey, Maryland DNR	http://www.fws.gov
Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity, The Nature Conservancy, Master et al. (1998)	http://conserveonline.org/2000/11/a/en/ws2ks2.pdf
Ruffed Grouse Society	http://www.ruffedgrousesociety.org/
Scenic Rivers Land Trust	http://www.srlt.org/
Severn River Association	http://www.severnriver.org
South River Federation	http://www.southriverfederation.org
South Riverkeeper (monitoring river condition), South River Federation	http://www.geocities.com/RainForest/Wetlands/2002
Spatial Distribution and Dynamics of Breeding Bird Species and Communities in an Urban/Suburban Landscape (bird monitoring in Washington D.C. and suburban MD), USGS Patuxent Wildlife Research Center	http://www.usgs.gov
State of the Birds: USA 2004, Audubon, Butcher (2004)	http://www.audubon.org/bird/pdf/StateOfTheBirds.pdf
State of the Maryland Coastal Bays 2004	http://www.mdcoastalbays.org/
State of the Maryland Coastal Bays 2004, MD DNR (2004d)	http://www.dnr.state.md.us/coastalbays

Statewide Fisheries Survey And Management: Investigations of Largemouth Bass Populations Inhabiting Maryland's Tidal Waters, Maryland DNR	http://www.dnr.state.md.us/sw_index_flash.asp
Status of the Bald Eagle in Maryland, Maryland DNR	http://www.dnr.state.md.us/wildlife/baldeagle.html
Stock Assessment of Selected Adult Resident and Migratory Finfish in Maryland's Chesapeake Bay, Maryland DNR	http://www.dnr.state.md.us/irc/lr.html
Stream water quality monitoring, Trout Unlimited	http://www.tu.org/site/pp.asp?c=7dJEKTNuFmG&b=275410
Striped Bass Monitoring and Research, Maryland DNR	http://www.dnr.state.md.us/fisheries/commercial/fmp.html
Submerged Aquatic Vegetation (SAV) Surveys, Virginia Institute of Marine Sciences	http://www.vims.edu/bio/sav/clamdredge
Surfrider Foundation	http://www.surfrider.org/
Survey, Inventory, and Management of Maryland's Coldwater Fishery Resource, Maryland DNR	http://www.dnr.state.md.us/streams/pubs/ea01-10_qaqc.pdf
Susquehanna River Fishery Investigations: Investigation of the Smallmouth Bass in the Susquehanna River Below Conowingo Dam, Maryland DNR	http://www.dnr.state.md.us/sw_index_flash.asp
Tagging Studies and Stock Characterization of Summer Flounder in Maryland's Coastal Waters Near Ocean City, MD, Maryland DNR	http://www.dnr.state.md.us/sw_index_flash.asp
Teaming With Wildlife	http://www.teaming.com/
Terrestrial Ecoregions of North America: A Conservation Assessment, World Wildlife Fund, Ricketts et al. (1999)	http://www.worldwildlife.org/science/ecoregions/delineation.cfm
The American Bird Conservancy Guide to the 500 Most Important Bird Areas in the United States, American Bird Conservancy, Chipley et al. (2003)	http://www.findarticles.com/p/articles/mi_qa3793/is_200407/ai_n9456728
The Breton Bay Watershed Restoration Action Strategy, St. Mary's County and the Town of Leonardtown, Center for Watershed Protection and MD DNR (2003)	http://dnrweb.dnr.state.md.us/download/bays/brbay_char.pdf

The Global 200: Priority ecoregions for global conservation, World Wildlife Fund, Olson and Dinerstein 2002	http://www.worldwildlife.org/science/pubs/annals_of_missouri.pdf
The Magothy River Index (water quality, vital habitats), Magothy River Association	http://www.magothyriver.org
The Nature Conservancy	http://nature.org/wherewework/northamerica/states/maryland/
The State of the Chesapeake Bay and its Watershed	http://www.chesapeakebay.net/SOTB04/index.cfm
The State of the Chesapeake Bay and Its Watershed: A Report to the Citizens of the Bay Region, Chesapeake Bay Program (2004a)	http://www.dartmouth.edu/~kfv/waterqualitytradingdatabase.pdf
The State of the Streams: 1995-1997 Maryland Biological Stream Survey (MBSS) Results, MD DNR, Roth et al. (1999)	http://www.dnr.state.md.us/streams/pubs/ea-03-7_changes2002.pdf
The Western Branch Watershed Restoration Action Strategy – Prince George's County and the City of Bowie, MD, Prince George's County 2004	http://www.dnr.state.md.us/watersheds/surf/proj/wras.html
The Western Branch Watershed Restoration Action Strategy Plan – City of Bowie (2004)	http://dnrweb.dnr.state.md.us/download/bays/westbr_strategy_text.pdf
The Wildlife Society	http://www.wildlife.org/
Town of Ocean City	http://www.town.ocean-city.md.us/
Trout Unlimited	http://www.tu.org/index.asp
Trust for Public Land	http://www.tpl.org/
U.S. Army Corps of Engineers, Baltimore District	http://www.nab.usace.army.mil/
U.S. Army Environmental Center	http://aec.army.mil/usaec/
U.S. Dept. of Agriculture	http://www.usda.gov/wps/portal/usdahome
U.S. Fish & Wildlife Service (USFWS)	http://www.fws.gov
U.S. Forest Service	http://www.fs.fed.us/
U.S. Geological Survey	http://www.usgs.gov
University of Maryland Center for Environmental Science	http://www.umces.edu/
Upper Choptank River Strategic Watershed Restoration Action Plan delete, Caroline and Talbot County Departments of Planning et al. (2003)	http://www.dnr.state.md.us/watersheds/wras/docs/ucr/strat/ucr_strategy.pdf
Upper Eastern Shore Basin Overview, Upper Eastern Shore Tributary Strategies Team, MD DNR (2003i)	http://www.dnr.state.md.us/bay/tribstrat/upper_east/up_east_shore.html

Upper Patuxent River Watershed Restoration Action Strategy for Anne Arundel and Prince George's Counties, MD Anne Arundel and Prince George's Counties, Anne Arundel County (2004), Prince George's County (2003)	http://www.dnr.state.md.us/watersheds/surf/proj/upat_strategy.html
Upper Potomac River Basin Overview, Upper Potomac River Tributary Strategies Team, MD DNR (2003k)	http://www.dnr.state.md.us/bay/tribstrat/upper_pot/upper_pot.html
Upper Western Shore Basin Overview, Upper Western Shore Tributary Strategies Team, MD DNR (2003j)	http://www.dnr.state.md.us/bay/tribstrat/upper_west/up_west_shore.html
USGS Patuxent Wildlife Research Center	http://www.pwrc.usgs.gov/
USGS-NPS Vegetation Mapping Program (at Assateague Island National Seashore), USGS, National Park Service	http://biology.usgs.gov/npsveg/index.html
Virginia Dept. of Game and Inland Fisheries	http://www.dgif.state.va.us/
Virginia Institute of Marine Sciences	http://www.vims.edu/
Water Quality Monitoring (Potomac River), Potomac Riverkeeper	http://www.potomacriverkeeper.org
Watershed Restoration Action Strategies Program	http://www.dnr.state.md.us/watersheds/wras/
West Nile Virus Surveillance, USGS, MD Dept. of Health and Mental Hygiene	http://westnilevirus.nbii.gov/states/maryland.html
Wild Turkey and Upland Game Bird Program (turkey, ruffed grouse, bobwhite quail, ring-necked pheasants populations), Maryland DNR	http://www.dnr.state.md.us/wildlife/gpar/gpupland.asp
Worcester County	http://www.co.worcester.md.us/
World Wildlife Fund	http://www.worldwildlife.org/index.cfm

Table 1a.2. Existing Management Plans Consulted

Numerous species-focused conservation/management plans and articles in the technical literature were compiled, analyzed and hereby incorporated by reference into this WDCP plan. Each of these plans addresses the full array of wildlife found in Maryland, providing information on life history, abundance and status, distribution, threats and problems, conservation actions, monitoring, and research needs. Full citations are listed in the references.

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Interstate Fishery Management Plan for American Lobster	ASMFC (1997)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Atlantic Sturgeon	ASMFC (1998a)	X	X	X	X	X	X	X
Fishery Management Plan for Inshore Stocks of Winter Flounder	ASMFC (1998b)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Horseshoe Crab	ASMFC (1998b)	X	X	X	X	X	X	X
Atlantic Herring Fishery Management Plan	ASMFC (1999a)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Shad and River Herring	ASMFC (1999b)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for American Eel	ASMFC (2000)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Atlantic Menhaden	ASMFC (2001)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Spiny Dogfish	ASMFC (2002a)	X	X	X	X	X	X	X
Fishery Management Plan for Tautog	ASMFC (2002b)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Weakfish	ASMFC (2002c)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Interstate Fishery Management Plan for Red Drum	ASMFC (2002d)	X	X	X	X	X	X	X
Interstate Fishery Management Plan for Atlantic Striped Bass	ASMFC (2003)	X	X	X	X	X	X	X
Diamondback Terrapin Project (sightings, tag/release; Assateague Is.)	Assateague Coastal Trust		X	X	X	X	X	X
Atlantic Coast Joint Venture Strategic Plan	Atlantic Coast Joint Venture, ACJV (2004)		X	X	X	X	X	X
North American Waterfowl Management Plan 2004. Strategic Guidance: Strengthening the Biological Foundation	U.S. Fish and Wildlife Service, North American Waterfowl Management Plan, Plan Committee (ACJV 2004)	X	X	X	X	X	X	X
Chesapeake Bay Alosid (Shad and Herring) Management Plan	Chesapeake Bay Program (1989a)	X	X	X	X	X	X	X
Chesapeake Bay Striped Bass Management Plan	Chesapeake Bay Program (1989b)	X	X	X	X	X	X	X
Chesapeake Bay Weakfish and Spotted Seatrout Management Plan	Chesapeake Bay Program (1990a)	X	X	X	X	X	X	X
Chesapeake Bay Waterfowl Policy and Management Plan	Chesapeake Bay Program (1990b)	X	X	X	X	X	X	X
Chesapeake Bay Atlantic Croaker and Spot Management Plan	Chesapeake Bay Program (1991a)	X	X	X	X	X	X	X
Chesapeake Bay Summer Flounder Fishery Management Plan	Chesapeake Bay Program (1991b)	X	X	X	X	X	X	X
Chesapeake Bay Red Drum Management Plan	Chesapeake Bay Program (1993a)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Chesapeake Bay Black Drum Management Plan	Chesapeake Bay Program (1993b)	X	X	X	X	X	X	X
Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan	Chesapeake Bay Program (1994a)	X	X	X	X	X	X	X
Aquatic Reef Habitat Management Plan	Chesapeake Bay Program (1994b)		X	X	X	X	X	X
Chesapeake Bay and Atlantic Coast Black Sea Bass Management Plan	Chesapeake Bay Program (1996a)	X	X	X	X	X	X	X
Chesapeake Bay Blue Crab Fishery Management Plan	Chesapeake Bay Program (1997)	X	X	X	X	X	X	X
Tautog Fishery Management Plan	Chesapeake Bay Program (1998)	X	X	X	X	X	X	X
Chesapeake Bay Oyster Management Plan	Chesapeake Bay Program (2004b)	X	X	X	X	X	X	X
American Eel Fishery Management Plan	Chesapeake Bay Program, (1987)	X	X	X	X	X	X	X
Chesapeake Bay and Atlantic Coast Horseshoe Crab Fishery Management Plan	Chesapeake Bay Program, Butowski (1994)	X	X	X	X	X	X	X
Ducks Unlimited's conservation plan: Meeting the annual life cycle needs of North America's waterfowl	Ducks Unlimited (2001)	X	X	X	X	X	X	X
Reptiles in Decline: The Global Decline of Reptiles, Déjà Vu Amphibians	Gibbons et al. (2000)	X	X	X	X	X	X	X
Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan	MAFMC (1983)	X	X	X	X	X	X	X
Bluefish Fishery Management Plan	MAFMC (1984)	X	X	X	X	X	X	X
Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan	MAFMC (1988)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Monkfish Fishery Management Plan	MAFMC (1999)	X	X	X	X	X	X	X
Tilefish Fishery Management Plan	MAFMC (2000)	X	X	X	X	X	X	X
Spiny Dogfish Fishery Management Plan	MAFMC and NEFMC (1999)	X	X	X	X	X	X	X
United States Shorebird Conservation Plan	Manomet Center for Conservation Sciences, Brown et al. (2001)	X	X	X	X	X	X	X
Mosquito Control Program (wildlife disease monitoring)	Maryland Dept. of Agriculture	X	X	X	X	X	X	X
Forest Pest Management program (Asian longhorned beetle, gypsy moth, et al.)	Maryland Dept. of Agriculture	X	X	X	X	X	X	X
Plant Protection and Weed Management program (noxious weeds, plant pests, ginseng, sudden oak death)	Maryland Dept. of Agriculture	X	X	X	X	X	X	X
American and Hickory Shad Restoration in Three MD Rivers	Maryland DNR (CBP 1989a)	X	X	X	X	X	X	X
Fall and Winter (Fish) Stock Assessment	Maryland DNR (unpubl. rep.)	X	X	X	X	X	X	X
Striped Bass Monitoring and Research (fishing mortality, spawning stocks, juveniles, hatchery introductions, tag recovery, abundance and distribution, contaminants)	Maryland DNR (CBP 1989b)	X	X	X	X	X	X	X
Survey, Inventory, and Management of Maryland's Coldwater Fishery Resource (for 11 streams, 10 river basins)	Maryland DNR (unpubl. rep.)	X	X	X	X	X	X	X
Upper Chesapeake Bay Largemouth Bass Management Program	Maryland DNR (unpubl. rep.)	X	X	X	X	X	X	X
Deer Management Program (population status	Maryland DNR (1998)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
and trends, white-tailed and sika deer)								
Black Bear Management Program (population status and trends, mortality, radio telemetry, public opinion)	Maryland DNR (2004a)	X	X	X	X	X	X	X
Furbearer Management Program (furbearer species)	Maryland DNR (unpubl. rep.)	X	X	X	X	X	X	X
Marine Mammal and Sea Turtle Stranding Response program	Maryland DNR, Litwiler (2001)	X	X	X	X	X	X	X
The Distribution and Status of the Hellbender in Maryland [FWRS 1979, 1983]	Maryland DNR (unpubl. rep.)	X	X	X	X	X	X	X
Eastern Tiger Salamander Study (distribution, population status) [FWRS 1979]	Maryland DNR (unpubl. rep.)	X	X	X	X	X	X	X
Charting the course for deer management in Maryland: A management plan for white-tailed deer in Maryland	MD DNR (1998)	X	X	X	X	X	X	X
Black bear management plan 2004 - 2013	MD DNR (2004a)	X	X	X	X	X	X	X
Maryland Coastal and Estuarine Land Conservation Plan (DRAFT)	MD DNR, Burke et al. (2004)				X	X	X	X
Conservation Plan for Sea Turtles, Marine Mammals, and the Shortnose Sturgeon in Maryland	MD DNR, Litwiler (2001)	X	X	X	X	X	X	X
Maryland's Green Infrastructure Assessment: A Comprehensive Strategy for Land Conservation and Restoration	MD DNR, Weber (2003)		X	X	X	X	X	X
Best development practices: Conserving pool-breeding amphibians in residential and	Metropolitan Conservation Alliance, Calhoun and Klemens	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
commercial developments in the northeastern United States	(2002)							
Atlantic Surfclam and Ocean Quahog Fishery Management Plan	Mid-Atlantic Fishery Management Council (MAFMC 1977)	X	X	X	X	X	X	X
Recovery Plan for the Humpback Whale *(Megaptera novaeangliae)*	National Marine Fisheries Service (NMFS 1991a)	X	X	X	X	X	X	X
Piping Plover Breeding Biology, Foraging Ecology and Behavior on Assateague Island NS	National Park Service (Kumer 2004)	X	X	X	X	X	X	X
Recovery Plan for the Northern Right Whale *(Eubalaena glacialis)*	NMFS (1991b)	X	X	X	X	X	X	X
Recovery plan for the blue whale *(Balaenoptera musculus)*	NMFS (1998a)	X	X	X	X	X	X	X
Recovery Plan for the Shortnose Sturgeon *(Acipenser brevirostrum)*	NMFS (1998b)	X	X	X	X	X	X	X
Draft Recovery Plan for the Fin Whale *(Balaenoptera Physalus)* and Sei Whale *(Balaenoptera Borealis)*	NMFS (1998c)	X	X	X	X	X	X	X
Final Amendment 1 to the Fishery Management Plan for Atlantic Tunas, Swordfish and Sharks	NMFS (2003a)	X	X	X	X	X	X	X
Recovery Plan for the North Atlantic Right Whale *(Eubalaena glacialis)* - DRAFT Revision	NMFS (2003b)	X	X	X	X	X	X	X
Fishery Management Plan for Atlantic Tunas,	NMFS (2003c)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Swordfish and Sharks								
Recovery Plan for U.S. Population of Atlantic Green Turtle	NMFS and USFWS (1991a)	X	X	X	X	X	X	X
Recovery Plan for U.S. Population of Loggerhead Turtle	NMFS and USFWS (1991b)	X	X	X	X	X	X	X
Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico	NMFS and USFWS (1992a)	X	X	X	X	X	X	X
Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico	NMFS and USFWS (1993)	X	X	X	X	X	X	X
Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Water	NOAA, Fonseca et al. (1998)	X	X	X	X	X	X	X
North American Bird Conservation Initiative Strategic Plan	North American Bird Conservation Initiative (1999)	X	X	X	X	X	X	X
North American grouse management plan – DRAFT	North American Grouse Partnership (2004)	X	X	X	X	X	X	X
Northern Atlantic Regional Shorebird Plan	Northern Atlantic Shorebird Habitat Working Group, Clark and Niles (2000)	X	X	X	X	X	X	X
PARC Habitat Management Guidelines: a National Update and Regional Status Report	PARC (2004)	X	X	X	X	X	X	X
Conserving Amphibians and Reptiles in the New Millennium	PARC, Gibbons and Stangel (1999)	X	X	X	X	X	X	X
Partners in Flight Landbird Conservation Plan: Physiographic Area 10: Mid-Atlantic	Partners in Flight, Kearney (2003)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Piedmont								
Partners in Flight North American Landbird Conservation Plan	Partners in Flight, Rich et al. (2004)	X	X	X	X	X	X	X
Partners In Flight Landbird Conservation Plan, Physiographic Area 12: Mid-Atlantic Ridge and Valley	Partners in Flight, Rosenberg (2003)	X	X	X	X	X	X	X
Partners In Flight Continental Priorities and Objectives Defined at the State and Bird Conservation Region Levels: Maryland	Partners in Flight, Rosenberg (2004)	X	X	X	X	X	X	X
Partners In Flight Landbird Conservation Plan, Physiographic Area 44: Mid-Atlantic Coastal Plain	Partners in Flight, Watts (1999)	X	X	X	X	X	X	X
The South Atlantic Migratory Bird Initiative Implementation Plan: An Integrated Approach to Conservation of "All Birds Across All Habitats" DRAFT	SAMBI, Watson and McWilliams (2004)	X	X	X	X	X	X	X
The Northern Bobwhite Conservation Initiative	Southeastern Association of Fish and Wildlife Agencies, Dimmick et al. (2002)	X	X	X	X	X	X	X
Priorities for Conservation: 1996 Annual Report Card for U.S. Plant and Animal Species	The Nature Conservancy (1996)	X	X	X	X	X	X	X
Lower New England – Northern Piedmont Ecoregional Conservation Plan	The Nature Conservancy, Barbour et al. (2003)		X	X	X	X	X	X
Chesapeake Bay Lowlands Ecoregional Conservation Plan	The Nature Conservancy, Samson et al. (2003)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
The North American Bird Conservation Initiative in the United States: A Vision of American Bird Conservation	U.S. North American Bird Conservation Initiative Committee (2000)	X	X	X	X	X	X	X
Bog Turtle *(Clemmys muhlenbergii)*, Northern Population, Recovery Plan	USFWS (2001	X	X	X	X	X	X	X
Eastern Cougar *(Puma concolor)* Recovery Plan	USFWS (1982a)	X	X	X	X	X	X	X
Revised Maryland Darter *(Etheostoma sellare)* Recovery Plan	USFWS (1985)	X	X	X	X	X	X	X
Dwarf Wedge Mussel *(Alasmidonta heterodon)* Recovery Plan	USFWS (1993a)	X	X	X	X	X	X	X
Puritan Tiger Beetle *(Cicindela puritana G. Horn)* Recovery Plan	USFWS (1993b)	X	X	X	X	X	X	X
Delmarva Fox Squirrel *(Sciurus niger cinereus)* Recovery Plan	USFWS (1993c)	X	X	X	X	X	X	X
Northeastern Beach Tiger Beetle *(Cicindela Dorsalis Dorsalis Say)* Recovery Plan	USFWS (1994)	X	X	X	X	X	X	X
American Woodcock Management Plan	USFWS (1996a)	X	X	X	X	X	X	X
Piping Plover *(Charadrius melodus)*, Atlantic Coast Population, Revised Recovery Plan	USFWS (1996b)	X	X	X	X	X	X	X
Agency Draft Indiana Bat *(Myotis sodalis)* Revised Recovery Plan	USFWS (1999b)	X	X	X	X	X	X	X
A Blueprint for the Future of Migratory Birds - Draft Strategic Plan	USFWS (2003a)	X	X	X	X	X	X	X
Recovery plan for the red-cockaded woodpecker *(Picoides borealis)*	USFWS (2003b)	X	X	X	X	X	X	X

Title	Author/Source	Life History	Abundance and Status	Distribution	Threats	Conservation Actions	Monitoring	Research Needs
Recovery Plan for the Kemp's Ridley Sea Turtle *(Lepidochelys kempii)*	NMFS and USFWS (1992b)	X	X	X	X	X	X	X
Southeastern Coastal Plains and Caribbean Regional Shorebird Plan	USFWS, Hunter (2003)	X	X	X	X	X	X	X
Expanding the Vision: 1998 Update, North American Waterfowl Management Plan	USFWS, SEMARNAP Mexico, and Canadian Wildlife Service, USFWS (1999a)	X	X	X	X	X	X	X
Canvasback population, mortality and life history in Chesapeake Bay	USGS Patuxent Wildlife Research Center (unpubl. rep.)	X	X	X	X			
Waterbird Conservation for the Americas: The North America Waterbird Conservation Plan	Waterbird Conservation for the Americas, Kushlan et al. (2002)	X	X	X	X	X	X	X
Shorebird Management Manual	Western Hemisphere Shorebird Reserve Network, Helmers (1992)	X	X	X	X	X	X	X

Appendix 1b. Compilation of Threats

This appendix lists the threats identified from a review of existing, relevant local, state, regional, national and international conservation plans (Appendix 1a) compiled for this WDCP effort (**Element #3**). The table identifies detailed threats to Maryland watersheds (listed in alphabetical order), and the matrices represent the final condensation of a compilation that was then used as a foundation from which the MD DNR and its partners began the development of conservation actions to address these threats. The matrices list existing threats and the categories of key wildlife habitats to which they apply for each broad habitat grouping – Forested, Non-Forested, Wetland, and Marine.

Table 1b.1. Threats to Maryland Watersheds

Watershed: **Aberdeen Proving Ground** 02130705

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	4	2	5	5	1	4	3

Habitat Alteration	Channelization	2	2	3	3	2	1	1
Habitat Alteration	Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration	Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration	Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration	Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration	Sedimentation	1	3	3	4	3	1	1
Habitat Alteration	Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration	Wetland Loss	1	3	3	4	2	1	1
Non-natives	Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives	Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Anacostia River** 02140205

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	5	3	3	4	3	2	4
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	4	3	3	4	2	2	3
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Antietam Creek** 02140502

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Assawoman Bay** 02130102

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Atkisson Reservoir** 02130703

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Back Creek** 02130604

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Back River** 02130901

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	5	3	3	4	2	2	4
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Baltimore Harbor** 02130903

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	5	3	3	4	3	2	4
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	5	3	3	4	2	2	4
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Big Annemessex River** 02130207

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Big Elk Creek** 02130606

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Bird River** 02130803

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Bodkin Creek** 02130902

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Bohemia River** 02130602

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Breton Bay** 02140104

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Brighton Dam** 02131108

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Broad Creek** 02120205

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Bush River** 02130701

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Bynum Run** 02130704

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Cabin John Creek** 02140207

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	4	3	3	4	2	2	3
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Casselman River** 05020204

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	4	1	5	5	1	4	3
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Catoctin Creek** 02140305

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	5	3	3	4	3	2	4
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Chincoteague Bay** 02130106

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	1	2	2	3	2	1	1

Watershed: **Christina River** 02130607

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	0	3	3	4	2	0	0
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Conewago Creek** 02050301

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Conococheague Creek** 02140504

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Conowingo Dam Susq R** 02120204

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Corsica River** 02130507

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Deep Creek Lake** 05020203

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	4	1	5	5	1	4	3
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Deer Creek** 02120202

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Dividing Creek** 02130204

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Double Pipe Creek** 02140304

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Eastern Bay** 02130501

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Evitts Creek** 02141002

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Fifteen Mile Creek** 02140511

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	5	3	3	4	3	2	4
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Fishing Bay** 02130307

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Furnace Bay** 02130609

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Dep osition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Georges Creek** 02141004

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	4	1	5	5	1	4	3
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Gilbert Swamp** 02140107

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Gunpowder River** 02130801

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Gwynns Falls** 02130905

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	5	3	3	4	2	2	4
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Honga River** 02130401

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Isle of Wight Bay** 02130103

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	1	2	2	3	2	1	1

Watershed: **Jones Falls** 02130904

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	5	3	3	4	2	2	4
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Kent Island Bay** 02130511

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Kent Narrows** 02130504

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **L Susquehanna River** 02120201

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Langford Creek** 02130506

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Liberty Reservoir** 02130907

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	5	3	3	4	3	2	4
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Licking Creek** 02140506

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Little Choptank** 02130402

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	5	3	3	4	2	2	4
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Little Conococheague** 02140505

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Little Elk Creek** 02130605

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Little Gunpowder Falls** 02130804

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Little Patuxent River** 02131105

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	3	2	2	3	3	1	2
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Little Tonoloway Creek** 02140509

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Little Youghiogheny R** 05020202

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Loch Raven Reservoir** 02130805

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Lower Chester River** 02130505

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	3	2	2	3	3	1	2
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	5	3	2	3	2	2	3
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Lower Choptank** 02130403

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Lower Elk River** 02130601

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Lower Gunpowder Falls** 02130802

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Lower Monocacy River** 02140302

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Dep osition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Lower Pocomoke River** 02130202

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	4	2	5	5	1	4	3
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Lower Wicomico River** 02130301

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	3	2	2	3	3	1	2
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Lower Winters Run** 02130702

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	3	2	2	3	3	1	2
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Magothy River** 02131001

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Manokin River** 02130208

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	1	2	2	3	2	1	1

Watershed: **Marsh Run** 02140503

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Marshyhope Creek** 02130306

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Mattawoman Creek** 02140111

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Middle Chester River** 02130509

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Middle Patuxent River** 02131106

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Middle River - Browns** 02130807

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	4	3	3	4	2	2	3
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Miles River** 02130502

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	5	3	3	4	2	2	4
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	1	2	2	3	2	1	1

Watershed: **Monie Bay** 02130302

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Nanjemoy Creek** 02140110

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Nanticoke River** 02130305

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Nassawango Creek** 02130205

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Newport Bay** 02130105

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Northeast River** 02130608

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Octoraro Creek** 02120203

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Oxon Creek** 02140204

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	5	3	3	4	2	2	4
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	1	2	2	3	2	1	1

Watershed: **Patapsco River L N Br** 02130906

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Patuxent River lower** 02131101

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Patuxent River middle** 02131102

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Patuxent River upper** 02131104

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Piscataway Creek** 02140203

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Pocomoke Sound** 02130201

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Port Tobacco River** 02140109

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Potomac River AL Cnty** 02140508

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Potomac River FR Cnty** 02140301

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Potomac River L N Branch** 02141001

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	1	1	5	5	1	2	1
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Potomac River L tidal** 02140101

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	4	2	5	5	1	4	3
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Potomac River M tidal** 02140102

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	4	2	5	5	1	4	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Potomac River MO Cnty** 02140202

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Potomac River U N Branch** 02141005

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	4	1	5	5	1	4	3
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Potomac River U tidal** 02140201

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Potomac River WA Cnty** 02140501

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Prettyboy Reservoir** 02130806

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Rock Creek** 02140206

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	4	3	3	4	2	2	3
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Rocky Gorge Dam** 02131107

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **S Branch Patapsco** 02130908

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Sassafras River** 02130610

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Savage River** 02141006

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	1	1	5	5	1	2	1
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	5	3	3	4	3	2	4
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Seneca Creek** 02140208

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Severn River** 02131002

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Sideling Hill Creek** 02140510

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	5	2	2	3	2	2	3

Watershed: **Sinepuxent Bay** 02130104

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	5	3	3	4	2	2	4
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **South River** 02131003

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	3	2	2	3	3	1	2
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Southeast Creek** 02130508

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **St. Clements Bay** 02140105

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **St. Mary's River** 02140103

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	4	3	4	2	3	1	4
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Stillpond-Fairlee** 02130611

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Swan Creek** 02130706

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	2	3	2	3	3	1	1
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	3	2	2	3	3	1	2
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Tangier Sound** 02130206

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	2	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Tonoloway Creek** 02140507

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	3	4	4	5	1	4	2
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	0	2	2	3	2	0	0

Watershed: **Town Creek** 02140512

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	2	3	2	3	4	1	2
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	4	3	4	2	3	1	4
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Transquaking River** 02130308

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Tuckahoe Creek** 02130405

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Upper Chester River** 02130510

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	3	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	3	2	3	3	2	1	2
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Upper Choptank** 02130404

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	4	2	2	2	3	1	3
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Upper Elk River** 02130603

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	3	3	3	4	3	1	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Upper Monocacy River** 02140303

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	3	3	2	3	3	1	2
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	4	3	3	4	3	2	3
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Upper Pocomoke River** 02130203

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	5	3	2	3	3	2	4
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	5	2	2	3	3	2	4
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	5	2	3	3	2	2	4
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	4	3	3	4	2	2	3
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	5	3	3	4	2	2	4
Non-natives		Invasive plants (riparian)	2	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **West Chesapeake Bay** 02131005

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	4	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	2	3	3	4	3	1	2
Habitat Alteration		Surface water withdrawal	5	2	2	2	3	1	4
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **West River** 02131004

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	3	3	4	2	3	1	3
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	0	2	3	3	2	0	0
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	4	2	3	3	2	2	3
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Western Branch** 02131103

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	1	2	4	4	2	1	1
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	4	3	2	3	2	2	2
Habitat Alteration		Ground Water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Migration Barriers	5	2	3	3	2	2	4
Habitat Alteration		Runoff/ baseflow/ down cutting	3	3	3	4	2	2	2
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Wicomico Creek** 02130303

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	0	3	2	3	3	0	0
Chemical	Non-point Source	Excess Phosphorus	0	3	2	3	4	0	0
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	5	2	5	5	1	5	4
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	0	3	2	3	2	0	0
Non-natives		Non-native species (aquatic)	1	2	2	3	2	1	1

Watershed: **Wicomico River** 02140106

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	4	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	0	2	3	3	3	0	0
Chemical	Point Source	Pathogens/ Endocrine disruptors	1	3	4	2	3	1	1
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	2	2	5	5	1	3	2
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	5	3	3	4	3	2	4
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	3	3	3	4	2	2	2
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Wicomico River Head** 02130304

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	3	2	4	4	2	2	3
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	1	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	5	2	3	3	3	2	4
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	4	4	4	5	1	4	3
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	3	3	2	3	2	1	2
Habitat Alteration		Ground Water withdrawal	3	2	2	2	3	1	2
Habitat Alteration		Migration Barriers	3	2	3	3	2	1	2
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	4	3	2	3	2	2	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Wills Creek** 02141003

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	2	2	4	4	2	1	2
Chemical	Non-point Source	Acid Mine Drainage	2	1	5	5	1	2	2
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	3	3	3	4	3	1	3
Chemical	Point Source	Agricultural Pesticides	0	2	2	3	3	0	0
Chemical	Point Source	Dissolved Oxygen	0	3	4	2	3	0	0
Chemical	Point Source	Industrial (NPDES)	3	2	3	3	3	1	3
Chemical	Point Source	Pathogens/ Endocrine disruptors	3	3	4	2	3	1	3
Future Changes		Land Conversion	1	4	4	5	1	2	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	4	2	3	3	2	2	3
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	4	2	2	3	2	2	2

Watershed: **Wye River** 02130503

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	0	2	4	4	2	0	0
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	4	3	2	3	3	1	3
Chemical	Non-point Source	Excess Phosphorus	5	3	2	3	4	1	4
Chemical	Non-point Source	Mercury Deposition	2	3	2	4	2	1	1
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	4	2	2	3	3	1	3
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	3	2	5	5	1	3	3
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	5	3	2	3	2	2	3
Habitat Alteration		Ground Water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	4	3	3	4	3	2	3
Habitat Alteration		Surface water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Wetland Loss	4	3	3	4	2	2	3
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	2	2	2	3	2	1	1

Watershed: **Youghiogheny River** 05020201

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	1	1	5	5	1	2	1
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	1	3	2	3	4	0	1
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	2	3	3	4	3	1	2
Chemical	Point Source	Agricultural Pesticides	2	2	2	3	3	1	1
Chemical	Point Source	Dissolved Oxygen	1	3	4	2	3	1	1
Chemical	Point Source	Industrial (NPDES)	2	2	3	3	3	1	2
Chemical	Point Source	Pathogens/ Endocrine disruptors	2	3	4	2	3	1	2
Future Changes		Land Conversion	2	4	4	5	1	3	1
Future Changes		Sea Level Rise	0	2	5	5	1	1	0
Habitat Alteration		Channelization	1	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	1	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	2	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	1	3	3	4	3	1	1
Habitat Alteration		Surface water withdrawal	2	2	2	2	3	1	1
Habitat Alteration		Wetland Loss	1	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	1	3	2	3	2	1	1
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Watershed: **Zekiah Swamp** 02140108

Category	Subcategory	Name	Extent	Trend	Severity	Persistence	Reversibility	Prevention	Restoration
Chemical	Non-point Source	Acid deposition/ Low pH	5	2	4	4	2	2	4
Chemical	Non-point Source	Acid Mine Drainage	0	1	5	5	1	1	0
Chemical	Non-point Source	Excess Nitrates	1	3	2	3	3	0	1
Chemical	Non-point Source	Excess Phosphorus	4	3	2	3	4	1	3
Chemical	Non-point Source	Mercury Deposition	4	3	2	4	2	2	2
Chemical	Non-point Source	Organic Matter Retention	1	3	3	4	3	1	1
Chemical	Point Source	Agricultural Pesticides	1	2	2	3	3	0	1
Chemical	Point Source	Dissolved Oxygen	2	3	4	2	3	1	2
Chemical	Point Source	Industrial (NPDES)	1	2	3	3	3	0	1
Chemical	Point Source	Pathogens/ Endocrine disruptors	5	3	4	2	3	1	5
Future Changes		Land Conversion	5	4	4	5	1	5	4
Future Changes		Sea Level Rise	1	2	5	5	1	2	1
Habitat Alteration		Channelization	2	2	3	3	2	1	1
Habitat Alteration		Forest Fragmentation	2	3	2	3	2	1	1
Habitat Alteration		Ground Water withdrawal	1	2	2	2	3	0	1
Habitat Alteration		Migration Barriers	1	2	3	3	2	1	1
Habitat Alteration		Runoff/ baseflow/ down cutting	1	3	3	4	2	1	1
Habitat Alteration		Sedimentation	0	3	3	4	3	0	0
Habitat Alteration		Surface water withdrawal	0	2	2	2	3	0	0
Habitat Alteration		Wetland Loss	2	3	3	4	2	1	1
Non-natives		Invasive plants (riparian)	3	3	2	3	2	1	2
Non-natives		Non-native species (aquatic)	3	2	2	3	2	1	2

Legend for previous table

EXTENT (0-5) Based on the estimated percentage of stream miles or, in some cases, area in the watershed that are affected
0 = None or negligible
1 = 1-10%
2 = 11-20%
3 = 21-30%
4 = 31- 60%
5 = 61-100%

TREND (1-5) Based on the projected rate of change and immediacy of the impact
0 = Threat extent deceasing over time, either due to human intervention or natural rejuvenation
1 = Threat extent unchanging
2 = Threat slowly getting worse; up to 0.25% change per year
3 = Threat extent is getting worse; up to 0.5% change per year
4 = Threat extent is steadily growing, up to 2% change per year
5 = Threat extent is rapidly growing, 2 or more percent per year

SEVERITY (0-5) Based on the estimated or known impact to aquatic ecosystems.
0 = No impact likely
1 = Mild
2 = Moderate; degradation of some forms of biological function; detectable shift in community structure & species loss
3 = Serious; significant loss of biological function, communities often dominated by tolerant generalists &/or richness declines
4 = Very serious; heavy loss of biological function; only tolerant species remain
5 = Catastrophic; near-total loss of biological function in affected areas

PERSISTANCE (1-5) Based on duration of impact
0 = Recovery nearly immediate
1 = Short duration, substantial recovery possible in less than 1 year
2 = Moderate duration, substantial recovery possible within 5 years
3 = Long duration, substantial recovery possible within 5-50 years with human remediation
4 = Extreme duration, substantial recovery not likely for 50 to 100s of years, even with intensive human intervention
5 = Essentially permanent environmental feature lasting hundreds of years, even with intensive human intervention

PREVENTION RANK

((TREND + SEVERITY + PERSISTENCE) X EXTENT / REVERSABILITY) + EXTENT = PREVENTION RANK

Critical (5). Will almost certainly result in widespread, complete loss of GCN habitat and/or populations within the watershed. Action is imperative.

Serious (4). Will result in widespread and severe degradation of GCN habitat and/or reduction in populations within the watershed. Action is highly important.

Moderate (3). Will contribute to degradation of GCN habitat and/or decline in GCN population levels. Action should be taken.

Low (2). Evidence indicates that without action, a long-term decline in GCN habitat and/or population levels is probable due to the cumulative effect of this and other threats. A plan for long-term action to eliminate or reduce this threat should be considered to ensure sustainability of GCN habitat/populations.

Slight (1). Evidence indicates that some long-term decline in GCN habitat/populations is possible. Better monitoring of this threat should be considered.

None (0). Available information in this watershed indicates little or no need for action.

RESTORATION RANK

(REVERSABILITY + SEVERITY) = RESTORATION RANK

Critical (5). Will almost certainly result in widespread, complete loss of GCN habitat and/or populations within the watershed. Action is imperative.

Serious (4). Will result in widespread and severe degradation of GCN habitat and/or reduction in populations within the watershed. Action is highly important.

Moderate (3). Will contribute to degradation of GCN habitat and/or decline in GCN population levels. Action should be taken.

Low (2). Evidence indicates that without action, a long-term decline in GCN habitat and/or population levels is probable due to the cumulative effect of this and other threats. A plan for long-term action to eliminate or reduce this threat should be considered to ensure sustainability of GCN habitat/populations.

Slight (1). Evidence indicates that some long-term decline in GCN habitat/populations is possible. Better monitoring of this threat should be considered.

None (0). Available information in this watershed indicates little or no need for action.

Table 1b.2 Threats to Terrestrial and Marine Habitats

Threat Descriptions for **Forested Habitats**	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forest	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood Forests	Floodplain Forests
Development, including roads, impoundments and conversion to other land uses, that results in habitat loss and/or fragmentation and isolation of local populations	X		X	X	X	X	X	X
Pesticide use and contamination that directly or indirectly affects GCN species, such as non-target impacts of gypsy moth and mosquito control on GCN	X		X	X	X	X	X	X
Lack of scientific understanding of appropriate habitat requirements and management for all GCN species	X	X	X	X	X	X	X	X
Inappropriate forestry practices that result in habitat degradation, imbalanced vegetation structure and species composition, or conversion to less diverse pine plantations or other habitat types	X		X	X	X	X	X	X
Deer overbrowsing that results in loss of forest structural diversity	X			X	X	X	X	X
Invasive species that result in habitat loss or degradation	X	X		X		X		X
Windpower development on ridgetops that results in habitat loss						X	X	
Exclusion or alteration of natural fire regimes that results in habitat loss or conversion	X					X		
Human use and/or disturbance, including ATV use, that results in habitat degradation	X		X					
Sudden oak death causing loss of oak component in forest structure					X	X		
Hemlock wooly adelgid causing loss of spruce and hemlock forest components							X	

Threat Descriptions for **Forested Habitats**	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forest	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood Forests	Floodplain Forests
Pest species invasion, such as southern pine bark beetle and gypsy moth, that may have landscape level effects				X				
Inappropriate agricultural practices such as ditching and channelization, livestock grazing, inadequate buffers, and pond construction that result in habitat degradation								X
Reduced water quality and hydrological changes resulting from development and roads								X
Encroachment by woody vegetation or buffer planting on riverine prairies and rare herbaceous species								X
Acid mine drainage								X
Groundwater withdrawal for residential, commercial, and agricultural use								X
Removal of beaver populations								X
Disturbance of sensitive species, especially during the breeding season						X		
Disturbance of sensitive barrens habitat				X				
Lack of disturbance of natural processes that results in loss or conversion of early successional conditions		X						
Non-native species, including feral horses on Assateague Island, that cause habitat degradation			X					
Acid precipitation	X				X		X	
Sea-level rise			X					

Threat Descriptions for **Non-Forested Terrestrial Habitats**	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Development, including housing and commercial, road construction and salt application, and conversion to other land uses that results in habitat loss, degradation, and/or fragmentation	X	X	X	X	X
Inappropriate agricultural practices, including overgrazing, that result in habitat loss or degradation	X			X	
Inappropriate forestry practices, including reforestation or timber harvest, that result in habitat loss, fragmentation or degradation	X		X	X	
Human disturbance, including boating and ORV, that results in habitat degradation	X	X	X		X
Pesticide use and contamination that directly or indirectly affects GCN species, such as gypsy moth suppression	X	X			
Altered natural fire regimes that results in habitat loss or conversion	X	X			
Lack of disturbance of natural processes that results in loss or conversion of early successional conditions	X	X			
Invasive and non-native species that results in habitat loss or degradation	X	X	X		X
Lack of scientific understanding of appropriate habitat requirements and management for all GCN species	X	X	X	X	X
Inappropriate resource utilization from mining and wind farms that results in habitat degradation		X	X	X	
Deer overbrowsing that results in loss of forest structural diversity		X			
Inappropriate shore erosion control			X		X
Pollution of groundwater from pesticides, such as dimlin, toxins, and nutrient overload				X	
Hydrologic disturbances, siltation, groundwater flow alternation, and disturbances of recharge areas affecting water flow or quality				X	
Vegetation removal at upwellings resulting in loss of allochthonous input				X	

Threat Descriptions for **Non-Forested Terrestrial Habitats**	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Spelunker disturbances to caves and mines resulting in compaction of littoral zone				X	
Sea-level rise, climate change and shoreline erosion resulting in modification of natural processes					X
Sedimentation that results in habitat degradation					X
Oil spills that result in habitat degradation and direct GCN species impact					X

Threat Descriptions for **Wetland Habitats**	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Development, including residential development, roads, impervious surfaces, urbanization, conversion to other land uses, surface mining, coal mining (deep mines and strip mines), peat mining, that results in habitat loss and/or fragmentation	X	X	X	X		X	X	X	

Threat Descriptions for **Wetland Habitats**	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Inappropriate management practices, including draining, filling, burning, impounding, artificial control of water levels, lack of beaver impoundments, inadequate buffers, that results in habitat loss, degradation and/or fragmentation	X	X	X	X	X	X	X	X	X
Inappropriate timber harvesting, including logging that results in habitat degradation	X		X	X		X	X		
Inappropriate agricultural practices, including livestock overgrazing, ditching, channelization, pond construction, inadequate buffers and conversion to agricultural use, that result in habitat loss, degradation and/or fragmentation	X	X		X		X	X	X	
Hydrologic disturbances, changes in surface and groundwater features, including, ditches, central pivitot irrigation, water withdrawal, diversions, that result in reduced water quality and changes in quantity	X	X	X	X		X	X	X	
Eutrophication, excess nutrient loading and siltation due to agriculture runoff and chemical lawn treatments, that result in reduced water quality		X	X		X			X	
Pesticide use, chemical contamination, and acidification of habitat that directly or indirectly affects GCN species		X	X		X			X	X
Non-target impacts of gypsy moth control	X			X			X		

Threat Descriptions for **Wetland Habitats**	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Non-target impacts of mosquito control practices such as adulticide use and introduction of larvicides or biological control agents such as mosquitofish or mudminnows to control mosquito larvae	X		X	X		X			X
Invasive species that result in habitat loss and/or degradation, especially phragmites, purple loosestrife, nutria, and cormorants	X	X		X	X	X	X	X	X
Human use and/or disturbance, including recreational off-road vehicles, that results in habitat degradation	X		X				X		
Lack of scientific understanding of appropriate habitat requirements and management for all GCN species		X	X	X	X	X	X	X	X
Fire exclusion		X							
Succession and woody vegetation encroachment (buttonbush, red maple, sweetgum, and other species succeeding into forest open-canopy herbaceous-dominated seasonal wetlands)		X	X					X	
Groundwater contamination from development and agriculture			X						
Altered natural disturbance patterns resulting in inadequate habitat conditions for some GCN species				X		X	X		
Increased flooding events due to sea-level rise, subduction, and increased erosion rates that results in habitat loss					X				X
Acid mine drainage						X	X		

Threat Descriptions for **Wetland Habitats**	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Acid precipitation							X		X
High deer densities resulting in overbrowsing							X		
In Allegheny Plateau, loss of northern conifers (red spruce, eastern white pine, balsam fir, eastern hemlock) due to timber harvesting							X		
In Coastal Plain, decline of Atlantic white cedar							X		
Loss of eastern hemlock due to hemlock wooly adelgid							X		
Water quality degradation of wetlands, streams and rivers feeding wetlands								X	
Channelization and damming of streams feeding wetlands								X	
Sedimentation and siltation within wetlands								X	
Conversion to impoundments								X	
Habitat degradation due to the impact of piers, docks and boat wakes									X
Shoreline stabilization through rip-rap placement and bulkhead construction									X
Contamination from oil spills, boat fuels, and other sources of harmful chemicals									X

Threat Descriptions for **Estuarine and Marine Habitats**	Oligohaline, Mesohaline and Polyhaline Estuaries	Ocean
Inappropriate agricultural practices, including erosion, sedimentation, and nutrient enrichment, that result in habitat loss, degradation and/or fragmentation	X	
Development/urban sprawl that results in erosion, sedimentation and nutrient enrichment, habitat loss and/or fragmentation	X	X
Lack of scientific understanding of appropriate habitat requirements and management for all GCN species	X	X
Pollution, including metalloids, changes in pH, and thermal and toxic discharges, nutrients (especially nitrogen and phosphorus) and sedimentation, that result in water quality degradation	X	X
Non-native species	X	
Oil and chemical spills	X	X
Dredge spoil dumping	X	
Channel dredging	X	X
Loss of submerged aquatic vegetation	X	
Loss of oxygen	X	
Habitat loss due to oyster reef extraction	X	
Dredges and scrapes (commercial uses) that result in habitat degradation	X	
Hydrologic and ground water alteration that results in changes in salinity	X	
Release of sediment from impoundments	X	
Acoustic disturbance		X
Excessive human recreational use that results in habitat degradation		X

Appendix 2. Crosswalk of Maryland's Terrestrial Key Wildlife Habitats to Ecological Systems

This appendix provides a crosswalk linkage between the WDCP Key Wildlife Habitats and the 38 Terrestrial Ecological Systems found in Maryland. Terrestrial Ecological Systems were developed by NatureServe to classify mid-scale ecological units nationally and as part of the effort to develop an International Terrestrial Ecological Systems Classification. More information can be found at http://www.natureserve.org/publications/usEcologicalsystems.jsp. IAFWA guidance (2002) and subsequent Steering Committee correspondence recommended that the crosswalk linkages to regional and national standardized classification systems for use in large landscape level analysis and monitoring be included. This crosswalk directly addresses **Element #2** and IAFWA guidance.

KWH #	Key Wildlife Habitat	Terrestrial Ecological Systems
1	Old Growth Forests	N/A
2	Early Successional Forests	N/A
3	Maritime Forests and Shrublands	Atlantic Coastal Plain Northern Maritime Forest
4	Loblolly Pine - Oak Forests	Atlantic Coastal Plain Northern Mixed Oak-Heath Forest
5	Mesic Deciduous Forests	Atlantic Coastal Plain Mesic Hardwood and Mixed Forest Southern and Central Appalachian Cove Forest
6	Dry Oak - Pine Forests	Appalachian Serpentine Woodland Appalachian Shale Barrens Allegheny-Cumberland Dry Oak Forest and Woodland Atlantic Coastal Plain Northern Mixed Oak-Heath Forest Central Appalachian Oak and Pine Forest

KWH #	Key Wildlife Habitat	Terrestrial Ecological Systems
		Central Appalachian Pine-Oak Rocky Woodland
		Central Appalachian Montane Rocky Bald
		Southern Piedmont Northern Triassic Basin Dry Forest
		Northeastern Interior Dry Oak Forest
		Southern Piedmont Dry Oak-Heath Forest
		Atlantic Coastal Plain Northern Dry Hardwood Forest
7	Northern Conifer - Hardwood Forests	Appalachian Hemlock-Hardwood Forest
8	Floodlplain Forests	Atlantic Coastal Plain Northern Tidal Wooded Swamp
		Atlantic Coastal Plain Small Brownwater River Floodplain Forest
		Atlantic Coastal Plain Blackwater Stream Floodplain Forest
		Atlantic Coastal Plain Brownwater Stream Floodplain Forest
		Atlantic Coastal Plain Northern Basin Peat Swamp
		Central Appalachian Floodplain
		Central Appalachian Riparian
9	Upland Depressional Swamps	Atlantic Coastal Plain Northern Basin Swamp and Wet Hardwood Forest
		Atlantic Coastal Plain Northern Pondshore
		North-Central Appalachian Acidic Swamp
		Atlantic Coastal Plain Northern Basin Peat Swamp
10	Carolina Bays	Atlantic Coastal Plain Northern Pondshore
11	Vernal Pools	Atlantic Coastal Plain Northern Basin Swamp and Wet Hardwood Forest
12	Forested Seepage Wetlands	North-Central Appalachian Acidic Swamp
		Atlantic Coastal Plain Northern Basin Peat Swamp

KWH #	Key Wildlife Habitat	Terrestrial Ecological Systems
13	Tidal Shrub Wetlands	Atlantic Coastal Plain Northern Tidal Wooded Swamp
		Atlantic Coastal Plain Northern Tidal Salt Marsh
		Atlantic Coastal Plain Northern Fresh and Oligohaline Tidal Marsh
14	Nontidal Shrub Wetlands	Southern and Central Appalachian Bog and Fen
15	Bog and Fen Wetland Complexes	Atlantic Coastal Plain Northern Basin Peat Swamp
		Southern and Central Appalachian Bog and Fen
		North-Central Appalachian Seepage Fen
16	Nontidal Emergent Wetlands	Atlantic Coastal Plain Northern Pondshore
		North-Central Appalachian Seepage Fen
17	Tidal Marshes	Atlantic Coastal Plain Northern Fresh and Oligohaline Tidal Marsh
		Atlantic Coastal Plain Northern Tidal Salt Marsh
		Atlantic Coastal Plain Northern Brackish Tidal Marsh
18	Grasslands	Atlantic Coastal Plain Northern Dune and Maritime Grassland
19	Barrens and Dry Glades	Appalachian Serpentine Woodland
		Appalachian Shale Barrens
		Central Appalachian Alkaline Glade and Woodland
		Southern Piedmont Glade and Barrens
		Southern and Central Appalachian Mafic Glade and Barrens
20	Cliffs and Rock Outcrops	Central Appalachian Pine-Oak Rocky Woodland
		North-Central Appalachian Acidic Cliff and Talus

KWH #	Key Wildlife Habitat	Terrestrial Ecological Systems
		North-Central Appalachian Circumneutral Cliff and Talus
21	Caves, Mines, and Springs	N/A
22	Coastal Beaches, Dunes, and Mudflats	Atlantic Coastal Plain Northern Dune and Maritime Grassland Atlantic Coastal Plain Northern Sandy Beach

Appendix 3a. Maryland's Full Array of Wildlife

This appendix lists all the vertebrate species known to occur or having occurred or likely to occur in Maryland along with their state, regional and national status categories if known. Many invertebrates are also included, which primarily represent those being tracked by NHP. However, this list greatly underrepresents the thousands, if not tens of thousands, of invertebrates that are likely to occur in Maryland. It represents the best available information from the most current MD DNR and partner datasets (**Element #1**). The faunal list was reviewed and refined by taxonomic scientific experts for accuracy and supplemental information relevant to the WDCP. Multiple datasets were consulted to compile data and current ranks including the NHP database, NatureServe, Fishbase, and numerous regional and national programs. Key status categories include:
G-Rank = TNC / NatureServe global conservation status rank
S-Rank = TNC / NatureServe state conservation status rank (assigned by NHP)

An explanation of these rank codes is located at the end of the species list.

Table 3a.1. NHP list of Maryland's Full Array of Wildlife.

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
	VERTEBRATES		
MAMMALS			
Allegheny woodrat	Neotoma magister	G3G4	S1
American beaver	Castor canadensis	G5	S5
American bison	Bos bison	G4	SX
American elk	Cervus elaphus	G5	SX
American marten	Martes americana	G5	SX
Atlantic spotted dolphin	Stenella frontalis	G5	SZN
Atlantic white-sided dolphin	Leucopleurus acutus	G4	SZN
Big brown bat	Eptesicus fuscus	G5	S5B,S5N
Black bear	Ursus americanus	G5	S3S4
Black rat	Rattus rattus	G5	SE
Black right whale	Eubalaena glacialis	G1	SZN
Blue whale	Balaenoptera musculus	G3G4	SZN
Bobcat	Lynx rufus	G5	S3
Bottle-nosed dolphin	Tursiops truncatus	G5	SZN
Common gray fox	Urocyon cinereoargenteus	G5	S5
Common raccoon	Procyon lotor	G5	S5
Coyote	Canis latrans	G5	S4
Deer mouse	Peromyscus maniculatus	G5	S5
Delmarva fox squirrel	Sciurus niger cinereus	G5T3	S1
Dwarf sperm whale	Kogia simus	G4	SZN
Eastern chipmunk	Tamias striatus	G5	S5
Eastern cottontail	Sylvilagus floridanus	G5	S5

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Eastern cougar	Puma concolor couguar	G5TH	SH
Eastern fox squirrel	Sciurus niger	G5	S4
Eastern gray squirrel	Sciurus carolinensis	G5	S5
Eastern harvest mouse	Reithrodontomys humulis	G5	SH
Eastern mole	Scalopus aquaticus	G5	S5
Eastern pipistrelle	Pipistrellus subflavus	G5	S5B,S5N
Eastern red bat	Lasiurus borealis	G5	S5B,S5N
Eastern small-footed bat	Myotis leibii	G3	S1B,S2N
Eastern spotted skunk	Spilogale putorius	G5	S1
Ermine	Mustela erminea	G5	SR
Evening bat	Nycticeius humeralis	G5	S5B
False killer whale	Pseudorca crassidens	G4	SR
Feral horse (assateague pony)	Equus caballus	G5	SE
Fin whale	Balaenoptera physalus	G3G4	SZN
Fisher	Martes pennanti	G5	S3S4
Goose-beaked whale	Ziphius cavirostris	G4	SZN
Gray seal	Halichoerus grypus	G4G5	SA
Gray wolf	Canis lupus	G4	SX
Hairy-tailed mole	Parascalops breweri	G5	S4
Harbor porpoise	Phocoena phocoena	G4G5	SZN
Harbor seal	Phoca vitulina	G5	SA
Harp seal	Pagophilus groenlandica	G5	SA
Hoary bat	Lasiurus cinereus	G5	SPB,S5N
Hooded seal	Cystophora cristata	G4G5	SA
House mouse	Mus musculus	G5	SE
Humpback whale	Megaptera novaeangliae	G3	SZN
Indiana bat	Myotis sodalis	G2	S1
Killer whale	Orcinus orca	G4G5	SZN
Least shrew	Cryptotis parva	G5	S3S5
Least weasel	Mustela nivalis	G5	S2S3
Little brown myotis	Myotis lucifugus	G5	S5B,S5N
Long-finned pilot whale	Globicephala melas	G5	SZN
Long-tailed shrew	Sorex dispar	G4	S2
Long-tailed weasel	Mustela frenata	G5	S5
Manatee	Trichechus manatus	G2	SA
Marsh rice rat	Oryzomys palustris	G5	S4
Maryland shrew	Sorex fontinalis	G4Q	S?
Masked shrew	Sorex cinereus	G5	S5
Meadow jumping mouse	Zapus hudsonius	G5	S5
Meadow vole	Microtus pennsylvanicus	G5	S5
Melon-headed whale	Peponocephala electra	G4	SZN
Mink	Mustela vison	G5	S4
Minke whale	Balaenoptera acutorostrata	G5	SZN
Muskrat	Ondatra zibethicus	G5	S5
New England cottontail	Sylvilagus transitionalis	G4	S1
Northern myotis	Myotis septentrionalis	G4	S4B,S4N

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Northern river otter	Lontra canadensis	G5	S5
Northern short-tailed shrew	Blarina brevicauda	G5	S5
Norway rat	Rattus norvegicus	G5	SE
Nutria	Myocastor coypus	G5	SE
Porcupine	Erethizon dorsatum	G5	S1S2
Pygmy sperm whale	Kogia breviceps	G4	SZN
Rafinesque's big-eared bat	Corynorhinus rafinesquii	G3G4	SP
Red fox	Vulpes vulpes	G5	S5
Red squirrel	Tamiasciurus hudsonicus	G5	S5
Risso's dolphin	Grampus griseus	G5	SZN
Sei whale	Balaenoptera borealis	G3	SZN
Short-beaked common dolphin	Delphinus delphis	G5	SZN
Short-finned pilot whale	Globicephala macrorhynchus	G5	SZN
Sika deer	Cervus nippon	G4	SE
Silver-haired bat	Lasionycteris noctivagans	G5	SPB,S5N
Smoky shrew	Sorex fumeus	G5	S2S3
Snowshoe hare	Lepus americanus	G5	SH
Southeastern shrew	Sorex longirostris	G5	S3S4
Southeastern star-nosed mole	Condylura cristata parva	G5T4	SU
Southern bog lemming	Synaptomys cooperi	G5	S3
Southern flying squirrel	Glaucomys volans	G5	S5
Southern pygmy shrew	Sorex hoyi winnemana	G5T4	S2
Southern red-backed vole	Clethrionomys gapperi	G5	S5
Southern rock vole	Microtus chrotorrhinus carolinensis	G4T3	S1
Southern water shrew	Sorex palustris punctulatus	G5T3	S1
Sperm whale	Physeter catodon	G3G4	SZN
Striped dolphin	Stenella coeruleoalba	G5	SZN
Striped skunk	Mephitis mephitis	G5	S5
True's beaked whale	Mesoplodon mirus	G3	SZN
Virginia northern flying squirrel	Glaucomys sabrinus fuscus	G5T2	SP
Virginia oppossum	Didelphis virginiana	G5	S5
White-footed mouse	Peromyscus leucopus	G5	S5
White-tailed deer	Odocoileus virginianus	G5	S5
Woodchuck	Marmota monax	G5	S5
Woodland jumping mouse	Napaeozapus insignis	G5	S4
Woodland vole	Microtus pinetorum	G5	S5
BIRDS			
Acadian flycatcher	Empidonax virescens	G5	S5B
Alder flycatcher	Empidonax alnorum	G5	S2B
American avocet	Recurvirostra americana	G5	SZN
American bittern	Botaurus lentiginosus	G4	S1S2B,S1N
American black duck	Anas rubripes	G5	S4B,S5N
American coot	Fulica americana	G5	SAB,S3N
American crow	Corvus brachyrhynchos	G5	S5
American golden-plover	Pluvialis dominica	G5	SZN

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
American goldfinch	Carduelis tristis	G5	S5
American kestrel	Falco sparverius	G5	S5B,S4N
American oystercatcher	Haematopus palliatus	G5	S3B,SAN
American peregrine falcon	Falco peregrinus anatum	G4T3	S2
American pipit	Anthus rubescens	G5	S3N
American redstart	Setophaga ruticilla	G5	S4B
American robin	Turdus migratorius	G5	S5B,S5N
American tree sparrow	Spizella arborea	G5	S3N
American white pelican	Pelecanus erythrorhynchos	G3	SAN
American wigeon	Anas americana	G5	S4N
American woodcock	Scolopax minor	G5	S4B,S4N
Anhinga	Anhinga anhinga	G5	SAN
Arctic peregrine falcon	Falco peregrinus tundrius	G4T3T4	S3N
Arctic tern	Sterna paradisaea	G5	SAN
Ash-throated flycatcher	Myiarchus cinerascens	G5	SAN
Atlantic puffin	Fratercula arctica	G5	SZN
Audubon's shearwater	Puffinus lherminieri	G4G5	SZN
Bachman's sparrow	Aimophila aestivalis	G3	SHB
Baird's sandpiper	Calidris bairdii	G5	SZN
Baird's sparrow	Ammodramus bairdii	G4	SAN
Bald eagle	Haliaeetus leucocephalus	G4	S2S3B,S3N
Baltimore oriole	Icterus galbula	G5	S5B
Bank swallow	Riparia riparia	G5	S3S4B
Barn owl	Tyto alba	G5	S3
Barn swallow	Hirundo rustica	G5	S5B
Barred owl	Strix varia	G5	S5
Barrow's goldeneye	Bucephala islandica	G5	SAN
Bay-breasted warbler	Dendroica castanea	G5	SZN
Belted kingfisher	Ceryle alcyon	G5	S5B,S4N
Bewick's wren	Thryomanes bewickii altus	G5T2Q	S1B
Bicknell's thrush	Catharus bicknelli	G4	SZN
Black rail	Laterallus jamaicensis	G4	S2S3B
Black scoter	Melanitta nigra	G5	S3N
Black skimmer	Rynchops niger	G5	S1B
Black tern	Chlidonias niger	G4	SZN
Black vulture	Coragyps atratus	G5	S4B,S4N
Black-and-white warbler	Mniotilta varia	G5	S4B
Black-bellied plover	Pluvialis squatarola	G5	S3N
Black-bellied whistling-duck	Dendrocygna autumnalis	G5	SAN
Black-billed cuckoo	Coccyzus erythropthalmus	G5	S4B
Blackburnian warbler	Dendroica fusca	G5	S1S2B
Black-capped chickadee	Poecile atricapilla	G5	S4
Black-capped petrel	Pterodroma hasitata	G1	SAN
Black-crowned night-heron	Nycticorax nycticorax	G5	S3B,S2N
Black-headed grosbeak	Pheucticus melanocephalus	G5	SAN
Black-headed gull	Larus ridibundus	G5	SZN

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Black-legged kittiwake	Rissa tridactyla	G5	SZN
Black-necked stilt	Himantopus mexicanus	G5	SNA
Blackpoll warbler	Dendroica striata	G5	SZN
Black-throated blue warbler	Dendroica caerulescens	G5	S3S4B
Black-throated gray warbler	Dendroica nigrescens	G5	SAN
Black-throated green warbler	Dendroica virens	G5	S4B
Blue grosbeak	Guiraca caerulea	G5	S5B
Blue jay	Cyanocitta cristata	G5	S5B,S5N
Blue-gray gnatcatcher	Polioptila caerulea	G5	S5B
Blue-headed vireo	Vireo solitarius	G5	S3S4B
Blue-winged teal	Anas discors	G5	S2B,S3S4N
Blue-winged warbler	Vermivora pinus	G5	S4B
Boat-tailed grackle	Quiscalus major	G5	S3S4
Bobolink	Dolichonyx oryzivorus	G5	S3S4B
Bohemian waxwing	Bombycilla garrulus	G5	SAN
Bonaparte's gull	Larus philadelphia	G5	S2N
Boreal chickadee	Poecile hudsonica	G5	SAN
Brant	Branta bernicla	G5	S3N
Brewer's blackbird	Euphagus cyanocephalus	G5	SAN
Bridled tern	Sterna anaethetus	G5	SAN
Broad-winged hawk	Buteo platypterus	G5	S4B
Brown creeper	Certhia americana	G5	S4
Brown pelican	Pelecanus occidentalis	G4	S1B
Brown thrasher	Toxostoma rufum	G5	S5B,S2N
Brown-headed cowbird	Molothrus ater	G5	S5
Brown-headed nuthatch	Sitta pusilla	G5	S3S4
Buff-breasted sandpiper	Tryngites subruficollis	G4	SZN
Bufflehead	Bucephala albeola	G5	S5N
Bullock's oriole	Icterus bullockii	G5	SAN
Burrowing owl	Athene cunicularia	G4	SAN
California gull	Larus californicus	G5	SAN
Canada goose	Branta canadensis	G5	S4B,S5N
Canada warbler	Wilsonia canadensis	G5	S3B
Canvasback	Aythya valisineria	G5	S3S4N
Cape may warbler	Dendroica tigrina	G5	SZN
Carolina chickadee	Poecile carolinensis	G5	S5
Carolina parakeet	Conuropsis carolinensis	GX	SX
Carolina wren	Thryothorus ludovicianus	G5	S5
Caspian tern	Sterna caspia	G5	SZN
Cattle egret	Bubulcus ibis	G5	S3S4B
Cedar waxwing	Bombycilla cedrorum	G5	S5B,S5N
Cerulean warbler	Dendroica cerulea	G4	S3S4B
Chestnut-collared longspur	Calcarius ornatus	G5	SAN
Chestnut-sided warbler	Dendroica pensylvanica	G5	S4B
Chimney swift	Chaetura pelagica	G5	S5B
Chipping sparrow	Spizella passerina	G5	S5B,S1N

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Chuck-will's-widow	Caprimulgus carolinensis	G5	S4B
Cinnamon teal	Anas cyanoptera	G5	SAN
Clapper rail	Rallus longirostris	G5	S3S4B,S3N
Clay-colored sparrow	Spizella pallida	G5	SAN
Cliff swallow	Petrochelidon pyrrhonota	G5	S3S4B
Coastal plain swamp sparrow	Melospiza georgiana nigrescens	G5T3	S2B,SZN
Common eider	Somateria mollissima	G5	S1N
Common goldeneye	Bucephala clangula	G5	S5N
Common grackle	Quiscalus quiscula	G5	S5
Common ground-dove	Columbina passerina	G5	SAN
Common loon	Gavia immer	G5	S4N
Common merganser	Mergus merganser	G5	S3N
Common moorhen	Gallinula chloropus	G5	S2B,SAN
Common murre	Uria aalge	G5	SAN
Common nighthawk	Chordeiles minor	G5	S3S4B
Common raven	Corvus corax	G5	S2
Common redpoll	Carduelis flammea	G5	S1N
Common tern	Sterna hirundo	G5	S4B
Common yellowthroat	Geothlypis trichas	G5	S5B
Connecticut warbler	Oporornis agilis	G4	SZN
Cooper's hawk	Accipiter cooperii	G5	S4B,S4N
Corn crake	Crex crex	G5	SAN
Cory's shearwater	Calonectris diomedea	G5	SZN
Curlew sandpiper	Calidris ferruginea	G5?	SAN
Dark-eyed junco	Junco hyemalis	G5	S2B,S5N
Dickcissel	Spiza americana	G5	S2B
Double-crested cormorant	Phalacrocorax auritus	G5	S1B,S3S4N
Dovekie	Alle alle	G5	SZN
Downy woodpecker	Picoides pubescens	G5	S5
Dunlin	Calidris alpina	G5	S3N
Eared grebe	Podiceps nigricollis	G5	SAN
Eastern bluebird	Sialia sialis	G5	S5B,S4N
Eastern kingbird	Tyrannus tyrannus	G5	S5B
Eastern meadowlark	Sturnella magna	G5	S5B,S3N
Eastern phoebe	Sayornis phoebe	G5	S5B
Eastern screech-owl	Otus asio	G5	S5
Eastern towhee	Pipilo erythrophthalmus	G5	S5B,S4N
Eastern wood-pewee	Contopus virens	G5	S5B
Eskimo curlew	Numenius borealis	GH	SXN
Eurasian wigeon	Anas penelope	G5	S1N
European starling	Sturnus vulgaris	G5	SE
Evening grosbeak	Coccothraustes vespertinus	G5	S2N
Field sparrow	Spizella pusilla	G5	S5
Fish crow	Corvus ossifragus	G5	S5
Fork-tailed flycatcher	Tyrannus savana	G5	SAN
Forster's tern	Sterna forsteri	G5	S4B

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Fox sparrow	Passerella iliaca	G5	S2N
Franklin's gull	Larus pipixcan	G4G5	SAN
Fulvous whistling-duck	Dendrocygna bicolor	G5	SAN
Gadwall	Anas strepera	G5	S2B,S4N
Glaucous gull	Larus hyperboreus	G5	SZN
Glossy ibis	Plegadis falcinellus	G5	S4B
Golden eagle	Aquila chrysaetos	G5	S1N
Golden-crowned kinglet	Regulus satrapa	G5	S2B,S4N
Golden-winged warbler	Vermivora chrysoptera	G4	S3B
Grasshopper sparrow	Ammodramus savannarum	G5	S4B
Gray catbird	Dumetella carolinensis	G5	S5B,S1N
Gray kingbird	Tyrannus dominicensis	G5	SAN
Gray-cheeked thrush	Catharus minimus	G5	SZN
Great black-backed gull	Larus marinus	G5	S4B,S4N
Great blue heron	Ardea herodias	G5	S4B,S3S4N
Great cormorant	Phalacrocorax carbo	G5	S2N
Great crested flycatcher	Myiarchus crinitus	G5	S5B
Great egret	Ardea alba	G5	S4B
Great horned owl	Bubo virginianus	G5	S5
Great skua	Stercorarius skua	G4G5	SZN
Greater flamingo	Phoenicopterus ruber	G3	SAN
Greater scaup	Aythya marila	G5	S4N
Greater shearwater	Puffinus gravis	G5	SZN
Greater white-fronted goose	Anser albifrons	G5	SZN
Greater yellowlegs	Tringa melanoleuca	G5	S1N
Green heron	Butorides virescens	G5	S5B
Green-winged teal	Anas crecca	G5	SAB,S4N
Groove-billed ani	Crotophaga sulcirostris	G5	SAN
Gull-billed tern	Sterna nilotica	G5	S1B
Gyrfalcon	Falco rusticolus	G5	SAN
Hairy woodpecker	Picoides villosus	G5	S5
Hammond's flycatcher	Empidonax hammondii	G5	SAN
Harlequin duck	Histrionicus histrionicus	G4	S1N
Harris' sparrow	Zonotrichia querula	G5	SAN
Heath hen	Tympanuchus cupido cupido	G4TX	SX
Henslow's sparrow	Ammodramus henslowii	G4	S1S2B
Hermit thrush	Catharus guttatus	G5	S3S4B,S4N
Herring gull	Larus argentatus	G5	S5B,S5N
Hoary redpoll	Carduelis hornemanni	G5	SAN
Hooded merganser	Lophodytes cucullatus	G5	S1B,S2N
Hooded warbler	Wilsonia citrina	G5	S4S5B
Horned grebe	Podiceps auritus	G5	S4N
Horned lark	Eremophila alpestris	G5	S4B,S4N
House finch	Carpodacus mexicanus	G5	SE
House sparrow	Passer domesticus	G5	SE
House wren	Troglodytes aedon	G5	S5B

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Hudsonian godwit	Limosa haemastica	G4	SZN
Iceland gull	Larus glaucoides	G5	SZN
Indigo bunting	Passerina cyanea	G5	S5B
Ivory-billed woodpecker	Campephilus principalis	GH	SX
Kentucky warbler	Oporornis formosus	G5	S4B
Killdeer	Charadrius vociferus	G5	S5B,S4N
King eider	Somateria spectabilis	G5	S1N
King rail	Rallus elegans	G4G5	S3S4B,S2N
Labrador duck	Camptorhynchus labradorius	GX	SX
Lapland longspur	Calcarius lapponicus	G5	S1N
Lark bunting	Calamospiza melanocorys	G5	SAN
Lark sparrow	Chondestes grammacus	G5	SXB,SAN
Laughing gull	Larus atricilla	G5	S1B,S4N
Lazuli bunting	Passerina amoena	G5	SAN
Le conte's sparrow	Ammodramus leconteii	G4	SAN
Leach's storm-petrel	Oceanodroma leucorhoa	G5	SZN
Least bittern	Ixobrychus exilis	G5	S2S3B
Least flycatcher	Empidonax minimus	G5	S3S4B
Least sandpiper	Calidris minutilla	G5	SZN
Least tern	Sterna antillarum	G4	S2B
Lesser black-backed gull	Larus fuscus	G5	SZN
Lesser scaup	Aythya affinis	G5	S4N
Lesser yellowlegs	Tringa flavipes	G5	S1N
Limpkin	Aramus guarauna	G5	SAN
Lincoln's sparrow	Melospiza lincolnii	G5	SZN
Little blue heron	Egretta caerulea	G5	S3B
Little gull	Larus minutus	G5	SZN
Little stint	Calidris minuta	G5	SAN
Loggerhead shrike	Lanius ludovicianus	G4	S1B,S1N
Long-billed curlew	Numenius americanus	G5	SAN
Long-billed dowitcher	Limnodromus scolopaceus	G5	SZN
Long-eared owl	Asio otus	G5	SHB,S1N
Long-tailed duck	Clangula hyemalis	G5	S4N
Long-tailed jaeger	Stercorarius longicaudus	G5	SZN
Louisiana waterthrush	Seiurus motacilla	G5	S5B
Magnificent frigatebird	Fregata magnificens	G5	SAN
Magnolia warbler	Dendroica magnolia	G5	S3S4B
Mallard	Anas platyrhynchos	G5	SE
Manx shearwater	Puffinus puffinus	G5	SZN
Marbled godwit	Limosa fedoa	G5	SZN
Marsh wren	Cistothorus palustris	G5	S4B,S2N
Masked duck	Nomonyx dominicus	G5	SAN
Merlin	Falco columbarius	G5	S1N
Mew gull	Larus canus	G5	SAN
Mississippi kite	Ictinia mississippiensis	G5	SAN
Mountain bluebird	Sialia currucoides	G5	SAN

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Mourning dove	Zenaida macroura	G5	S5
Mourning warbler	Oporornis philadelphia	G5	S1B
Mute swan	Cygnus olor	G5	SE
Nashville warbler	Vermivora ruficapilla	G5	S1S2B
Nelson's sharp-tailed sparrow	Ammodramus nelsoni	G5	SAN
Northern bobwhite	Colinus virginianus	G5	S5
Northern cardinal	Cardinalis cardinalis	G5	S5
Northern flicker	Colaptes auratus	G5	S5B,S5N
Northern fulmar	Fulmarus glacialis	G5	SZN
Northern gannet	Morus bassanus	G5	SZN
Northern goshawk	Accipiter gentilis	G5	S1B,SZN
Northern harrier	Circus cyaneus	G5	S2B,S4N
Northern mockingbird	Mimus polyglottos	G5	S5
Northern parula	Parula americana	G5	S4S5B
Northern pintail	Anas acuta	G5	S4N
Northern rough-winged swallow	Stelgidopteryx serripennis	G5	S4B
Northern saw-whet owl	Aegolius acadicus	G5	S1B,S1N
Northern shoveler	Anas clypeata	G5	SAB,S2N
Northern shrike	Lanius excubitor	G5	SAN
Northern waterthrush	Seiurus noveboracensis	G5	S2S3B
Northern wheatear	Oenanthe oenanthe	G5	SAN
Olive-sided flycatcher	Contopus cooperi	G4	SHB,SZN
Orange-crowned warbler	Vermivora celata	G5	SZN
Orchard oriole	Icterus spurius	G5	S5B
Osprey	Pandion haliaetus	G5	S4B
Ovenbird	Seiurus aurocapillus	G5	S5B
Painted bunting	Passerina ciris	G5	SAN
Palm warbler	Dendroica palmarum	G5	S2N
Parasitic jaeger	Stercorarius parasiticus	G5	SZN
Passenger pigeon	Ectopistes migratorius	GX	SX
Pectoral sandpiper	Calidris melanotos	G5	SZN
Philadelphia vireo	Vireo philadelphicus	G5	SZN
Pied-billed grebe	Podilymbus podiceps	G5	S2B,S3N
Pileated woodpecker	Dryocopus pileatus	G5	S5
Pine grosbeak	Pinicola enucleator	G5	SAN
Pine siskin	Carduelis pinus	G5	SAB,S1S2N
Pine warbler	Dendroica pinus	G5	S4B,S2N
Piping plover	Charadrius melodus	G3	S1B,SAN
Pomarine jaeger	Stercorarius pomarinus	G5	SZN
Prairie warbler	Dendroica discolor	G5	S4B
Prothonotary warbler	Protonotaria citrea	G5	S4B
Purple finch	Carpodacus purpureus	G5	S3B,S3N
Purple gallinule	Porphyrula martinica	G5	SAB
Purple martin	Progne subis	G5	S5B
Purple sandpiper	Calidris maritima	G5	S2N
Razorbill	Alca torda	G5	SZN

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Red crossbill	Loxia curvirostra	G5	SNA
Red knot	Calidris canutus	G5	SZN
Red phalarope	Phalaropus fulicaria	G5	SZN
Red-bellied woodpecker	Melanerpes carolinus	G5	S5
Red-breasted merganser	Mergus serrator	G5	S3N
Red-breasted nuthatch	Sitta canadensis	G5	S1B,S3N
Red-cockaded woodpecker	Picoides borealis	G3	SHB,SAN
Red-eyed vireo	Vireo olivaceus	G5	S5B
Redhead	Aythya americana	G5	S2N
Red-headed woodpecker	Melanerpes erythrocephalus	G5	S4
Red-necked grebe	Podiceps grisegena	G5	SZN
Red-necked phalarope	Phalaropus lobatus	G4G5	SZN
Red-necked stint	Calidris ruficollis	G5	SAN
Red-shouldered hawk	Buteo lineatus	G5	S4S5B,S4N
Red-tailed hawk	Buteo jamaicensis	G5	S5B,S5N
Red-throated loon	Gavia stellata	G5	S3S4N
Red-winged blackbird	Agelaius phoeniceus	G5	S5
Ring-billed gull	Larus delawarensis	G5	S5N
Ring-necked duck	Aythya collaris	G5	S2N
Ring-necked pheasant	Phasianus colchicus	G5	SE
Rock dove	Columba livia	G5	SE
Rock wren	Salpinctes obsoletus	G5	SAN
Roseate spoonbill	Ajaia ajaja	G5	SAN
Roseate tern	Sterna dougallii dougallii	G4T3	SHB,SAN
Rose-breasted grosbeak	Pheucticus ludovicianus	G5	S3S4B
Ross' goose	Chen rossii	G4	SAN
Ross's gull	Rhodostethia rosea	G3G4	SAN
Rough-legged hawk	Buteo lagopus	G5	S2N
Royal tern	Sterna maxima	G5	S1B
Ruby-crowned kinglet	Regulus calendula	G5	S3N
Ruby-throated hummingbird	Archilochus colubris	G5	S5B
Ruddy duck	Oxyura jamaicensis	G5	S3N
Ruddy turnstone	Arenaria interpres	G5	S1N
Ruff	Philomachus pugnax	G5	SAN
Ruffed grouse	Bonasa umbellus	G5	S4
Rufous hummingbird	Selasphorus rufus	G5	SAN
Rusty blackbird	Euphagus carolinus	G5	S2S3N
Sabine's gull	Xema sabini	G5	SAN
Sage thrasher	Oreoscoptes montanus	G5	SAN
Saltmarsh sharp-tailed sparrow	Ammodramus caudacutus	G4	S3B,S1N
Sanderling	Calidris alba	G5	S3N
Sandhill crane	Grus canadensis	G5	SAN
Sandwich tern	Sterna sandvicensis	G5	S1B
Savannah sparrow	Passerculus sandwichensis	G5	S3S4B,S4N
Scarlet tanager	Piranga olivacea	G5	S5B
Scissor-tailed flycatcher	Tyrannus forficatus	G5	SAN

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Seaside sparrow	Ammodramus maritimus	G4	S4B,S2N
Sedge wren	Cistothorus platensis	G5	S1B
Semipalmated plover	Charadrius semipalmatus	G5	SZN
Semipalmated sandpiper	Calidris pusilla	G5	SZN
Sharp-shinned hawk	Accipiter striatus	G5	S1S2B,S4N
Short-billed dowitcher	Limnodromus griseus	G5	SZN
Short-eared owl	Asio flammeus	G5	S1B,S2N
Smith's longspur	Calcarius pictus	G5	SAN
Snow bunting	Plectrophenax nivalis	G5	S1N
Snow goose	Chen caerulescens	G5	S4N
Snowy egret	Egretta thula	G5	S3S4B
Snowy owl	Nyctea scandiaca	G5	SAN
Solitary sandpiper	Tringa solitaria	G5	SZN
Song sparrow	Melospiza melodia	G5	S5
Sooty shearwater	Puffinus griseus	G5	SZN
Sooty tern	Sterna fuscata	G5	SAN
Sora	Porzana carolina	G5	S1B,SZN
South polar skua	Stercorarius maccormicki	G5	SZN
Spotted sandpiper	Actitis macularia	G5	S3S4B
Spotted towhee	Pipilo maculatus	G5	SAN
Stilt sandpiper	Calidris himantopus	G5	SZN
Summer tanager	Piranga rubra	G5	S4B
Surf scoter	Melanitta perspicillata	G5	S4N
Swainson's hawk	Buteo swainsoni	G5	SAN
Swainson's thrush	Catharus ustulatus	G5	SXB
Swainson's warbler	Limnothlypis swainsonii	G4	S1B
Swallow-tailed kite	Elanoides forficatus	G5	SAN
Swamp sparrow	Melospiza georgiana	G5	S4B,S5N
Tennessee warbler	Vermivora peregrina	G5	SZN
Thick-billed murre	Uria lomvia	G5	SAN
Townsend's solitaire	Myadestes townsendi	G5	SAN
Tree swallow	Tachycineta bicolor	G5	S4B
Tricolored heron	Egretta tricolor	G5	S3B
Trumpeter swan	Cygnus buccinator	G4	SXN
Tufted duck	Aythya fuligula	G5	SAN
Tufted titmouse	Baeolophus bicolor	G5	S5
Tundra swan	Cygnus columbianus	G5	S4N
Turkey vulture	Cathartes aura	G5	S5B,S5N
Upland sandpiper	Bartramia longicauda	G5	S1B
Varied thrush	Ixoreus naevius	G5	SAN
Veery	Catharus fuscescens	G5	S4B
Vermilion flycatcher	Pyrocephalus rubinus	G5	SAN
Vesper sparrow	Pooecetes gramineus	G5	S3S4B,S2N
Virginia rail	Rallus limicola	G5	S4B,S4N
Warbling vireo	Vireo gilvus	G5	S4B
Wayne's black-throated green warbler	Dendroica virens waynei	G5TU	SU

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Western grebe	Aechmophorus occidentalis	G5	SAN
Western kingbird	Tyrannus verticalis	G5	SAN
Western sandpiper	Calidris mauri	G5	SZN
Western tanager	Piranga ludoviciana	G5	SAN
Whimbrel	Numenius phaeopus	G5	SZN
Whip-poor-will	Caprimulgus vociferus	G5	S3S4B
White ibis	Eudocimus albus	G5	SAN
White-breasted nuthatch	Sitta carolinensis	G5	S5
White-crowned sparrow	Zonotrichia leucophrys	G5	S3S4N
White-eyed vireo	Vireo griseus	G5	S5B
White-faced storm-petrel	Pelagodroma marina	G5	SAN
White-rumped sandpiper	Calidris fuscicollis	G5	SZN
White-throated sparrow	Zonotrichia albicollis	G5	SAB,S5N
White-winged crossbill	Loxia leucoptera	G5	SAN
White-winged dove	Zenaida asiatica	G5	SAN
White-winged scoter	Melanitta fusca	G5	S3N
Wild turkey	Meleagris gallopavo	G5	S4
Willet	Catoptrophorus semipalmatus	G5	S3S4B
Willow flycatcher	Empidonax traillii	G5	S4B
Wilson's phalarope	Phalaropus tricolor	G5	SZN
Wilson's plover	Charadrius wilsonia	G5	S1B
Wilson's snipe	Gallinago delicata	G5	S2N
Wilson's storm-petrel	Oceanites oceanicus	G5	SZN
Wilson's warbler	Wilsonia pusilla	G5	SZN
Winter wren	Troglodytes troglodytes	G5	S2B,S3N
Wood duck	Aix sponsa	G5	S5B,S3N
Wood stork	Mycteria americana	G4	SAN
Wood thrush	Hylocichla mustelina	G5	S5B
Worm-eating warbler	Helmitheros vermivorus	G5	S4B
Yellow rail	Coturnicops noveboracensis	G4	SAN
Yellow warbler	Dendroica petechia	G5	S5B
Yellow-bellied flycatcher	Empidonax flaviventris	G5	SZN
Yellow-bellied sapsucker	Sphyrapicus varius	G5	SHB,S3N
Yellow-billed cuckoo	Coccyzus americanus	G5	S5B
Yellow-breasted chat	Icteria virens	G5	S5B
Yellow-crowned night-heron	Nyctanassa violacea	G5	S2B
Yellow-headed blackbird	Xanthocephalus xanthocephalus	G5	SAN
Yellow-legged gull	Larus cachinnans	G5	SAN
Yellow-nosed albatross	Thalassarche chlororhynchos	G3	SAN
Yellow-rumped warbler	Dendroica coronata	G5	SAB,S4N
Yellow-throated vireo	Vireo flavifrons	G5	S4S5B
Yellow-throated warbler	Dendroica dominica	G5	S4B
REPTILES			
Atlantic hawksbill seaturtle	Eretmochelys imbricata	G3	SRN
Black ratsnake	Elaphe obsoleta	G5	S5

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Bog turtle	Clemmys muhlenbergii	G3	S2
Broad-headed skink	Eumeces laticeps	G5	S4
Common five-lined skink	Eumeces fasciatus	G5	S5
Common ribbonsnake	Thamnophis sauritus	G5	S5
Cornsnake	Elaphe guttata	G5	S4
Eastern box turtle	Terrapene carolina	G5	S5
Eastern gartersnake	Thamnophis sirtalis	G5	S5
Eastern hog-nosed snake	Heterodon platirhinos	G5	S5
Eastern kingsnake	Lampropeltis getula	G5	S5
Eastern mud turtle	Kinosternon subrubrum	G5	S5
Eastern six-lined racerunner	Cnemidophorus sexlineatus	G5	S4
Eastern smooth earthsnake	Virginia valeriae valeriae	G5	S4S5
Eastern snapping turtle	Chelydra serpentina	G5	S5
Eastern spiny softshell	Apalone spinifera	G5	S1
Eastern wormsnake	Carphophis amoenus	G5	S5
Green seaturtle	Chelonia mydas	G3	S1N
Kemp's ridley seaturtle	Lepidochelys kempii	G1	S1N
Leatherback seaturtle	Dermochelys coriacea	G2	S1
Little brown skink	Scincella lateralis	G5	S5
Loggerhead seaturtle	Caretta caretta	G3	S1B,S1N
Mediterranean gecko	Hemidactylus turcicus	G5	SE
Milksnake	Lampropeltis triangulum	G5	S5
Mole kingsnake	Lampropeltis calligaster	G5	S4
Mountain earthsnake	Virginia valeriae pulchra	G5T3T4	S2
Northern black racer	Coluber constrictor	G5	S5
Northern brownsnake	Storeria dekayi	G5	S5
Northern coal skink	Eumeces anthracinus	G5	SU
Northern copperhead	Agkistrodon contortrix	G5	S5
Northern diamond-backed terrapin	Malaclemys terrapin terrapin	G4T4	S4
Northern fence lizard	Sceloporus undulatus	G5	S5
Northern map turtle	Graptemys geographica	G5	S1
Northern pinesnake	Pituophis melanoleucus	G4	SH
Northern red-bellied snake	Storeria occipitomaculata	G5	S5
Northern red-bellied turtle	Pseudemys rubriventris	G5	S5
Northern rough greensnake	Opheodrys aestivus	G5	S5
Northern scarletsnake	Cemophora coccinea	G5	S3
Northern watersnake	Nerodia sipedon	G5	S5
Painted turtle	Chrysemys picta	G5	S5
Queen snake	Regina septemvittata	G5	S5
Rainbow snake	Farancia erytrogramma	G5	S1
Red-bellied watersnake	Nerodia erythrogaster erythrogaster	G5T5	S2S3
Red-eared slider	Trachemys scripta	G5	S5
Ring-necked snake	Diadophis punctatus	G5	S5
Smooth greensnake	Liochlorophis vernalis	G5	S5
Southeastern five-lined skink	Eumeces inexpectatus	G5	S4
Spotted turtle	Clemmys guttata	G5	S5

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Stinkpot	Sternotherus odoratus	G5	S5
Timber rattlesnake	Crotalus horridus	G4	S3
Wood turtle	Glyptemys insculpta	G4	S4
AMPHIBIANS			
Allegheny Mountain dusky salamander	Desmognathus ochrophaeus	G5	S5
American bullfrog	Rana catesbeiana	G5	S5
American toad	Bufo americanus	G5	S5
Barking treefrog	Hyla gratiosa	G5	S1
Carpenter frog	Rana virgatipes	G5	S2
Common mudpuppy	Necturus maculosus	G5	S1
Cope's gray treefrog	Hyla chrysoscelis	G5	S5
Eastern cricket frog	Acris crepitans	G5	S5
Eastern hellbender	Cryptobranchus alleganiensis	G3G4	S1
Eastern mud salamander	Pseudotriton montanus	G5	S2?
Eastern narrow-mouthed toad	Gastrophryne carolinensis	G5	S1S2
Eastern red-backed salamander	Plethodon cinereus	G5	S5
Eastern spadefoot	Scaphiopus holbrookii	G5	S4
Eastern tiger salamander	Ambystoma tigrinum	G5	S2
Four-toed salamander	Hemidactylium scutatum	G5	S5
Fowler's toad	Bufo fowleri	G5	S5
Gray treefrog	Hyla versicolor	G5	S5
Green salamander	Aneides aeneus	G3G4	S2
Green treefrog	Hyla cinerea	G5	S5
Jefferson salamander	Ambystoma jeffersonianum	G4	S3
Long-tailed salamander	Eurycea longicauda	G5	S5
Marbled salamander	Ambystoma opacum	G5	S5
Mountain chorus frog	Pseudacris brachyphona	G5	S2
New Jersey chorus frog	Pseudacris feriarum kalmi	G5T4	S4
Northern dusky salamander	Desmognathus fuscus	G5	S5
Northern green frog	Rana clamitans	G5	S5
Northern leopard frog	Rana pipiens	G5	S4
Northern red salamander	Pseudotriton ruber	G5	S5
Northern slimy salamander	Plethodon glutinosus	G5	S5
Northern spring peeper	Pseudacris crucifer	G5	S5
Northern spring salamander	Gyrinophilus porphyriticus	G5	S4
Northern two-lined salamander	Eurycea bislineata	G5	S5
Pickerel frog	Rana palustris	G5	S5
Pine woods treefrog	Hyla femoralis	G5	SP
Red-spotted newt	Notophthalmus viridescens	G5	S5
Seal salamander	Desmognathus monticola	G5	S5
Southern leopard frog	Rana sphenocephala	G5	S4S5
Spotted salamander	Ambystoma maculatum	G5	S5
Upland chorus frog	Pseudacris feriarum feriarum	G5	S5
Valley and ridge salamander	Plethodon hoffmani	G5	S5
Wehrle's salamander	Plethodon wehrlei	G5	S2

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Wood frog	Rana sylvatica	G5	S5
FISHES			
Alewife	Alosa pseudoharengus	G5	S5
American brook lamprey	Lampetra appendix	G4	S1S2
American eel	Anguilla rostrata	G5	S4
American shad	Alosa sapidissima	G5	S3
Atlantic angel shark	Squatina dumeril	G?	S?
Atlantic sturgeon	Acipenser oxyrinchus	G3	S1
Banded darter	Etheostoma zonale	G5	SE
Banded killifish	Fundulus diaphanus	G5	S5
Banded sunfish	Enneacanthus obesus	G5	S2
Black bullhead	Ameiurus melas	G5	S?
Black crappie	Pomoxis nigromaculatus	G5	SE
Black dogfish	Centroscyllium fabricii	G?	S?
Blackbanded sunfish	Enneacanthus chaetodon	G4	S1
Blacknose dace	Rhinichthys atratulus	G5	S5
Blue catfish	Ictalurus furcatus	G5	SE
Blue ridge sculpin	Cottus caeruleomentum	G4	S4
Blueback herring	Alosa aestivalis	G5	S5
Bluegill	Lepomis macrochirus	G5	SE?
Bluespotted sunfish	Enneacanthus gloriosus	G5	S3S4
Bluntnose minnow	Pimephales notatus	G5	S5
Bowfin	Amia calva	G5	S1?
Bramble shark	Echinorhinus brucus	G?	S?
Bridle shiner	Notropis bifrenatus	G5	SH
Brook trout	Salvelinus fontinalis	G5	S3S4
Broudband shark	Etmopterus gracilispinis	G?	S?
Brown bullhead	Ameiurus nebulosus	G5	S5
Brown trout	Salmo trutta	G5	SE
Central stoneroller	Campostoma anomalum	G5	S5
Chain pickerel	Esox niger	G5	S5
Channel catfish	Ictalurus punctatus	G5	SE
Cheat minnow	Pararhinichthys bowersi	G1G2Q	SX
Checkered sculpin	Cottus sp 7	G4Q	S1S2
Comely shiner	Notropis amoenus	G5	S2
Common carp	Cyprinus carpio	G5	SE
Common shiner	Luxilus cornutus	G5	S5
Creek chub	Semotilus atromaculatus	G5	S5
Creek chubsucker	Erimyzon oblongus	G5	S5
Cuban dogfish	Squalus cubensis	G?	S?
Cutlips minnow	Exoglossum maxillingua	G5	S5
Cutthroat trout	Oncorhynchus clarki	G4	SE
Eastern mosquitofish	Gambusia holbrooki	G5	S4S5
Eastern mudminnow	Umbra pygmaea	G5	S5
Eastern silvery minnow	Hybognathus regius	G5	S4

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Emerald shiner	Notropis atherinoides	G5	SE
Fallfish	Semotilus corporalis	G5	S5
Fantail darter	Etheostoma flabellare	G5	S4
Fathead minnow	Pimephales promelas	G5	SE
Flathead catfish	Pylodictis olivaris	G5	SE?
Flier	Centrarchus macropterus	G5	S1S2
Gizzard shad	Dorosoma cepedianum	G5	S5
Glassy darter	Etheostoma vitreum	G4G5	S1S2
Golden redhorse	Moxostoma erythrurum	G5	S4
Golden shiner	Notemigonus crysoleucas	G5	S5
Goldfish	Carassius auratus	G5	SE
Grass carp	Ctenopharyngodon idella	G5	SE
Green sunfish	Lepomis cyanellus	G5	SE?
Greenland shark	Somniosus microcephalus	G?	S?
Greenside darter	Etheostoma blennioides	G5	S5
Hickory shad	Alosa mediocris	G5	S3
Ironcolor shiner	Notropis chalybaeus	G4	S1
Johnny darter	Etheostoma nigrum	G5	S3
Kitefin shark	Dalatias licha	G?	S?
Lake trout	Salvelinus namaycush	G5	SE
Largemouth bass	Micropterus salmoides	G5	SE
Least brook lamprey	Lampetra aepyptera	G5	S4
Logperch	Percina caprodes	G5	S1S2
Longear sunfish	Lepomis megalotis	G5	S4
Longnose dace	Rhinichthys cataractae	G5	S5
Longnose gar	Lepisosteus osseus	G5	S2?
Longnose sucker	Catostomus catostomus	G5	SH
Margined madtom	Noturus insignis	G5	S5
Maryland darter	Etheostoma sellare	GH	SH
Mottled sculpin	Cottus bairdi	G5	S3S4
Mud sunfish	Acantharchus pomotis	G5	S2
Mummichog	Fundulus heteroclitus	G5	S5
Muskellunge	Esox masquinongy	G5	SE
Northern hogsucker	Hypentelium nigricans	G5	S5
Northern pike	Esox lucius	G5	SE
Pacific angel shark	Squatina californica	G?	S?
Pacific sleeper shark	Somniosus pacificus	G?	S?
Pearl dace	Margariscus margarita	G5	S1S2
Pirate perch	Aphredoderus sayanus	G5	S5
Portuguese shark	Centroscymnus coelolepis	G?	S?
Potomac sculpin	Cottus girardi	G4	S4
Prickly shark	Echinorhinus cookei	G?	S?
Pumpkinseed	Lepomis gibbosus	G5	S5
Quillback	Carpiodes cyprinus	G5	S4?
Rainbow darter	Etheostoma caeruleum	G5	SE
Rainbow trout	Oncorhynchus mykiss	G5	SE

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Redbreast sunfish	Lepomis auritus	G5	S5
Redfin pickerel	Esox americanus	G5	S5
Redside dace	Clinostomus elongatus	G4	SX
River chub	Nocomis micropogon	G5	S5
Rock bass	Ambloplites rupestris	G5	S5
Rosyface shiner	Notropis rubellus	G5	S4S5
Rosyside dace	Clinostomus funduloides	G5	S5
Roughskin dogfish	Squalus asper	G?	S?
Satinfin shiner	Cyprinella analostana	G5	S4S5
Scup	Stenotomus chrysops	G?	S?
Sea lamprey	Petromyzon marinus	G5	S4
Shield darter	Percina peltata	G5	S3
Shorthead redhorse	Moxostoma macrolepidotum	G5	S4
Shortnose sturgeon	Acipenser brevirostrum	G3	S1
Silver shiner	Notropis photogenis	G5	SE
Silverjaw minnow	Ericymba buccata	G5	S4
Smallmouth bass	Micropterus dolomieu	G5	S5
Spanish mackerel	Scomberomorus maculatus	G5	S?
Spiny dogfish	Squalus acanthias	G?	S?
Spotfin killifish	Fundulus luciae	G4	S2?
Spotfin shiner	Cyprinella spiloptera	G5	S4
Spottail shiner	Notropis hudsonius	G5	S5
Stonecat	Noturus flavus	G5	S1
Stripeback darter	Percina notogramma	G4	S1
Striped bass	Morone saxatilis	G5	S5
Striped shiner	Luxilus chrysocephalus	G5	S1S2
Swallowtail shiner	Notropis procne	G5	S5
Swamp darter	Etheostoma fusiforme	G5	S2
Tadpole madtom	Noturus gyrinus	G5	S4
Tautog	Tautoga onitis	G?	S?
Tessellated darter	Etheostoma olmstedi	G5	S5
Threadfin shad	Dorosoma petenense	G5	SE?
Threespine stickleback	Gasterosteus aculeatus	G5	S?
Trout-perch	Percopsis omiscomaycus	G5	SX
Walleye	Stizostedion vitreum	G5	SE?
Warmouth	Lepomis gulosus	G5	S3?
White bass	Morone chrysops	G5	SE
White catfish	Ameiurus catus	G5	SU
White crappie	Pomoxis annularis	G5	SE
White perch	Morone americana	G5	S5
White sucker	Catostomus commersoni	G5	S5
Yellow bullhead	Ameiurus natalis	G5	S5
Yellow perch	Perca flavescens	G5	S5

INVERTEBRATES

DRAGONFLIES & DAMSELFLIES

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Allegheny river cruiser	Macromia alleghaniensis	G4	S2
Allegheny snaketail	Ophiogomphus incurvatus	G3	S2
Amber-winged spreadwing	Lestes eurinus	G4	S3
American emerald	Cordulia shurtleffi	G5	S3
American rubyspot	Hetaerina americana	G5	S3S4
Appalachian jewelwing	Calopteryx angustipennis	G4	SP
Arrow clubtail	Stylurus spiniceps	G5	S3
Arrowhead spiketail	Cordulegaster obliqua	G4	S2
Ashy clubtail	Gomphus lividus	G5	S5
Atlantic bluet	Enallagma doubledayi	G5	SH
Attenuated bluet	Enallagma daeckii	G4	S3
Aurora damsel	Chromagrion conditum	G5	S3S4
Azure bluet	Enallagma aspersum	G5	S3S4
Banded pennant	Celithemis fasciata	G5	S3
Band-winged meadowhawk	Sympetrum semicinctum	G5	S3
Bar-winged skimmer	Libellula axilena	G5	S3
Beaverpond baskettail	Epitheca canis	G5	S3
Beaverpond clubtail	Gomphus borealis	G4	SP
Big bluet	Enallagma durum	G5	S3
Black saddlebags	Tramea lacerata	G5	S5
Black-shouldered spinyleg	Dromogomphus spinosus	G5	S4
Black-tipped darner	Aeshna tuberculifera	G4	S2
Blackwater bluet	Enallagma weewa	G5	S1
Blue corporal	Libellula deplanata	G5	S4S5
Blue dasher	Pachydiplax longipennis	G5	S5
Blue-faced meadowhawk	Sympetrum ambiguum	G5	S3S4
Blue-fronted dancer	Argia apicalis	G5	S4
Blue-ringed dancer	Argia sedula	G5	S3
Blue-tipped dancer	Argia tibialis	G5	S4
Brown spiketail	Cordulegaster bilineata	G5	S2
Burgundy bluet	Enallagma dubium	G5	S1
Calico pennant	Celithemis elisa	G5	S5
Canada darner	Aeshna canadensis	G5	S2
Carolina saddlebags	Tramea carolina	G5	S4S5
Chalk-fronted skimmer	Libellula julia	G5	S2
Cherry-faced meadowhawk	Sympetrum internum	G5	SR
Cinnamon shadowdragon	Neurocordulia virginiensis	G4	S1
Citrine forktail	Ischnura hastata	G5	S4S5
Clamp-tipped emerald	Somatochlora tenebrosa	G5	S3S4
Cobra clubtail	Gomphus vastus	G5	S3
Comet darner	Anax longipes	G5	S3
Common baskettail	Epitheca cynosura	G5	S5
Common green darner	Anax junius	G5	S5
Common sanddragon	Progomphus obscurus	G5	S3
Common spreadwing	Lestes disjunctus	G5	S5
Common whitetail	Libellula lydia	G5	S5

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Crimson-ringed whiteface	Leucorrhinia glacialis	G5	S1
Cyrano darner	Nasiaeschna pentacantha	G5	S3
Delta-spotted spiketail	Cordulegaster diastatops	G5	S3
Dot-tailed whiteface	Leucorrhinia intacta	G5	S3
Double-ringed pennant	Celithemis verna	G5	S2
Double-striped bluet	Enallagma basidens	G5	S4
Dragonhunter	Hagenius brevistylus	G5	S4
Dusky clubtail	Gomphus spicatus	G5	SP
Dusky dancer	Argia translata	G5	S4
Eastern amberwing	Perithemis tenera	G5	S5
Eastern forktail	Ischnura verticalis	G5	S5
Eastern pondhawk	Erythemis simplicicollis	G5	S5
Eastern red damsel	Amphiagrion saucium	G5	S3
Eastern ringtail	Erpetogomphus designatus	G5	S2
Ebony jewelwing	Calopteryx maculata	G5	S5
Elegant spreadwing	Lestes inaequalis	G5	S4
Elfin skimmer	Nannothemis bella	G4	S1
Elusive clubtail	Stylurus notatus	G3	SU
Emerald spreadwing	Lestes dryas	G5	SH
Faded pennant	Celithemis ornata	G5	S1
Familiar bluet	Enallagma civile	G5	S5
Fawn darner	Boyeria vinosa	G5	S4S5
Fine-lined emerald	Somatochlora filosa	G5	S2
Flag-tailed spinyleg	Dromogomphus spoliatus	G4G5	SR
Four-spotted pennant	Brachymesia gravida	G5	S3S4
Four-spotted skimmer	Libellula quadrimaculata	G5	SA?
Fragile forktail	Ischnura posita	G5	S5
Frosted whiteface	Leucorrhinia frigida	G5	SP
Furtive forktail	Ischnura prognata	G4	SP
Georgia river cruiser	Macromia illinoiensis georgina	G5T5	S3S4
Golden bluet	Enallagma sulcatum	G4	SU
Golden-winged skimmer	Libellula auripennis	G5	S3
Gray petaltail	Tachopteryx thoreyi	G4	S2
Great blue skimmer	Libellula vibrans	G5	S4S5
Great spreadwing	Archilestes grandis	G5	S3
Greater hyacinth glider	Miathyria marcella	G5	SA
Green-faced clubtail	Gomphus viridifrons	G3	S1
Green-striped darner	Aeshna verticalis	G5	S2
Hagen's bluet	Enallagma hageni	G5	S3S4
Halloween pennant	Celithemis eponina	G5	S4S5
Harlequin darner	Gomphaeschna furcillata	G5	S3
Harpoon clubtail	Gomphus descriptus	G4	S1
Hudsonian whiteface	Leucorrhinia hudsonica	G5	S1
Illinois river cruiser	Macromia illinoiensis	G5	S4
Jane's meadowhawk	Sympetrum janeae	G5	SU
Lake darner	Aeshna eremita	G5	SR

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Lancet clubtail	Gomphus exilis	G5	S5
Lance-tipped darner	Aeshna constricta	G5	SH
Laura's clubtail	Stylurus laurae	G4	S2
Least clubtail	Stylogomphus albistylus	G5	S3S4
Lilypad clubtail	Arigomphus furcifer	G5	SP
Lilypad forktail	Ischnura kellicotti	G5	S3S4
Little blue dragonlet	Erythrodiplax minuscula	G5	S1
Lyre-tipped spreadwing	Lestes unguiculatus	G5	SH
Maine snaketail	Ophiogomphus mainensis	G4	SP
Mantled baskettail	Epitheca semiaquea	G4	SH
Marsh bluet	Enallagma ebrium	G5	SH
Martha's pennant	Celithemis martha	G4	S2
Midland clubtail	Gomphus fraternus	G5	S2
Mocha emerald	Somatochlora linearis	G5	S3S4
Needham's skimmer	Libellula needhami	G5	S4S5
Northern pygmy clubtail	Lanthus parvulus	G4	S1
Ocellated darner	Boyeria grafiana	G5	S1
Orange bluet	Enallagma signatum	G5	S4
Painted skimmer	Libellula semifasciata	G5	S4S5
Pale bluet	Enallagma pallidum	G4	SH
Petite emerald	Dorocordulia lepida	G5	SH
Piedmont clubtail	Gomphus parvidens	G4	SH
Powdered dancer	Argia moesta	G5	S4
Prince baskettail	Epitheca princeps	G5	S4
Pronghorn clubtail	Gomphus graslinellus	G5	SR
Rainbow bluet	Enallagma antennatum	G5	S1
Rambur's forktail	Ischnura ramburii	G5	S4
Rapids clubtail	Gomphus quadricolor	G3G4	S1
Red-mantled saddlebags	Tramea onusta	G5	SA
Riffle snaketail	Ophiogomphus carolus	G5	SP
River jewelwing	Calopteryx aequabilis	G5	S1
Riverine clubtail	Stylurus amnicola	G4	SH
Robust baskettail	Epitheca spinosa	G4	S1S2
Roseate skimmer	Orthemis ferruginea	G5	SA
Royal river cruiser	Macromia taeniolata	G5	S3
Ruby meadowhawk	Sympetrum rubicundulum	G5	S4
Russet-tipped clubtail	Stylurus plagiatus	G5	S3
Rusty snaketail	Ophiogomphus rupinsulensis	G5	S2
Sable clubtail	Gomphus rogersi	G4	S1
Seaside dragonlet	Erythrodiplax berenice	G5	S4
Sedge sprite	Nehalennia irene	G5	S3
Seepage dancer	Argia bipunctulata	G4	S3
Selys' sunfly	Helocordulia selysii	G4	S2
Shadow darner	Aeshna umbrosa	G5	S4
Skillet clubtail	Gomphus ventricosus	G3	SH
Skimming bluet	Enallagma geminatum	G5	S4S5

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Ski-tailed emerald	Somatochlora elongata	G5	S1
Slaty skimmer	Libellula incesta	G5	S5
Slender bluet	Enallagma traviatum	G5	S3
Slender spreadwing	Lestes rectangularis	G5	S4S5
Smoky rubyspot	Hetaerina titia	G5	SH
Southern pygmy clubtail	Lanthus vernalis	G4	S1
Southern sprite	Nehalennia integricollis	G5	S1S2
Sparkling jewelwing	Calopteryx dimidiata	G5	SH
Sphagnum sprite	Nehalennia gracilis	G5	S2
Spine-crowned clubtail	Gomphus abbreviatus	G3G4	SH
Spiny baskettail	Epitheca spinigera	G5	SP
Splendid clubtail	Gomphus lineatifrons	G4	SH
Spotted spreadwing	Lestes congener	G5	S3
Spot-winged glider	Pantala hymenaea	G5	S5
Spring blue darner	Aeshna mutata	G3G4	S1
Springtime darner	Basiaeschna janata	G5	S4
Stream bluet	Enallagma exsulans	G5	S5
Stream cruiser	Didymops transversa	G5	S4S5
Striped saddlebags	Tramea calverti	G5	SA
Stripe-winged baskettail	Epitheca costalis	G4	S1
Stygian shadowdragon	Neurocordulia yamaskanensis	G5	S2
Superb jewelwing	Calopteryx amata	G4	S2
Swamp darner	Epiaeschna heros	G5	S5
Swamp spreadwing	Lestes vigilax	G5	S4
Sweetflag spreadwing	Lestes forcipatus	G5	S3
Taper-tailed darner	Gomphaeschna antilope	G4	S2
Tiger spiketail	Cordulegaster erronea	G4	S2
Treetop emerald	Somatochlora provocans	G4	S1
Tule bluet	Enallagma carunculatum	G5	SH
Turquoise bluet	Enallagma divagans	G5	S3S4
Twelve-spotted skimmer	Libellula pulchella	G5	S4S5
Twin-spotted spiketail	Cordulegaster maculata	G5	S4
Uhler's sundragon	Helocordulia uhleri	G5	S3
Umber shadowdragon	Neurocordulia obsoleta	G4	S3
Unicorn clubtail	Arigomphus villosipes	G5	S4
Variable dancer	Argia fumipennis	G5	S4S5
Vesper bluet	Enallagma vesperum	G5	S3
Wandering glider	Pantala flavescens	G5	S5
White corporal	Libellula exusta	G4	S1
White-faced meadowhawk	Sympetrum obtrusum	G5	S3
White-spangled skimmer	Libellula cyanea	G5	S5
Widow skimmer	Libellula luctuosa	G5	S5
Yellow-legged meadowhawk	Sympetrum vicinum	G5	S5
Yellow-sided skimmer	Libellula flavida	G5	S2
Zebra clubtail	Stylurus scudderi	G4	S1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
BUTTERFLIES & MOTHS			
A borer moth	Papaipema arctivorens	G5	S?
A borer moth	Papaipema baptisiae	G4	S?
A borer moth	Papaipema cataphracta	G5	S?
A borer moth	Papaipema cerussata	G5	S?
A borer moth	Papaipema marginidens	G4	S4
A borer moth	Papaipema nebris	G5	S?
A borer moth	Papaipema rutila	G4	S?
A borer moth	Papaipema stenocelis	G4	S?
A geometer moth	Apodrepanulatrix liberaria	G4	SU
A geometrid moth	Cyclophora nanaria	G5	S1?
A geometrid moth	Idaea eremiata	G4	S1?
A geometrid moth	Semiothisa aequiferaria	G5	S?
A lasiocampid moth	Artace cribraria	G5	S5
A lasiocampid moth	Tolype notialis	G?	S4
A lymantriid moth	Dasychira atrivenosa	G4	SU
A moth	Caripeta aretaria	G4	S4
A noctuid moth	Apamea apamiformis	G4	S2S3
A noctuid moth	Apamea mixta	GU	S1
A noctuid moth	Apamea plutonia	G4	SU
A noctuid moth	Capis curvata	G4	S1S2
A noctuid moth	Catocala praeclara	G5	S?
A noctuid moth	Elaphria georgei	G4	SU
A noctuid moth	Euxoa immixta	G4	S?
A noctuid moth	Hadena ectypa	G3G4	SU
A noctuid moth	Macrochilo hypocritalis	G4	S4?
A noctuid moth	Meropleon diversicolor	G4	S?
A noctuid moth	Meropleon titan	G2G4	SU
A noctuid moth	Renia nemoralis	G4	S1S3
A noctuid moth	Schinia parmeliana	GU	SH
A noctuid moth	Xestia bollii	G4?	SU
A noctuid moth	Zale curema	G3G4	S1?
A noctuid moth	Zale obliqua	G5	S4S5
A noctuid moth	Zale squamularis	G4	SU
A noctuid moth	Zale submediana	G4	S1S3
Aaron's skipper	Poanes aaroni	G4	S4
Acadian hairstreak	Satyrium acadicum	G5	SA
American chestnut nepticulid moth	Ectoedemia castaneae	GH	SH
American copper	Lycaena phlaeas	G5	S5
American holly azure	Celastrina idella	G4G5	S?
American lady	Vanessa virginiensis	G5	S5B,SZN
American snout	Libytheana carinenta	G5	SZB,SZN
An underwing moth	Catocala amica	G5	S?
An underwing moth	Catocala andromedae	G5	S?
An underwing moth	Catocala carissima	G5	S?
An underwing moth	Catocala cerogama	G5	S?

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
An underwing moth	Catocala coccinata	G5	S?
An underwing moth	Catocala dejecta	G4	S?
An underwing moth	Catocala flebilis	G5	S?
An underwing moth	Catocala grynea	G5	S?
An underwing moth	Catocala habilis	G5	S?
An underwing moth	Catocala innubens	G5	S?
An underwing moth	Catocala judith	G5	S?
An underwing moth	Catocala lineella	G5	S?
An underwing moth	Catocala maestosa	G5	S?
An underwing moth	Catocala micronympha	G5	S?
An underwing moth	Catocala muliercula	G5	S?
An underwing moth	Catocala palaeogama	G5	S?
An underwing moth	Catocala parta	G5	S?
An underwing moth	Catocala relicta	G5	S?
An underwing moth	Catocala residua	G5	S?
An underwing moth	Catocala similis	G5	S?
An underwing moth	Catocala sordida	G5	S?
An underwing moth	Catocala subnata	G5	S?
An underwing moth	Catocala ultronia	G5	S?
An underwing moth	Catocala vidua	G5	S?
Aphrodite fritillary	Speyeria aphrodite	G5	S4
Appalachian blue	Celastrina neglectamajor	G4	S3S4
Appalachian eyed brown	Satyrodes appalachia	G4	S4
Aralia shoot borer moth	Papaipema araliae	G3G4	S?
Ash borer moth	Papaipema furcata	G4	S?
Atlantis fritillary	Speyeria atlantis	G5	S1
Aureolaria seed borer	Rhodoecia aurantiago	G4	S?
Baltimore checkerspot	Euphydryas phaeton	G4	S3
Banded hairstreak	Satyrium calanus	G5	S5
Barred yellow	Eurema daira	G5	SAN
Barrens xylotype	Xylotype capax	G4	SU
Black dash	Euphyes conspicuus	G4	S4
Black swallowtail	Papilio polyxenes	G5	S5
Black-waved flannel moth	Lagoa crispata	G5	SU
Bog copper	Lycaena epixanthe	G4G5	S1
Brazilian skipper	Calpodes ethlius	G5	SAN
Broad-lined catopyrrha	Erastria coloraria	G4	SH
Broad-winged skipper	Poanes viator	G5	S4
Bronze copper	Lycaena hyllus	G5	S4
Brown elfin	Incisalia augustinus	G5	S4
Cannubial underwing	Catocala connubialis	G5	S?
Carolina satyr	Hermeuptychia sosybius	G5	S1S3
Checkered white	Pontia protodice	G4	S4
Chermock's mulberry wing	Poanes massasoit chermocki	G4T1	S1
Chestnut clearwing moth	Synanthedon castaneae	G3G5	SX
Clouded skipper	Lerema accius	G5	SZN

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Clouded sulphur	Colias philodice	G5	S5
Clouded underwing	Catocala nebulosa	G5	S?
Cloudless sulphur	Phoebis sennae	G5	SZB,SZN
Cobweb skipper	Hesperia metea	G4G5	S3
Common buckeye	Junonia coenia	G5	S5B,SZN
Common checkered-skipper	Pyrgus communis	G5	S5
Common ptichodis	Ptichodis herbarum	G4	S?
Common roadside-skipper	Amblyscirtes vialis	G5	S4
Common sootywing	Pholisora catullus	G5	S5
Common wood-nymph	Cercyonis pegala	G5	S5
Compton tortoiseshell	Nymphalis vaualbum	G5	S1B,SZN
Confused cloudywing	Thorybes confusis	G4	SU
Coral hairstreak	Harkenclenus titus	G5	S4
Crossline skipper	Polites origenes	G5	S5
Cypress sphinx moth	Isoparce cupressi	G4	SU
Darling underwing	Catocala cara	G5	S?
Delaware skipper	Atrytone logan	G5	S4
Diana fritillary	Speyeria diana	G3	SAH
Dion skipper	Euphyes dion	G4	S3
Dog face	Colias cesonia	G5	SAN
Dotted skipper	Hesperia attalus slossonae	G3G4T3	SH
Dreamy duskywing	Erynnis icelus	G5	S5
Dun skipper	Euphyes vestris	G5	S5
Dusky azure	Celastrina ebenina	G4	SH
Dusted skipper	Atrytonopsis hianna	G4G5	S4
Early hairstreak	Erora laeta	G3G4	S1
Eastern comma	Polygonia comma	G5	S5
Eastern pine elfin	Incisalia niphon	G5	S4
Eastern tailed-blue	Everes comyntas	G5	S5
Eastern tiger swallowtail	Papilio glaucus	G5	S5
Edwards' hairstreak	Satyrium edwardsii	G4	S1
Epione underwing	Catocala epione	G5	S?
Esther moth	Hypagyrtis esther	G5	S5
Eufala skipper	Lerodea eufala	G5	SAN
European cabbage white	Pieris rapae	G5	SE
European skipper	Thymelicus lineola	G5	SE
Falcate orange tip	Anthocharis midea	G4G5	S5
Fiery skipper	Hylephila phyleus	G5	SZB,SZN
Footpath sallow moth	Metaxaglaea semitaria	G5	S4
Four-lined chocolate moth	Argyrostrotis quadrifilaris	G4	S?
Franck's sphinx	Sphinx franckii	G4	S1S2
Frosted elfin	Incisalia irus	G3	S1
Gemmed satyr	Cyllopsis gemma	G5	SR
Giant swallowtail	Papilio cresphontes	G5	S2
Golden-banded skipper	Autochton cellus	G4	SH
Graceful underwing	Catocala gracilis	G5	S?

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Gray comma	Polygonia progne	G5	S1S3
Gray hairstreak	Strymon melinus	G5	S5
Great purple hairstreak	Atlides halesus	G5	S1S2
Great southern white	Ascia monuste	G5	SAN
Great spangled fritillary	Speyeria cybele	G5	S5
Gulf fritillary	Agraulis vanillae	G5	SAN
Gypsy moth	Lymantria dispar	G5	SE
Hackberry emperor	Asterocampa celtis	G5	S5
Harris's checkerspot	Chlosyne harrisii	G4	S2
Harvester	Feniseca tarquinius	G4	S4
Hayhurst's scallopwing	Staphylus hayhurstii	G5	S4
Henry's elfin	Incisalia henrici	G5	S4
Hessel's hairstreak	Mitoura hesseli	G3G4	SH
Hickory hairstreak	Satyrium caryaevorum	G4	S1
Hoary edge	Achalarus lyciades	G5	S5
Hoary elfin	Callophrys polios	G5	S1
Hobomok skipper	Poanes hobomok	G5	S5
Horace's duskywing	Erynnis horatius	G5	S5
Ilia underwing	Catocala ilia	G5	S?
Indian skipper	Hesperia sassacus	G5	S3
Joyful holomelina moth	Holomelina laeta	G5	S1?
Juniper hairstreak	Mitoura grynea	G5	S4
Juvenal's duskywing	Erynnis juvenalis	G5	S5
King's hairstreak	Satyrium kingi	G3G4	S1
Large orange sulphur	Phoebis agarithe	G5	SA
Least skipper	Ancyloxypha numitor	G5	S5
Lemmer's noctuid moth	Lithophane lemmeri	G3G4	S?
Leonard's skipper	Hesperia leonardus	G4	S4
Little glassywing	Pompeius verna	G5	S5
Little metalmark	Calephelis virginiensis	G4	SR
Little sulphur	Eurema lisa	G5	SZB,SZN
Little wood satyr	Megisto cymela	G5	S5
Long dash	Polites mystic	G5	S3
Long-tailed skipper	Urbanus proteus	G5	SZN
Marbled underwing	Catocala marmorata	G3G4	SH
Meadow fritillary	Boloria bellona	G5	S4
Milbert's tortoiseshell	Nymphalis milberti	G5	SAN
Mitchell's satyr	Neonympha mitchellii	G1G2	SR
Monarch	Danaus plexippus	G4	SZB
Mottled duskywing	Erynnis martialis	G3G4	S1
Mourning cloak	Nymphalis antiopa	G5	S5B,SZN
Mulberry wing	Poanes massasoit	G4	S4
Northern broken-dash	Wallengrenia egeremet	G5	S5
Northern cloudywing	Thorybes pylades	G5	S5
Northern crescent	Phyciodes cocyta	G5	SP
Northern hairstreak	Fixsenia ontario	G4T4	S1S2

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Northern metalmark	Calephelis borealis	G3G4	S2
Northern pearly-eye	Enodia anthedon	G5	S4
Ocola skipper	Panoquina ocola	G5	SZN
Olympia marble	Euchloe olympia	G4G5	S2
Orange sulphur	Colias eurytheme	G5	S5
Packard's lichen moth	Cisthene packardii	G5	S5
Painted lady	Vanessa cardui	G5	S5B,SZN
Palamedes swallowtail	Papilio palamedes	G5	S1
Palatka skipper	Euphyes pilatka	G3G4	SA
Pearl crescent	Phyciodes tharos	G5	S5
Peck's skipper	Polites coras	G5	S5
Pepper and salt skipper	Amblyscirtes hegon	G5	S2
Persius duskywing	Erynnis persius persius	G5T2T3	SH
Phleophagan chestnut nepticulid moth	Ectoedemia phleophaga	GH	SH
Pine barrens zanclognatha	Zanclognatha martha	G4	S1S3
Pine devil	Citheronia sepulcralis	G5	S4
Pink-edged sulphur	Colias interior	G5	S1
Pipevine swallowtail	Battus philenor	G5	S4
Polymnia stalk borer	Papaipema polymniae	G4	SH
Precious underwing	Catocala pretiosa pretiosa	G4T2T3	SH
Question mark	Polygonia interrogationis	G5	S5
Rare skipper	Problema bulenta	G2G3	S1
Red admiral	Vanessa atalanta	G5	S5B,SZN
Red-banded hairstreak	Calycopis cecrops	G5	S4
Red-spotted purple	Limenitis arthemis	G5	S5
Regal fritillary	Speyeria idalia	G3	SH
Regal moth	Citheronia regalis	G5	S4
Sachem	Atalopedes campestris	G5	SZB,SZN
Salt marsh skipper	Panoquina panoquin	G5	S4
Seaside goldenrod stem borer	Papaipema duovata	G4	SU
Silver-bordered fritillary	Boloria selene	G5	S3
Silver-spotted skipper	Epargyreus clarus	G5	S5
Silvery blue	Glaucopsyche lygdamus	G5	S2
Silvery checkerspot	Chlosyne nycteis	G5	S4
Sinuous lytrosis	Lytrosis sinuosa	G4	S1S3
Sleepy duskywing	Erynnis brizo	G5	S5
Sleepy orange	Eurema nicippe	G5	SZB,SZN
Southern broken-dash	Wallengrenia otho	G5	S3S4
Southern cloudywing	Thorybes bathyllus	G5	S4
Southern grizzled skipper	Pyrgus wyandot	G2	S1
Southern hairstreak	Fixsenia favonius	G4	S?
Southern ptichodis	Ptichodis bistrigata	G3	S?
Southern variable dart moth	Anomogyna elimata	G5	S5
Spicebush swallowtail	Papilio troilus	G5	S5
Spiny oakworm	Anisota stigma	G5	S4
Spring azure	Celastrina argiolus	G5	S5

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Striped hairstreak	Satyrium liparops	G5	S4
Summer azure	Celastrina neglecta	G5	S?
Swarthy skipper	Nastra lherminier	G5	S5
Tawny crescent	Phyciodes batesii batesii	G4T1	SH
Tawny emperor	Asterocampa clyton	G5	S4
Tawny-edged skipper	Polites themistocles	G5	S5
Tearful underwing	Catocala lacrymosa	G5	S?
The bride	Catocala neogama	G5	S?
The buckmoth	Hemileuca maia maia	G5T5	SU
The penitent	Catocala piatrix	G5	S?
The sweetheart underwing	Catocala amatrix	G5	S?
Three-horned moth	Pachypolia atricornis	G3G4	SH
Twin-spot skipper	Oligoria maculata	G5	SAN
Two-spotted skipper	Euphyes bimacula	G4	S1
Variable tropic moth	Hemeroplanis scopulepes	G5	S?
Variegated fritillary	Euptoieta claudia	G5	SZB,SZN
Viceroy	Limenitis archippus	G5	S5
West virginia white	Pieris virginiensis	G3G4	S3
Whirlabout	Polites vibex	G5	SAN
White-m hairstreak	Parrhasius m-album	G5	S4
Wild indigo duskywing	Erynnis baptisiae	G5	S4
Yellow-gray underwing	Catocala retecta	G5	S?
Zabulon skipper	Poanes zabulon	G5	S5
Zarucco duskywing	Erynnis zarucco	G5	SAN
Zebra swallowtail	Eurytides marcellus	G5	S4
BEETLES			
A beetle	Hydrocolus deflatus	G?	S?
A cave beetle	Pseudanophthalmus sp 15	G1	S1
A chrysomelid beetle	Diabrotica cristata	G?	S?
A coccinellid beetle	Nephus gordoni	G?	SU
A dytiscid beetle	Agabetes acuductus	G?	S?
A dytiscid beetle	Hoperius planatus	G?	S2
A hydrophilid beetle	Hydrochara occultus	G?	SU
A hydrophilid beetle	Sperchopsis tessellatus	G?	S2
A hydrophylid beetle	Helocombus bifidus	G?	S?
A lampyrid firefly	Photuris bethaniensis	G1?	SP
A tenebrionid beetle	Schoenicus puberulus	G?	S?
A tiger beetle	Cicindela abdominalis	G5	S1
A tiger beetle	Cicindela ancocisconensis	G3	S1
A tiger beetle	Cicindela duodecimguttata	G5	S5
A tiger beetle	Cicindela marginata	G5	S5
A tiger beetle	Cicindela punctulata	G5	S5
A tiger beetle	Cicindela purpurea	G5	S3
A tiger beetle	Cicindela repanda	G5	S5
A tiger beetle	Cicindela rufiventris	G5	S4

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
A tiger beetle	Cicindela scutellaris	G5	S3
A tiger beetle	Cicindela sexguttata	G5	S5
A tiger beetle	Cicindela splendida	G5	S3
A tiger beetle	Cicindela tranquebarica	G5	S5
A tiger beetle	Cicindela unipunctata	G4	S3
A tiger beetle	Megacephala virginica	G5	S5
A water beetle	Cyphon sp 1	G?	S?
American burying beetle	Nicrophorus americanus	G2G3	SX
Beach-dune tiger beetle	Cicindela hirticollis	G5	S5
Big sand tiger beetle	Cicindela formosa	G5	SU
Black lordithon rove beetle	Lordithon niger	GU	SP
Cobblestone tiger beetle	Cicindela marginipennis	G2G3	SP
Giant stag beetle	Lucanus elephas	G3G5	S1
Green-patterned tiger beetle	Cicindela patruela	G3	S1
Little white tiger beetle	Cicindela lepida	G4	S1
Northeastern beach tiger beetle	Cicindela dorsalis dorsalis	G4T2	S1
Puritan tiger beetle	Cicindela puritana	G1G2	S1
Schwarz' diving beetle	Laccophilus schwarzi	G?	SX
Seth forest water scavenger beetle	Hydrochus spangleri	G1	S1
Six-banded longhorn beetle	Dryobius sexnotatus	G?	S1
White tiger beetle	Cicindela dorsalis media	G4T4	S1
OTHER INSECTS			
A scalaris trichopteran	Hydropsyche brunneipennis	G?	S3
A plecopteran	Allocapnia wrayi	G5	S?
A formicid ant	Proceratium croceum	G?	S?
A cicadellid leafhopper	Chlorotettix sp 1	G?	SU
Eastern sedge barrens planthopper	Limotettix minuendus	G1	S1
A microphysid bug	Chinaola quercicola	G?	S?
A mirid bug	Lygocoris nyssae	G?	S?
A plant bug	Hesperophylum heidemanni	G?	S?
A mayfly	Paraleptophlebia assimilis	G3	S?
A mayfly	Tricorythodes robacki	G3	S?
Walker's tusked sprawler	Potamanthus walkeri	G5	SU
A mosquito	Wyeomyia haynei	G4	S?
Pitcher-plant mosquito	Wyeomyia smithii	G5	S2
A springtail	Sinella cavernarum	G4G5	S?
A springtail	Sinella hoffmani	G4G5	S?
Crabtree cave springtail	Arrhopalites sp 1	G?	SU
SPIDERS			
Appalachian cave spider	Porhomma cavernicola	G4G5	S2
Red-legged purse-web spider	Sphodros rufipes	G4	S1S2
Snivelys cave spider	Oreonetides sp 1	G?	SU
CRUSTACEANS			

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
A branchiopod	Cyzicus mexicanus	G5	S?
A branchiopod	Eubranchipus holmanii	G5	S?
A branchiopod	Eubranchipus serratus	G5	S?
A branchiopod	Eubranchipus vernalis	G4	S?
A branchiopod	Streptocephalus sealii	G5	S?
A clam shrimp	Eulimnadia diversa	G5	SU
A crayfish	Cambarus acuminatus	G4	S3
A crayfish	Cambarus carolinus	G4	S?
A crayfish	Cambarus dubius	G5	S3S4
A crayfish	Fallicambarus uhleri	G5	S4
A crayfish	Orconectes obscurus	G5	S3
A cyclopoid copepod	Diacyclops palustris	G?	SU
A harpacticoid copepod	Attheyella spinipes	G?	SU
Allegheny cave amphipod	Stygobromus allegheniensis	G4	S2S3
American lobster	Homarus americanus	G?	S?
An amphipod	Stygobromus sp 6	G?	S1
An entocytherid ostracod	Ankylocythere tridentata	G?	SX
An entocytherid ostracod	Dactylocythere scotos	G?	S1
An isopod	Caecidotea sp 1	G1	S1
An isopod	Caecidotea sp 2	G?	S1
An isopod	Caecidotea sp 3	G3	S1
An isopod	Caecidotea sp 4	G?	S1
An isopod	Caecidotea sp 5	G?	S1
An isopod	Caecidotea sp 6	G?	S2
Appalachian brook crayfish	Cambarus bartonii	G5	S5
Barrelville amphipod	Stygobromus sp 5	G?	S1
Biggers' cave amphipod	Stygobromus biggersi	G2G4	S1
Blue crab	Callinectes sapidus	G?	S?
Dearolf's cave amphipod	Crangonyx dearolfi	G2G3	S1
Devil crawfish	Cambarus diogenes	G5	S4
Franz's cave amphipod	Stygobromus franzi	G2G3	S2S3
Franz's cave isopod	Caecidotea franzi	G2G3	S1
Greenbrier cave amphipod	Stygobromus emarginatus	G3	S1
Pizzini's amphipod	Stygobromus pizzinii	G2G4	S1
Potomac amphipod	Stygobromus tenuis potomacus	G4T3T4Q	S3
Price's cave isopod	Caecidotea pricei	G3G4	S3
Roundtop amphipod	Stygobromus sp 14	G?	S1
Shenandoah cave amphipod	Stygobromus gracilipes	G2G4	S1
Spinycheek crayfish	Orconectes limosus	G4G5	S4
Tenuis amphipod	Stygobromus tenuis tenuis	G4G5T2T3Q	SU
Tidewater amphipod	Stygobromus indentatus	G3	S1
Virile crayfish	Orconectes virilis	G5	SE
White river crawfish	Procambarus acutus	G5	S4
MEROSTOMATAN			
Horseshoe crab	Limulus polyphemus	G?	S?

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
MOLLUSCS			
A snail	Amnicola limosus	G5	SP
A snail	Aplexa elongata	G5	S?
A snail	Campeloma decisum	G5	SP
A snail	Elimia virginica	G4G5	SP
A snail	Ferrissia fragilis	G5	SP
A snail	Ferrissia parallelus	G5	SP
A snail	Ferrissia rivularis	G5	S?
A snail	Fossaria humilis	G5	SP
A snail	Fossaria obrussa	G5	S?
A snail	Fossaria parva	G5	S?
A snail	Gillia altilis	G5	SP
A snail	Gyraulus deflectus	G5	SP
A snail	Gyraulus parvus	G5	S?
A snail	Helisoma anceps	G5	S?
A snail	Leptoxis carinata	G5	SP
A snail	Lioplax subcarinata	G5	SP
A snail	Littoridinops tenuipes	G5	S?
A snail	Lyogyrus granum	G5	SP
A snail	Micromenetus dilatatus	G5	SP
A snail	Physella gyrina	G5	S?
A snail	Physella heterostropha	G5	SP
A snail	Planorbella trivolvis	G5	SP
A snail	Planorbula armigera	G5	SP
A snail	Pseudosuccinea columella	G5	SP
A snail	Stagnicola caperata	G5	S?
A snail	Stagnicola catascopium	G5	S?
A snail	Valvata tricarinata	G5	SP
A snail	Viviparus georgianus	G5	S?
Aldrich's spring snail	Fontigens aldrichi	G3G4	S?
Alewife floater	Anodonta implicata	G5	S3
American oyster	Crassostrea virginica	G5	S?
Angular disc	Discus catskillensis	G3G5	S1
Appalachian spring snail	Fontigens bottimeri	G2	S2
Asiatic clam	Corbicula fluminea	G5	SE
Atlantic spike	Elliptio producta	G4Q	S2S3
Bark snaggletooth	Gastrocopta corticaria	G4G5	SU
Bay scallop	Argopecten irradians	G?	S?
Bear creek slitmouth	Stenotrema simile	G?	SU
Blue ridge spring snail	Fontigens orolibas	G2G3	S1
Broad-banded forestsnail	Allogona profunda	G5	SU
Brook floater	Alasmidonta varicosa	G3	S1
Channel whelk	Busycotypus canaliculatus	G?	S?
Cherrydrop snail (cherrystone drop)	Hendersonia occulta	G4	S2
Common razor clam	Ensis directus	G?	S?

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK
Creeper	Strophitus undulatus	G5	S2
Cylindrically-ornate wood snail	Vertigo ventricosa	G3G4	SU
Dentate supercoil	Paravitrea multidentata	G4G5	SU
Dwarf wedge mussel	Alasmidonta heterodon	G1G2	S1
Eastern elliptio	Elliptio complanata	G5	S5
Eastern floater	Pyganodon cataracta	G5	S5
Eastern glass-snail	Vitrina angelicae	G?	SU
Eastern lampmussel	Lampsilis radiata	G5	SU
Eastern pondmussel	Ligumia nasuta	G4G5	SU
Flamed disc	Anguispira alternata	G5	S5
Green floater	Lasmigona subviridis	G3	S1
Hard-shell clam (northern quahog)	Mercenaria mercenaria	G?	S?
Inland slitmouth	Stenotrema stenotrema	G5	SU
Knobbed whelk	Busycon carica	G?	S?
Lightning whelk	Busycon sinistrum	G?	S?
Northern lance	Elliptio fisheriana	G4	S3
Paper pondshell	Utterbackia imbecillis	G5	S3
Plain pocketbook	Lampsilis cardium	G5	SE
Pocketbook	Lampsilis ovata	G5	SE
Rader's snail (maryland glyph)	Glyphyalinia raderi	G2	SH
Rust glyph	Glyphyalinia picea	G3	SU
Soft-shell clam	Mya arenaria	G?	S?
Spike-lip crater	Appalachina sayana	G4G5	SU
Spruce knob threetooth	Triodopsis picea	G3	S1
Striped whitelip	Webbhelix multilineata	G?	S1
Tidewater mucket	Leptodea ochracea	G4	SU
Triangle floater	Alasmidonta undulata	G4	S1
Variable vertigo	Vertigo gouldi	G4G5	SU
Watercress snail	Fontigens nickliniana	G5	SP
Yellow lampmussel	Lampsilis cariosa	G3G4	S1
Yellow lance	Elliptio lanceolata	G2G3	SU
FLATWORMS			
A planarian	Phagocata virilis	G?	S1
A planarian	Planaria dactyligera	G?	S2
A planarian	Procotyla typhlops	G1G2	S1
A planarian	Sphalloplana sp 1	G?	S1S2
Hoffmaster's cave planarian	Sphalloplana hoffmasteri	G2G3	S1

EXPLANATION OF CONSERVATION RANK CODES

Originally designed by The Nature Conservancy, the global and state ranking system is used by all 50 state Natural Heritage Programs and numerous Conservation Data Centers in other countries in this hemisphere, as well as by the coordinating organization, NatureServe. Because they are assigned based upon standard criteria, the ranks can be used to assess the range-wide status of a species as well as the status within portions of the species' range. The primary criterion used to define these ranks are the number of known distinct occurrences with consideration given to the total number of individuals at each locality. Additional factors considered include the current level of protection, the types and degree of threats, ecological vulnerability, and population trends. Global and state ranks are used in combination to set inventory, protection, and management priorities for species both at the state as well as regional level.

GLOBAL RANK

G1	Highly globally rare. Critically imperiled globally because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
G2	Globally rare. Imperiled globally because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
G3	Either very rare and local throughout its range or distributed locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; typically with 21 to 100 estimated occurrences.
G4	Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.
G5	Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery.
GH	No known extant occurrences (i.e., formerly part of the established biota, with the expectation that it may be rediscovered).
GU	Possibly in peril range-wide, but its status is uncertain; more information is needed.
GX	Believed to be extinct throughout its range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.
G?	The species has not yet been ranked.
_Q	Species containing a "Q" in the rank indicates that the taxon is of questionable or uncertain taxonomic standing (i.e., some taxonomists regard it as a full species, while others treat it at an infraspecific level).
_T	Ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species.

STATE RANK

S1	Highly State rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor(s) making it especially vulnerable to extirpation. Species with this rank are actively tracked by the Natural Heritage Program.
S2	State rare. Imperiled in Maryland because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor(s) making it vulnerable to becoming extirpated. Species with this rank are actively tracked by the Natural Heritage Program.
S3	Rare to uncommon with the number of occurrences typically in the range of 21 to 100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Natural Heritage Program.
S3.1	A species that is actively tracked by the Natural Heritage Program because of the global significance of Maryland occurrences. For instance, a G3 S3 species is globally rare to

uncommon, and although it may not be currently threatened with extirpation in Maryland, its occurrences in Maryland may be critical to the long term security of the species. Therefore, its status in the State is being monitored.

S4 Apparently secure in Maryland with typically more than 100 occurrences in the State or may have fewer occurrences if they contain large numbers of individuals. It is apparently secure under present conditions, although it may be restricted to only a portion of the State.

S5 Demonstrably secure in Maryland under present conditions.

SA Accidental or considered to be a vagrant in Maryland.

SE Established, but not native to Maryland; it may be native elsewhere in North America.

SH Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.

SP Potentially occurring in Maryland or likely to have occurred in Maryland (but without persuasive documentation).

SR Reported from Maryland, but without persuasive documentation that would provide a basis for either accepting or rejecting the report (e.g., no voucher specimen exists).

SU Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State. Uncertainty spans a range of 4 or 5 ranks as defined above.

SX Believed to be extirpated in Maryland with virtually no chance of rediscovery.

SZ A migratory species which does not inhabit specific locations for long periods of time.

S? The species has not yet been ranked.

_B This species is migratory and the rank refers only to the breeding status of the species. Such a migrant may have a different rarity rank for non-breeding populations.

_N This species is migratory and the rank refers only to the non-breeding status of the species. Such a migrant may have a different rarity rank for breeding populations.

Table 3a.2. MBSS Population Estimate and Relative Rarity Index.
This table lists the statewide population estimates and relative rarity as determined by the MBSS for fish species collected by the MBSS during 2000-2004. Many of the following species occur primarily in estuaries, tidal streams, reservoirs, ponds, or larger rivers; these population estimates are for 1st to 4th order freshwater streams.

Family	Common Name	Scientific Name	Population Estimate	Standard Error	Relative Standard Error	Rarity Weighted Index
Petromyzontidae						
	Least Brook Lamprey	*Lampetra aepyptera*	1,218,006	444,019	0.36	50.0
	American Brook Lamprey	*Lampetra appendix*	16,085	8,853	0.55	8.3
	Sea Lamprey	*Petromyzon marinus*	312,474	144,423	0.46	31.0
Lepisosteidae						
	Longnose Gar	*Lepisosteus osseus*	- -	- -	- -	2.4
Anguillidae						
	American Eel	*Anguilla rostrata*	1,885,854	237,320	0.13	85.7
Clupeidae						
	Blueback Herring	*Alosa aestivalis*	- -	- -	- -	1.2
	Alewife	*Alosa pseudoharengus*	939	939	1.00	2.4
	American Shad	*Alosa sapidissima*	34,106	33,966	1.00	1.2
	Gizzard Shad	*Dorosoma cepedianum*	17,342	7,319	0.42	11.9
Cyprinidae						
	Central Stoneroller	*Campostoma anomalum*	1,275,817	285,890	0.22	39.3

Family	Common Name	Scientific Name	Population Estimate	Standard Error	Relative Standard Error	Rarity Weighted Index
	Goldfish	*Carassius auratus*	2,984	1,024	0.34	20.2
	Rosyside Dace	*Clinostomus funduloides*	2,768,643	252,152	0.09	66.7
	Satinfin Shiner	*Cyprinella analostana*	366,824	97,017	0.26	54.8
	Spotfin Shiner	*Cyprinella spiloptera*	444,668	198,406	0.45	50.0
	Common Carp	*Cyprinus carpio*	2,777	1,073	0.39	36.9
	Cutlip Minnow	*Exoglossum maxillingua*	513,129	67,232	0.13	45.2
	Eastern Silvery Minnow	*Hybognathus regius*	65,493	55,693	0.85	32.1
	Striped Shiner	*Luxilus chrysocephalus*	190	190	1.00	3.6
	Common Shiner	*Luxilus cornutus*	982,909	177,389	0.18	54.8
	Pearl Dace	*Margariscus margarita*	134,983	110,418	0.82	6.0
	River Chub	*Nocomis micropogon*	1,208,206	780,994	0.65	47.6
	Golden Shiner	*Notemigonus crysoleucas*	748,061	151,793	0.20	79.8
	Comely Shiner	*Notropis amoenus*	13,053	7,129	0.55	17.9
	Silverjaw Minnow	*Notropis buccatus*	515,093	313,406	0.61	14.3
	Ironcolor Shiner	*Notropis chalybaeus*	4,800	4,800	1.00	4.8
	Spottail Shiner	*Notropis hudsonius*	2,454,881	1,771,155	0.72	66.7
	Swallowtail Shiner	*Notropis procne*	897,541	199,182	0.22	53.6
	Rosyface Shiner	*Notropis rubellus*	183,922	82,316	0.45	34.5
	Bluntnose Minnow	*Pimephales notatus*	6,522,897	2,652,632	0.41	41.7
	Fathead Minnow	*Pimephales promelas*	87,984	32,852	0.37	36.9
	Eastern Blacknose Dace	*Rhinichthys atratulus*	14,343,129	798,493	0.06	81.0
	Longnose Dace	*Rhinichthys cataractae*	2,524,940	313,648	0.12	56.0
	Creek Chub	*Semotilus atromaculatus*	3,524,739	289,317	0.08	69.0
	Fallfish	*Semotilus corporalis*	1,178,279	294,751	0.25	65.5
Catostomidae						
	White Sucker	*Catostomus commersonii*	2,967,035	281,078	0.09	79.8
	Creek Chubsucker	*Erimyzon oblongus*	687,579	115,343	0.17	70.2
	Northern Hog Sucker	*Hypentelium nigricans*	265,115	62,861	0.24	51.2
	Golden Redhorse	*Moxostoma erythrurum*	12,539	7,714	0.62	19.0
	Shorthead Redhorse	*Moxostoma macrolepidotum*	118	118	1.00	7.1
Ictaluridae						
	White Catfish	*Ameiurus catus*	301	301	1.00	11.9
	Yellow Bullhead	*Ameiurus natalis*	258,624	91,832	0.36	67.9
	Brown Bullhead	*Ameiurus nebulosus*	460,987	488,224	1.06	77.4
	Channel Catfish	*Ictalurus punctatus*	3,724	2,270	0.61	20.2
	Stonecat	*Noturus flavus*	660	- -	- -	1.2
	Tadpole Madtom	*Noturus gyrinus*	202,218	133,798	0.66	33.3
	Margined Madtom	*Noturus insignis*	733,458	408,676	0.56	69.0
Esocidae						
	Redfin Pickerel	*Esox americanus*	570,126	129,532	0.23	47.6
	Chain Pickerel	*Esox niger*	68,680	11,043	0.16	40.5
Umbridae						
	Eastern Mudminnow	*Umbra pygmaea*	12,498,604	2,140,057	0.17	54.8

Family	Common Name	Scientific Name	Population Estimate	Standard Error	Relative Standard Error	Rarity Weighted Index
Salmonidae						
	Cutthroat Trout	*Oncorhynchus clarki*	117	117	1.00	3.6
	Rainbow Trout	*Oncorhynchus mykiss*	14,514	4,793	0.33	38.1
	Brown Trout	*Salmo trutta*	247,316	93,617	0.38	38.1
	Brook Trout	*Salvelinus fontinalis*	407,262	69,942	0.17	21.4
Aphredoderidae						
	Pirate Perch	*Aphredoderus sayanus*	1,549,770	905,638	0.58	31.0
Atherinidae						
	Inland Silverside	*Menidia beryllina*	1,108	1,108	1.00	1.2
Fundulidae						
	Banded Killifish	*Fundulus diaphanus*	109,101	47,412	0.43	34.5
	Mummichog	*Fundulus heteroclitus*	197,474	96,245	0.49	29.8
	Striped Killifish	*Fundulus majalis*	- -	- -	- -	1.2
Poeciliidae						
	Mosquitofish	*Gambusia holbrooki*	376,892	164,792	0.44	52.4
Cottidae						
	Blue Ridge Sculpin	*Cottus caeruleomentum*	7,341,496	830,343	0.11	41.7
	Mottled Sculpin	*Cottus bairdii*	687,961	186,349	0.27	3.6
	Checkered Sculpin	*Cottus sp.*	60,251	41,524	0.69	2.4
	Potomac Sculpin	*Cottus girardi*	1,504,276	394,846	0.26	26.2
Percichthyidae						
	White Perch	*Morone americana*	1,791	862	0.48	31.0
	Striped Bass	*Morone saxatilis*	1,857	952	0.51	16.7
Centrarchidae						
	Mud Sunfish	*Acantharchus pomotis*	9,128	3,377	0.37	10.7
	Rock Bass	*Ambloplites rupestris*	190,134	43,192	0.23	38.1
	Flier	*Centrarchus macropterus*	6,588	5,197	0.79	6.0
	Bluespotted Sunfish	*Enneacanthus gloriosus*	494,446	108,404	0.22	34.5
	Banded Sunfish	*Enneacanthus obesus*	83,702	43,633	0.52	14.3
	Redbreast Sunfish	*Lepomis auritus*	771,869	104,004	0.13	78.6
	Green Sunfish	*Lepomis cyanellus*	1,000,153	255,245	0.26	69.0
	Pumpkinseed	*Lepomis gibbosus*	893,175	164,911	0.18	96.4
	Warmouth	*Lepomis gulosus*	34,429	18,597	0.54	17.9
	Bluegill	*Lepomis macrochirus*	1,630,342	240,248	0.15	96.4
	Longear Sunfish	*Lepomis megalotis*	16,114	6,551	0.41	14.3
	Smallmouth Bass	*Micropterus dolomieu*	275,775	49,812	0.18	54.8
	Largemouth Bass	*Micropterus salmoides*	236,345	31,312	0.13	96.4
	Black Crappie	*Pomoxis nigromaculatus*	15,048	8,031	0.53	35.7
	White Crappie	*Pomoxis annularis*				1.2
Percidae						
	Greenside Darter	*Etheostoma blennioides*	2,658,390	4,767,241	1.79	22.6
	Rainbow Darter	*Etheostoma caeruleum*	249,336	82,811	0.33	14.3
	Fantail Darter	*Etheostoma flabellare*	2,137,230	424,363	0.20	29.8
	Swamp Darter	*Etheostoma fusiforme*	9,734	3,742	0.38	14.3

Family	Common Name	Scientific Name	Population Estimate	Standard Error	Relative Standard Error	Rarity Weighted Index
	Johnny Darter	*Etheostoma nigrum*	31,958	16,142	0.51	3.6
	Tessellated Darter	*Etheostoma olmstedi*	4,907,866	612,645	0.12	86.9
	Glassy Darter	*Etheostoma vitreum*	27,602	23,244	0.84	7.1
	Banded Darter	*Etheostoma zonale*	- -	- -	- -	2.4
	Yellow Perch	*Perca flavescens*	13,321	5,210	0.39	42.9
	Logperch	*Percina caprodes*	1,342	1,342	1.00	4.8
	Stripeback Darter	*Percina notogramma*	- -	- -	- -	1.2
	Shield Darter	*Percina peltata*	60,567	23,125	0.38	16.7
Sciaenidae						
	Spot	*Leiostomus xanthurus*				1.2

Table 3a. 3. Preliminary List of Estuarine and Marine Fishes.
The following table is a provisional list of an additional 516 species of estuarine and marine fishes that are known to occur or that may occur in Maryland. This list was compiled primarily from the online database **www.fishbase.org**.

COMMON NAME	SCIENTIFIC NAME
A barracudina	Sudis hyalina
A bigscale	Melamphaes pumilus
A conger	Acromycter atlanticus
A cusk-eel	Bassogigas gillii
A cusk-eel	Bassozetus normalis
A cusk-eel	Holcomycteronus squamosus
A cusk-eel	Ophidion robinsi
A greeneye	Chlorophthalmus chalybeius
A grenadier	Coryphaenoides alateralis
A halosaur	Halosaurus guentheri
A lanternfish	Bolinichthys photothorax
A lanternfish	Diaphus dumerilii
A lanternfish	Diaphus mollis
A lanternfish	Hygophum hygomii
A lanternfish	Hygophum taaningi
A lanternfish	Lampadena urophaos atlantica
A lanternfish	Lampanyctus alatus
A lanternfish	Lampanyctus pusillus
A lanternfish	Lepidophanes guentheri
A lanternfish	Myctophum obtusirostre
A lanternfish	Nannobrachium atrum
A lanternfish	Nannobrachium lineatum
A loosejaw	Photostomias guernei
A morid cod	Laemonema melanurum
A scaleless dragonfish	Bathophilus brevis
A scaleless dragonfish	Bathophilus vaillanti

COMMON NAME	SCIENTIFIC NAME
A scaleless dragonfish	Chirostomias pliopterus
A scaleless dragonfish	Echiostoma barbatum
A scaleless dragonfish	Eustomias enbarbatus
A scaleless dragonfish	Eustomias filifer
A scaleless dragonfish	Eustomias obscurus
A scaleless dragonfish	Flagellostomias boureei
A scaleless dragonfish	Leptostomias gladiator
A scaleless dragonfish	Photonectes braueri
A scaleless dragonfish	Photonectes dinema
A scaly dragonfish	Stomias longibarbatus
A snaggletooth	Astronesthes niger
A snaggletooth	Neonesthes capensis
A snipe eel	Labichthys carinatus
A spiderfish	Bathypterois viridensis
A spiny eel	Polyacanthonotus africanus
A stingray	Dasyatis hastata
A waryfish	Scopelosaurus smithii
Abyssal halosaur	Halosauropsis macrochir
African pompano	Alectis ciliaris
Agujon needlefish	Tylosurus acus acus
Albacore (longfin) tuna	Thunnus alalunga
Almaco jack	Seriola rivoliana
Monkfish	Lophius americanus
Butterfish	Peprilus triacanthus
American conger eel	Conger oceanicus
Fourspot flounder	Hippoglossina oblonga
American halfbeak	Hyporhamphus meeki
American harvestfish	Peprilus paru
American sand lance	Ammodytes americanus
American stardrum	Stellifer lanceolata
Angler	Lophius piscatorius
Antenna codlet	Bregmaceros atlanticus
Armored searobin	Peristedion miniatum
Arrowhead dogfish	Deania profundorum
Arrowtail	Melanonus zugmayeri
Atlantic angel shark	Squatina dumeril
Atlantic bigeye tuna	Thunnus obesus
Atlantic blue marlin	Makaira nigricans
Atlantic bonito	Sarda sarda
Atlantic bumper	Chloroscombrus chrysurus
Atlantic chub mackerel	Scomber colias
Atlantic cod	Gadus morhua
Atlantic croaker	Micropogonias undulatus
Atlantic eelpout	Lycodes terraenovae
Atlantic fanfish	Pterycombus brama
Atlantic flyingfish	Cheilopogon melanurus

COMMON NAME	SCIENTIFIC NAME
Atlantic halibut	Hippoglossus hippoglossus
Atlantic herring	Clupea harengus harengus
Atlantic mackerel	Scomber scombrus
Atlantic menhaden	Brevoortia tyrannus
Atlantic moonfish	Selene setapinnus
Atlantic needlefish	Strongylura marina
Atlantic pomfret	Brama brama
Atlantic rainbow smelt	Osmerus mordax mordax
Atlantic roughy	Hoplostethus occidentalis
Atlantic sailfish	Istiophorus albicans
Atlantic saury	Scomberesox saurus saurus
Atlantic sharpnose shark	Rhizoprionodon terraenovae
Atlantic silverside	Menidia menidia
Atlantic soft pout	Melanostigma atlanticum
Atlantic spadefish	Chaetodipterus faber
Atlantic stingray	Dasyatis sabina
Atlantic thornyhead	Trachyscorpia cristulata cristulata
Atlantic thread	Herring opisthonema oglinum
Atlantic thread herring	Opisthonema oglinum
Atlantic threadfin	Polydactylus octonemus
Atlantic tomcod	Microgadus tomcod
Atlantic torpedo	Torpedo nobiliana
Tripletail	Lobotes surinamensis
Avocet snipe-eel	Avocettina infans
Balao halfbeak	Hemiramphus balao
Ballyhoo	Hemiramphus brasiliensis
Banded butterflyfish	Chaetodon striatus
Banded drum	Larimus fasciatus
Banded rudderfish	Seriola zonata
Bandtail puffer	Sphoeroides spengleri
Bandwing flyingfish	Cypselurus exsiliens
Bar jack	Carangoides ruber
Barndoor skate	Dipturus laevis
Barrelfish	Hyperoglyphe perciformis
Basking shark	Cetorhinus maximus
Bay anchovy	Anchoa mitchilli
Bay whiff	Citharichthys spilopterus
Beardfish	Polymixia lowei
Beardless codling	Gadella imberbis
Benoit's lanternfish	Hygophum benoiti
Bermuda sea chub	Kyphosus sectator
Bigelow's ray	Rajella bigelowi
Bigeye	Epigonus pandionis
Bigeye scad	Selar crumenophthalmus
Bigeye smooth-head	Bajacalifornia megalops
Bigeye soldierfish	Ostichthys trachypoma

COMMON NAME	SCIENTIFIC NAME
Bigeye squaretail	Tetragonurus atlanticus
Bigeye thresher shark	Alopias superciliosus
Black dogfish	Centroscyllium fabricii
Black drum	Pogonias cromis
Black gemfish	Nesiarchus nasutus
Black grouper	Mycteroperca bonaci
Black sawtoothed eel	Serrivomer brevidentatus
Black seabass	Centropristis striata
Black snake mackerel	Nealotus tripes
Blackbelly rosefish	Helicolenus dactylopterus dactylopterus
Blackcheek tonguefish	Symphurus plagiusa
Blackfin goby	Gobionellus atripinnis
Blackfin spiderfish	Bathypterois phenax
Blackfin tuna	Thunnus atlanticus
Blackfin waryfish	Scopelosaurus lepidus
Blackhead salmon	Narcetes stomias
Blackmouth bass	Synagrops bellus
Blackrim cusk-eel	Lepophidium profundorum
Blacktail pike-conger	Hoplunnis diomedianus
Blacktip shark	Carcharhinus limbatus
Blackwing flyingfish	Hirundichthys rondeletii
Bladefin bass	Jeboehlkia gladifer
Blue antimora	Antimora rostrata
Blue parrotfish	Scarus coeruleus
Blue runner	Caranx crysos
Blue shark	Prionace glauca
Blue tang surgeonfish	Acanthurus coeruleus
Blue whiting	Micromesistius poutassou
Bluefin driftfish	Psenes pellucidus
Bluefin tuna	Thunnus thynnus
Bluefish	Pomatomus saltatrix
Blunthead puffer	Sphoeroides pachygaster
Bluntnose stingray	Dasyatis say
Boxer snipe eel	Nemichthys curvirostris
Bramble shark	Echinorhinus brucus
Bristly grenadier	Trachonurus sulcatus
Broadbanded lanternshark	Etmopterus gracilispinis
Brown driftfish	Ariomma melanum
Common trunk fish	Lactophrys trigonus
Bull shark	Carcharhinus leucas
Bullet tuna	Auxis rochei rochei
Bullnose ray	Myliobatis freminvillii
Caribbean lanternshark	Etmopterus hillianus
Cero mackerel	Scomberomorus regalis
Chain dogfish	Scyliorhinus retifer
Chain pipefish	Syngnathus louisianae

COMMON NAME	SCIENTIFIC NAME
Checkered puffer	Sphoeroides testudineus
Chevron scutepout	Lycodonus mirabilis
Chub mackerel	Scomber japonicus
Clearnose skate	Raja eglanteria
Clown goby	Microgobius gulosus
Cobia	Rachycentron canadum
Cocco's lanternfish	Lobianchia gemellarii
Common Atlantic grenadier	Nezumia aequalis
Common fangtooth	Anoplogaster cornuta
Halfbeak	Hyporhamphus unifasciatus
Common remora	Remora remora
Red porgy	Pagrus pagrus
Common wolf eel	Lycenchelys paxillus
Bluespotted cornetfish	Fistularia tabacaria
Cornish blackfish	Schedophilus medusophagus
Cottonmouth Jack	Uraspis secunda
Cownose ray	Rhinoptera bonasus
Crested bigscale	Poromitra crassiceps
Crevalle jack	Caranx hippos
Cubera snapper	Lutjanus cyanopterus
Cunner	Tautogolabrus adspersus
Darwin's slimehead	Gephyroberyx darwinii
Deal fish	Trachipterus arcticus
Deepbody boarfish	Antigonia capros
Deepsea lizardfish	Bathysaurus ferox
Deepwater arrowtooth eel	Histiobranchus bathybius
Deepwater catshark	Apristurus profundorum
Deepwater flounder	Monolene sessilicauda
Diminutive worm eel	Pseudomyrophis fugesae
Doctorfish	Acanthurus chirurgus
Doflein's false headlightfish	Lobianchia dofleini
Dog snapper	Lutjanus jocu
Dolphinfish	Coryphaena hippurus
Dotterel filefish	Aluterus heudelotii
Duckbill barracudina	Magnisudis atlantica
Dusky pipefish	Syngnathus floridae
Dusky shark	Carcharhinus obscurus
Dwarf goatfish	Upeneus parvus
Emerald parrotfish	Nicholsina usta usta
Escolar	Lepidocybium flavobrunneum
Eyed flounder	Bothus ocellatus
False catshark	Pseudotriakis microdon
Feather blenny	Hypsoblennius hentzi
Flamefish	Apogon maculatus
Flat needlefish	Ablennes hians
Striped mullet	Mugil cephalus

COMMON NAME	SCIENTIFIC NAME
Florida pompano	Trachinotus carolinus
Flying gurnard	Dactylopterus volitans
Flying halfbeak	Euleptorhamphus velox
Fourbeard rockling	Enchelyopus cimbrius
Foureye butterflyfish	Chaetodon capistratus
Fourspine stickleback	Apeltes quadracus
Fourwing flyingfish	Hirundichthys affinis
Freckled driftfish	Psenes cyanophrys
Freckled skate	Leucoraja garmani
Freckled tonguefish	Symphurus nebulosus
Frigate mackerel	Auxis thazard thazard
Fringed filefish	Monacanthus ciliatus
Fringed flounder	Etropus crossotus
Gag	Mycteroperca microlepis
Garrick	Cyclothone braueri
Ghostly grenadier	Coryphaenoides leptolepis
Glacier lanternfish	Benthosema glaciale
Goby flathead	Bembrops gobioides
Goosehead scorpionfish	Scorpaena bergii
Gray angelfish	Pomacanthus arcuatus
Gray triggerfish	Balistes capriscus
Great barracuda	Sphyraena barracuda
Great northern tilefish	Lopholatilus chamaeleonticeps
Great white shark	Carcharodon carcharias
Greater amberjack	Seriola dumerili
Green goby	Microgobius thalassinus
Green moray	Gymnothorax funebris
Grey snapper	Lutjanus griseus
Grideye fish	Ipnops murrayi
Grunt	Haemulon plumierii
Guachanche barracuda	Sphyraena guachancho
Gulf Stream flounder	Citharichthys arctifrons
Hakeling	Physiculus fulvus
Half-naked hatchetfish	Argyropelecus hemigymnus
Hardhead sea catfish	Ariopsis felis
Harvestfish	Peprilus alepidotus
Hatchetfish	Argyropelecus gigas
Hawaiian halosaurid fish	Aldrovandia phalacra
Highfin lizardfish	Bathysaurus mollis
Hogchoker	Trinectes maculatus
Hogfish	Lachnolaimus maximus
Honeycomb cowfish	Acanthostracion polygonius
Horned lanternfish	Ceratoscopelus maderensis
Horse-eye jack	Caranx latus
Hound needlefish	Tylosurus crocodilus crocodilus
Iceland catshark	Apristurus laurussonii

COMMON NAME	SCIENTIFIC NAME
Inquiline snailfish	Liparis inquilinus
Inshore lizardfish	Synodus foetens
Jenny mojarra	Eucinostomus gula
Jewel lanternfish	Lampanyctus crocodilus
Jolthead porgy	Calamus bajonado
Kaup's arrowtooth eel	Synaphobranchus kaupii
King mackerel	Scomberomorus cavalla
King of herrings	Regalecus glesne
Kitefin shark	Dalatias licha
Kriete's tonguefish	Symphurus billykrietei
Ladyfish	Elops saurus
Lanternfish	Bolinichthys indicus
Largescale lantern fish	Symbolophorus veranyi
Largescale tonguefish	Symphurus minor
Laura's lanternfish	Loweina rara
Leatherjack	Oligoplites saurus
Lemon shark	Negaprion brevirostris
Lesser amberjack	Seriola fasciata
Lesser devil ray	Mobula hypostoma
Lightfish	Ichthyococcus ovatus
Lined seahorse	Hippocampus erectus
Little skate	Leucoraja erinacea
False albacore	Euthynnus alletteratus
Live sharksucker	Echeneis naucrates
Lobisomem	Notoscopelus caudispinosus
Longbill spearfish	Tetrapturus pfluegeri
Longfin hake	Phycis chesteri
Longfin lanternfish	Diogenichthys atlanticus
Longfinned bullseye	Cookeolus japonicus
Longhorn sculpin	Myoxocephalus octodecemspinosus
Longnose greeneye	Parasudis truculenta
Longnose lancetfish	Alepisaurus ferox
Longspine snipefish	Macroramphosus scolopax
Lookdown	Selene vomer
Loosejaw	Aristostomias tittmanni
Lovely hatchetfish	Argyropelecus aculeatus
Lowfin snailfish	Paraliparis calidus
Lumpsucker	Cyclopterus lumpus
Luvar	Luvarus imperialis
Lyre goby	Evorthodus lyricus
Mackerel scad	Decapterus macarellus
Man-of-war fish	Nomeus gronovii
Margined flyingfish	Cheilopogon cyanopterus
Margined snake eel	Ophichthus cruentifer
Margined tonguefish	Symphurus marginatus
Marlin sucker	Remora osteochir

COMMON NAME	SCIENTIFIC NAME
Metallic lanternfish	Metallic lantern fish
Michael Sars smooth-head	Bathytroctes michaelsarsi
Mosquitofish	Gambusia affinis
Muddy arrowtooth eel	Ilyophis brunneus
Mutton snapper	Lutjanus analis
Naked goby	Gobiosoma bosc
Narrownose chimaera	Harriotta raleighana
Night shark	Carcharhinus signatus
North American naked sole	Gymnachirus melas
Northern kingfish	Menticirrhus saxatilis
Northern pipefish	Syngnathus fuscus
Northern puffer	Sphoeroides maculatus
Northern red snapper	Lutjanus campechanus
Northern sand lance	Ammodytes dubius
Northern searobin	Prionotus carolinus
Northern sennet	Sphyraena borealis
Northern stargazer	Astroscopus guttatus
Northern tonguefish	Symphurus pusillus
Nurse shark	Ginglymostoma cirratum
Ocean pout	Zoarces americanus
Ocean sunfish	Mola mola
Ocean surgeon	Acanthurus bahianus
Ocean triggerfish	Canthidermis sufflamen
Oceanic puffer	Lagocephalus lagocephalus lagocephalus
Oceanic two-wing flyingfish	Exocoetus obtusirostris
Oceanic whitetip shark	Carcharhinus longimanus
Ocellated moray	Gymnothorax saxicola
Offshore hake	Merluccius albidus
Opah	Lampris guttatus
Opossum pipefish	Microphis brachyurus lineatus
Orange filefish	Aluteras schoepfii
Orangespotted filefish	Cantherhines pullus
Oyster toadfish	Opsanus tau
Palefin dragonet	Foetorepus goodenbeani
Pallid sculpin	Cottunculus thomsonii
Palometa	Trachinotus goodei
Pearlsides	Maurolicus muelleri
Pearly lanternfish	Myctophum nitidulum
Pelagic stingray	Pteroplatytrygon violacea
Permit	Trachinotus falcatus
Pigfish	Orthopristis chrysoptera
Pilotfish	Naucrates ductor
Pinfish	Lagodon rhomboides
Pink flabby whalefish	Cetostoma regani
Pipehorse	Acentronura dendritica
Planehead filefish	Stephanolepis hispidus

COMMON NAME	SCIENTIFIC NAME
Atlantic Pollock	Pollachius virens
Pompano dolphinfish	Coryphaena equiselis
Porbeagle	Lamna nasus
Pouty seasnail	Paraliparis garmani
Pricklefish	Stephanoberyx monae
Pudgy cuskeel	Spectrunculus grandis
Queen triggerfish	Balistes vetula
Rainbow runner	Elagatis bipinnulata
Rainwater killifish	Lucania parva
Red drum	Sciaenops ocellatus
Red goatfish	Mullus auratus
Red hake	Urophycis chuss
Red lionfish	Pterois volitans
Redear sunfish	Lepomis microlophus
Redeye gaper	Chaunax stigmaeus
Redfin parrotfish	Sparisoma rubripinne
Redmouth whalefish	Rondeletia loricata
Reinhardt's lanternfish	Hygophum reinhardtii
Reticulate moray	Muraena retifera
Ribbon barracudina	Arctozenus risso
Rock hind	Epinephelus adscensionis
Roudi escolar	Promethichthys prometheus
Rough pomfret	Taractes asper
Rough scad	Trachurus lathami
Rough silverside	Membras martinica
Roughtail stingray	Dasyatis centroura
Roughtip grenadier	Nezumia sclerorhynchus
Round herring	Etrumeus teres
Round sardinella	Sardinella aurita
Round scad	Decapterus punctatus
Roundnose lanternfish	Centrobranchus nigroocellatus
Sand drum	Umbrina coroides
Sand tiger shark	Carcharias taurus
Sandbar shark	Carcharhinus plumbeus
Scaled herring	Harengula jaguana
Scalloped hammerhead	Sphyrna lewini
Scamp	Mycteroperca phenax
Schoolmaster snapper	Lutjanus apodus
Scotian snailfish	Careproctus ranula
Scrawled cowfish	Acanthostracion quadricornis
Scrawled filefish	Aluterus scriptus
Scup	Stenotomus chrysops
Sea raven	Hemitripterus americanus
Seaboard goby	Gobiosoma ginsburgi
Seaweed blenny	Parablennius marmoreus
Sergeant major	Abudefduf saxatilis

COMMON NAME	SCIENTIFIC NAME
Sheepshead	Archosargus probatocephalus
Sheepshead minnow	Cyprinodon variegatus variegatus
Short bigeye	Pristigenys alta
Shortfin mako	Isurus oxyrinchus
Shortfinger anchovy	Anchoa lyolepis
Short-headed lantern fish	Diaphus brachycephalus
Shortnose greeneye	Chlorophthalmus agassizi
Shortnose lancetfish	Alepisaurus brevirostris
Shortspine boarfish	Antigonia combatia
Shrimp eel	Ophichthus gomesii
Silky shark	Carcharhinus falciformis
Silver anchovy	Engraulis eurystole
Silver perch	Bairdiella chrysoura
Silver driftfish	Psenes maculatus
Silver hake	Merluccius bilinearis
Silver mojarra	Eucinostomus argenteus
Silver seatrout	Cynoscion nothus
Silver-rag driftfish	Ariomma bondi
Silvery John dory	Zenopsis conchifera
Simony's frostfish	Benthodesmus simonyi
Singlespot frogfish	Antennarius radiosus
Skilletfish	Gobiesox strumosus
Skipjack tuna	Katsuwonus pelamis
Slender cuskeel	Porogadus miles
Slender searobin	Peristedion gracile
Slender snipe eel	Nemichthys scolopaceus
Slenderhead searobin	Peristedion imberbe
Slim flounder	Monolene antillarum
Slope hatchetfish	Polyipnus clarus
Smallfin lanternfish	Benthosema suborbitale
Smallmouth flounder	Etropus microstomus
Smallmouth spiny eel	Polyacanthonotus rissoanus
Smallscale smooth-head	Bathytroctes microlepis
Smallspine spookfish	Harriotta haeckeli
Smalltooth sawfish	Pristis pectinata
Smooth butterfly ray	Gymnura micrura
Smooth dogfish	Mustelus canis
Smooth hammerhead	Sphyrna zygaena
Smooth puffer	Lagocephalus laevigatus
Smooth trunkfish	Lactophrys triqueter
Snaggletooth	Astronesthes gemmifer
Snake mackerel	Gempylus serpens
Snakefish	Trachinocephalus myops
Snakehead	Channa argus argus
Snowy grouper	Epinephelus niveatus
Snubnosed eel	Simenchelys parasitica

COMMON NAME	SCIENTIFIC NAME
Southern kingfish	Menticirrhus americanus
Southern stingray	Dasyatis americana
Spanish mackerel	Scomberomorus maculatus
Spearfish remora	Remora brachyptera
Spiny butterfly ray	Gymnura altavela
Spiny dogfish	Squalus acanthias
Spiny eel	Notacanthus chemnitzii
Spinycheek scorpionfish	Neomerinthe hemingwayi
Spinyhead blenny	Acanthemblemaria spinosa
Spotfin butterflyfish	Chaetodon ocellatus
Spotfin dragonet	Foetorepus agassizii
Spotfin flyingfish	Cheilopogon furcatus
Spotfin killifish	Fundulus luciae
Porcupine fish	Diodon hystrix
Spottail pinfish	Diplodus holbrooki
Spotted burrfish	Chilomycterus atringa
Spotted driftfish	Ariomma regulus
Spotted eagle ray	Aetobatus narinari
Spotted goatfish	Pseudupeneus maculatus
Spotted hake	Urophycia regius
Spotted lanternfish	Myctophum punctatum
Spotted scorpionfish	Scorpaena plumieri
Spotted seatrout	Cynoscion nebulosus
Spotted tinselfish	Xenolepidichthys dalgleishi
Striated argentine	Argentina striata
Striated frogfish	Antennarius striatus
Striped anchovy	Anchoa hepsetus
Striped blenny	Chasmodes bosquianus
Striped burrfish	Chilomycterus schoepfii
Striped cusk-eel	Ophidion marginatum
Striped searobin	Prionotus evolans
Summer flounder	Paralichthys dentatus
Swordfish	Xiphias gladius
Synagrops spinosus	Synagrops spinosus
Tan bristlemouth	Cyclothone pallida
Thickbeard grenadier	Coryphaenoides zaniophorus
Thorny skate	Amblyraja radiata
Thorny tinselfish	Grammicolepis brachiusculus
Threadfin blenny	Nemaclinus atelestos
Threadfin rockling	Gaidropsarus ensis
Thresher shark	Alopias vulpinus
Tiger muskellunge	Esox lucius x Esox masquinongy
Tiger shark	Galeocerdo cuvier
Tomtate grunt	Haemulon aurolineatum
Tripodfish	Bathypterois grallator
Twospot cardinalfish	Apogon pseudomaculatus

COMMON NAME	SCIENTIFIC NAME
Twospot flounder	Bothus robinsi
Unicorn leatherjacket	Aluterus monoceros
Veiled anglemouth	Cyclothone microdon
Wahoo	Acanthocybium solandri
Warsaw grouper	Epinephelus nigritus
Waryfish	Scopelosaurus argenteus
Weakfish	Cynoscion regalis
Weitzman's pearlside	Maurolicus weitzmani
Western Atlantic seabream	Archosargus rhomboidalis
Western softhead grenadier	Malacocephalus occidentalis
Whale shark	Rhincodon typus
White baggar	Galeichthys feliceps
White hake	Urophycis tenuis
White marlin	Tetrapturus albidus
White mullet	Mugil curema
Whitefin sharksucker	Echeneis neucratoides
White-spoted lantern fish	Diaphus rafinesquii
Whitetip reef shark	Triaenodon obesus
Windowpane flounder	Scophthalmus aquosus
Winter flounder	Pseudopleuronectes americanus
Winter skate	Leucoraja ocellata
Witch	Glyptocephalus cynoglossus
Wolf eelpout	Lycenchelys verrillii
Wreckfish	Polyprion americanus
Yellow jack	Carangoides bartholomaei
Yellow sea chub	Kyphosus incisor
Yellowfin bass	Anthias nicholsi
Yellowfin tuna	Thunnus albacares
Yellowtail flounder	Limanda ferruginea
Yellowtail snapper	Ocyurus chrysurus

Appendix 3b. GCN Species

This appendix lists Maryland's wildlife species determined to be of Greatest Conservation Need (GCN). For each species, the best available status information is listed according to the guidance categories provided by the IAFWA steering committee (2002) and discussed in Chapter 3. These categories indicate reasons for conservation concern, including low and declining populations, endemism, etc. (see Table 3.2). These compiled rankings represent the best available information on status of these GCN species, as determined by MD DNR NHP staff and other leading experts. This appendix directly addresses **Element #1**. An explanation of the G-Rank and S-Rank codes is found in Appendix 3a. An explanation of the remaining acronyms is found at the end of this appendix.

VERTEBRATES

GCN Mammals – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
Allegheny woodrat	Neotoma magister	G3G4	S1	E	
American marten	Martes americana	G5	SX	X	
Blue whale	Balaenoptera musculus	G3G4	SZN	E	E
Bobcat	Lynx rufus	G5	S3	I	
Delmarva fox squirrel	Sciurus niger cinereus	G5T3	S1	E	E
Eastern harvest mouse	Reithrodontomys humulis	G5	SH	X	
Eastern red bat	Lasiurus borealis	G5	S5B,S5N		
Eastern small-footed myotis	Myotis leibii	G3	S1B,S2N	I	
Eastern spotted skunk	Spilogale putorius	G5	S1		
Fin whale	Balaenoptera physalus	G3G4	SZN	E	E
Harbor porpoise	Phocoena phocoena	G4G5	SZN		
Hoary bat	Lasiurus cinereus	G5	SPB,S5N		
Humpback whale	Megaptera novaeangliae	G3	SZN	E	E
Indiana bat	Myotis sodalis	G2	S1	E	E
Least shrew	Cryptotis parva	G5	S3S5		
Least weasel	Mustela nivalis	G5	S2S3	I	
Long-tailed shrew	Sorex dispar	G4	S2	I	
New england cottontail	Sylvilagus transitionalis	G4	S1	I	
North American Porcupine	Erethizon dorsatum	G5	S1S2	I	
Northern flying squirrel	Glaucomys sabrinus	G5	SP		
Northern right whale	Eubalaena glacialis	G1	SZN	E	E
Rafinesque's big-eared bat	Corynorhinus rafinesquii	G3G4	SP		
Sei whale	Balaenoptera borealis	G3	SZN	E	E
Silver-haired bat	Lasionycteris noctivagans	G5	SPB,S5N		
Smoky shrew	Sorex fumeus	G5	S2S3	I	
Snowshoe hare	Lepus americanus	G5	SH	X	
Southeastern myotis	Myotis austroiparius	G3G4	SP		
Southeastern shrew	Sorex longirostris	G5	S3S4		

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
Southeastern star-nosed mole	Condylura cristata parva	G5T4	SU		
Southern bog lemming	Synaptomys cooperi	G5	S3		
Southern pygmy shrew	Sorex hoyi winnemana	G5T4	S2		
Southern rock vole	Microtus chrotorrhinus carolinensis	G4T3	S1	E	
Southern water shrew	Sorex palustris punctulatus	G5T3	S1	E	
Sperm whale	Physeter catodon	G3G4	SZN	E	E

GCN Mammals – Part 2

COMMON NAME	CITES	IUCN	NE_Reg	TNC Ecoregion	BCI	Endemic	Responsibility
Allegheny woodrat		LR	NE_Reg	PRIMARY			
American marten							
Blue whale	1	EN					
Bobcat	2	LR					
Delmarva fox squirrel		LR		PRIMARY			
Eastern harvest mouse							
Eastern red bat		LR	NE_Reg				
Eastern small-footed myotis		LR	NE_Reg	PRIMARY	BCI		
Eastern spotted skunk							
Fin whale	1	EN					
Harbor porpoise	2	VU	NE_Reg				
Hoary bat		LR	NE_Reg				
Humpback whale	1	VU					
Indiana bat		EN		PRIMARY			
Least shrew			NE_Reg				
Least weasel		LR					
Long-tailed shrew							
New england cottontail		VU	NE_Reg	SECONDARY			
North American Porcupine		LR					
Northern flying squirrel		LR		PRIMARY			
Northern right whale	1	EN					
Rafinesque's big-eared bat		VU	NE_Reg	PRIMARY	BCI		
Sei whale	1	EN					
Silver-haired bat		LR	NE_Reg				
Smoky shrew							
Snowshoe hare							
Southeastern myotis					BCI		
Southeastern shrew							
Southeastern star-nosed mole							
Southern bog lemming							
Southern pygmy shrew							
Southern rock vole		LR	NE_Reg	PRIMARY			
Southern water shrew			NE_Reg	PRIMARY			
Sperm whale	1	VU					

GCN Birds – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
Acadian flycatcher	Empidonax virescens	G5	S5B				
Alder flycatcher	Empidonax alnorum	G5	S2B	I			
American bittern	Botaurus lentiginosus	G4	S1S2B,S1N	I			
American black duck	Anas rubripes	G5	S4B,S5N				
American oystercatcher	Haematopus palliatus	G5	S3B,SAN				
American peregrine falcon	Falco peregrinus anatum	G4T3	S2	I		1	
American redstart	Setophaga ruticilla	G5	S4B				
American woodcock	Scolopax minor	G5	S4B,S4N				
Bachman's sparrow	Aimophila aestivalis	G3	SHB	X			LR
Bald eagle	Haliaeetus leucocephalus	G4	S2S3B,S3N	T	T	1	
Bank swallow	Riparia riparia	G5	S3S4B				
Barn owl	Tyto alba	G5	S3			2	
Barred owl	Strix varia	G5	S5			2	
Bewick's wren	Thryomanes bewickii altus	G5T2Q	S1B	E			
Bicknell's thrush	Catharus bicknellii	G4	SZN				VU
Black rail	Laterallus jamaicensis	G4	S2S3B	I			LR
Black skimmer	Rynchops niger	G5	S1B	E			
Black tern	Chlidonias niger	G4	SZN				
Black-and-white warbler	Mniotilta varia	G5	S4B				
Black-bellied plover	Pluvialis squatarola	G5	S3N				
Black-billed cuckoo	Coccyzus erythropthalmus	G5	S4B				
Blackburnian warbler	Dendroica fusca	G5	S1S2B	T			
Black-crowned night-heron	Nycticorax nycticorax	G5	S3B,S2N				
Black-throated blue warbler	Dendroica caerulescens	G5	S3S4B				
Black-throated green warbler	Dendroica virens	G5	S4B				
Blue-headed vireo	Vireo solitarius	G5	S3S4B				
Blue-winged warbler	Vermivora pinus	G5	S4B				
Boat-tailed grackle	Quiscalus major	G5	S3S4				
Bobolink	Dolichonyx oryzivorus	G5	S3S4B				
Brant	Branta bernicla	G5	S3N				
Broad-winged hawk	Buteo platypterus	G5	S4B			2	
Brown creeper	Certhia americana	G5	S4				
Brown pelican	Pelecanus occidentalis	G4	S1B				
Brown thrasher	Toxostoma rufum	G5	S5B,S2N				
Brown-headed nuthatch	Sitta pusilla	G5	S3S4				
Canada warbler	Wilsonia canadensis	G5	S3B				
Canvasback	Aythya valisineria	G5	S3S4N				
Cerulean warbler	Dendroica cerulea	G4	S3S4B				
Chestnut-sided warbler	Dendroica pensylvanica	G5	S4B				
Chuck-will's-widow	Caprimulgus carolinensis	G5	S4B				
Coastal plain swamp sparrow	Melospiza georgiana nigrescens	G5T3	S2B,SZN	I			
Common loon	Gavia immer	G5	S4N				
Common moorhen	Gallinula chloropus	G5	S2B,SAN	I			
Common nighthawk	Chordeiles minor	G5	S3S4B				

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
Common raven	Corvus corax	G5	S2				
Common tern	Sterna hirundo	G5	S4B				
Dark-eyed junco	Junco hyemalis	G5	S2B,S5N				
Dickcissel	Spiza americana	G5	S2B				LR
Dunlin	Calidris alpina	G5	S3N				
Eastern meadowlark	Sturnella magna	G5	S5B,S3N				
Eastern towhee	Pipilo erythrophthalmus	G5	S5B,S4N				
Field sparrow	Spizella pusilla	G5	S5				
Forster's tern	Sterna forsteri	G5	S4B				
Glossy ibis	Plegadis falcinellus	G5	S4B				
Golden eagle	Aquila chrysaetos	G5	S1N			2	
Golden-crowned kinglet	Regulus satrapa	G5	S2B,S4N				
Golden-winged warbler	Vermivora chrysoptera	G4	S3B				
Grasshopper sparrow	Ammodramus savannarum	G5	S4B				
Great blue heron	Ardea herodias	G5	S4B,S3S4N				
Great egret	Ardea alba	G5	S4B				
Greater yellowlegs	Tringa melanoleuca	G5	S1N				
Gull-billed tern	Sterna nilotica	G5	S1B	E			
Hairy woodpecker	Picoides villosus	G5	S5				
Harlequin duck	Histrionicus histrionicus	G4	S1N				
Henslow's sparrow	Ammodramus henslowii	G4	S1S2B	T			LR
Hermit thrush	Catharus guttatus	G5	S3S4B,S4N				
Hooded warbler	Wilsonia citrina	G5	S4S5B				
Horned grebe	Podiceps auritus	G5	S4N				
Kentucky warbler	Oporornis formosus	G5	S4B				
King rail	Rallus elegans	G4G5	S3S4B,S2N				
Laughing gull	Larus atricilla	G5	S1B,S4N				
Least bittern	Ixobrychus exilis	G5	S2S3B	I			
Least flycatcher	Empidonax minimus	G5	S3S4B				
Least tern	Sterna antillarum	G4	S2B	T			
Little blue heron	Egretta caerulea	G5	S3B				
Loggerhead shrike	Lanius ludovicianus	G4	S1B,S1N	E			
Long-eared owl	Asio otus	G5	SHB,S1N			2	
Louisiana waterthrush	Seiurus motacilla	G5	S5B				
Magnolia warbler	Dendroica magnolia	G5	S3S4B				
Marsh wren	Cistothorus palustris	G5	S4B,S2N				
Mourning warbler	Oporornis philadelphia	G5	S1B	E			
Nashville warbler	Vermivora ruficapilla	G5	S1S2B	I			
Northern bobwhite	Colinus virginianus	G5	S5				
Northern gannet	Morus bassanus	G5	SZN				
Northern goshawk	Accipiter gentilis	G5	S1B,SZN	E*		2	
Northern harrier	Circus cyaneus	G5	S2B,S4N			2	
Northern parula	Parula americana	G5	S4S5B				
Northern saw-whet owl	Aegolius acadicus	G5	S1B,S1N			2	
Northern waterthrush	Seiurus noveboracensis	G5	S2S3B				
Olive-sided flycatcher	Contopus cooperi	G4	SHB,SZN	E			
Ovenbird	Seiurus aurocapillus	G5	S5B				

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
Pied-billed grebe	Podilymbus podiceps	G5	S2B,S3N				
Pileated woodpecker	Dryocopus pileatus	G5	S5				
Piping plover	Charadrius melodus	G3	S1B,SAN	E	T		VU
Prairie warbler	Dendroica discolor	G5	S4B				
Prothonotary warbler	Protonotaria citrea	G5	S4B				
Purple sandpiper	Calidris maritima	G5	S2N				
Red knot	Calidris canutus	G5	SZN				
Red-breasted nuthatch	Sitta canadensis	G5	S1B,S3N				
Red-cockaded woodpecker	Picoides borealis	G3	SHB,SAN	X	E		VU
Red-eyed vireo	Vireo olivaceus	G5	S5B				
Red-headed woodpecker	Melanerpes erythrocephalus	G5	S4				
Red-shouldered hawk	Buteo lineatus	G5	S4S5B,S4N			2	
Red-throated loon	Gavia stellata	G5	S3S4N				
Roseate tern	Sterna dougallii	G4	SHB,SAN	X	E		
Royal tern	Sterna maxima	G5	S1B	E			
Ruddy duck	Oxyura jamaicensis	G5	S3N				
Ruddy turnstone	Arenaria interpres	G5	S1N				
Saltmarsh sharp-tailed sparrow	Ammodramus caudacutus	G4	S3B,S1N				LR
Sanderling	Calidris alba	G5	S3N				
Sandwich tern	Sterna sandvicensis	G5	S1B				
Savannah sparrow	Passerculus sandwichensis	G5	S3S4B,S4N				
Scarlet tanager	Piranga olivacea	G5	S5B				
Seaside sparrow	Ammodramus maritimus	G4	S4B,S2N				
Sedge wren	Cistothorus platensis	G5	S1B	E			
Semipalmated sandpiper	Calidris pusilla	G5	SZN				
Sharp-shinned hawk	Accipiter striatus	G5	S1S2B,S4N			2	
Short-billed Dowitcher	Limnodromus griseus	G5	SZN				
Short-eared owl	Asio flammeus	G5	S1B,S2N	E		2	
Snowy egret	Egretta thula	G5	S3S4B				
Solitary sandpiper	Tringa solitaria	G5	SZN				
Summer tanager	Piranga rubra	G5	S4B				
Swainson's thrush	Catharus ustulatus	G5	SXB				
Swainson's warbler	Limnothlypis swainsonii	G4	S1B	E			
Tricolored heron	Egretta tricolor	G5	S3B				
Upland sandpiper	Bartramia longicauda	G5	S1B	E			
Veery	Catharus fuscescens	G5	S4B				
Vesper sparrow	Pooecetes gramineus	G5	S3S4B,S2N				
Wayne's black-throated green warbler	Dendroica virens waynei	G5TU	SU				
Whimbrel	Numenius phaeopus	G5	SZN				
Whip-poor-will	Caprimulgus vociferus	G5	S3S4B				
Willet	Catoptrophorus semipalmatus	G5	S3S4B				
Willow flycatcher	Empidonax traillii	G5	S4B				
Wilson's plover	Charadrius wilsonia	G5	S1B	E			
Wilson's snipe	Gallinago delicata	G5	S2N				
Winter wren	Troglodytes troglodytes	G5	S2B,S3N				

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
Wood thrush	Hylocichla mustelina	G5	S5B				
Worm-eating warbler	Helmitheros vermivorus	G5	S4B				
Yellow-bellied sapsucker	Sphyrapicus varius	G5	SHB,S3N				
Yellow-crowned night-heron	Nyctanassa violacea	G5	S2B				
Yellow-throated vireo	Vireo flavifrons	G5	S4S5B				

GCN Birds – Part 2

COMMON NAME	NE_Reg	PIFRank-B	PIFRank-W	MNBMCN	NAWMP	MANEM
Acadian flycatcher		PIF-I				
Alder flycatcher						
American bittern	NE_Reg			MNBMCN		Focal
American black duck	NE_Reg	PIF-I	PIF-I		Highest	
American oystercatcher		PIF-I	PIF-I			
American peregrine falcon				MNBMCN		
American redstart						
American woodcock	NE_Reg	PIF-I	PIF-I			
Bachman's sparrow		PIF-I	PIF-I	MNBMCN		
Bald eagle						
Bank swallow						
Barn owl						
Barred owl						
Bewick's wren	NE_Reg	PIF-I		MNBMCN		
Bicknell's thrush	NE_Reg			MNBMCN		
Black rail		PIF-I	PIF-I	MNBMCN		Focal
Black skimmer		PIF-I				Focal
Black tern	NE_Reg			MNBMCN		
Black-and-white warbler		PIF-II				
Black-bellied plover						
Black-billed cuckoo						
Blackburnian warbler						
Black-crowned night-heron						Focal
Black-throated blue warbler		PIF-I				
Black-throated green warbler						
Blue-headed vireo						
Blue-winged warbler		PIF-I		MNBMCN		
Boat-tailed grackle						
Bobolink						
Brant	NE_Reg				High	
Broad-winged hawk						
Brown creeper						
Brown pelican						
Brown thrasher		PIF-II				
Brown-headed nuthatch		PIF-I	PIF-I			

COMMON NAME	NE_Reg	PIFRank-B	PIFRank-W	MNBMCN	NAWMP	MANEM
Canada warbler	NE_Reg	PIF-I				
Canvasback			PIF-I		High	
Cerulean warbler	NE_Reg	PIF-I		MNBMCN		
Chestnut-sided warbler				MNBMCN		
Chuck-will's-widow						
Coastal plain swamp sparrow						
Common loon				MNBMCN		
Common moorhen						
Common nighthawk						
Common raven						
Common tern	NE_Reg			MNBMCN		Focal
Dark-eyed junco						
Dickcissel		PIF-I				
Dunlin			PIF-I			
Eastern meadowlark				MNBMCN		
Eastern towhee		PIF-II				
Field sparrow		PIF-I	PIF-I	MNBMCN		
Forster's tern						Focal
Glossy ibis						Focal
Golden eagle	NE_Reg					
Golden-crowned kinglet						
Golden-winged warbler	NE_Reg	PIF-I		MNBMCN		
Grasshopper sparrow		PIF-II		MNBMCN		
Great blue heron						
Great egret						Focal
Greater yellowlegs						
Gull-billed tern						Focal
Hairy woodpecker						
Harlequin duck	NE_Reg				High	
Henslow's sparrow	NE_Reg	PIF-I		MNBMCN		
Hermit thrush						
Hooded warbler		PIF-I				
Horned grebe						Focal
Kentucky warbler		PIF-I				
King rail						Focal
Laughing gull						Focal
Least bittern				MNBMCN		
Least flycatcher						
Least tern	NE_Reg					Focal
Little blue heron						Focal
Loggerhead shrike	NE_Reg			MNBMCN		
Long-eared owl	NE_Reg					
Louisiana waterthrush	NE_Reg	PIF-I		MNBMCN		
Magnolia warbler						
Marsh wren		PIF-II				
Mourning warbler						

COMMON NAME	NE_Reg	PIFRank-B	PIFRank-W	MNBMCN	NAWMP	MANEM
Nashville warbler						
Northern bobwhite	NE_Reg	PIF-II				
Northern gannet						Focal
Northern goshawk				MNBMCN		
Northern harrier	NE_Reg			MNBMCN		
Northern parula		PIF-I				
Northern saw-whet owl						
Northern waterthrush						
Olive-sided flycatcher				MNBMCN		
Ovenbird						
Pied-billed grebe	NE_Reg					
Pileated woodpecker						
Piping plover		PIF-I	PIF-I			
Prairie warbler		PIF-I				
Prothonotary warbler		PIF-I				
Purple sandpiper			PIF-I			
Red knot	NE_Reg					
Red-breasted nuthatch						
Red-cockaded woodpecker		PIF-I	PIF-I			
Red-eyed vireo						
Red-headed woodpecker		PIF-I	PIF-I	MNBMCN		
Red-shouldered hawk				MNBMCN		
Red-throated loon						Focal
Roseate tern						
Royal tern						Focal
Ruddy duck					Moderate	
Ruddy turnstone						
Saltmarsh sharp-tailed sparrow	NE_Reg	PIF-I	PIF-I			
Sanderling						
Sandwich tern						
Savannah sparrow						
Scarlet tanager		PIF-I				
Seaside sparrow		PIF-I	PIF-I			
Sedge wren	NE_Reg			MNBMCN		
Semipalmated sandpiper						
Sharp-shinned hawk						
Short-billed Dowitcher						
Short-eared owl	NE_Reg	PIF-I	PIF-I	MNBMCN		
Snowy egret						Focal
Solitary sandpiper						
Summer tanager						
Swainson's thrush						
Swainson's warbler		PIF-I		MNBMCN		
Tricolored heron						Focal
Upland sandpiper	NE_Reg			MNBMCN		
Veery				MNBMCN		

COMMON NAME	NE_Reg	PIFRank-B	PIFRank-W	MNBMCN	NAWMP	MANEM
Vesper sparrow						
Wayne's black-throated green warbler						
Whimbrel						
Whip-poor-will	NE_Reg	PIF-I				
Willet						
Willow flycatcher		PIF-I				
Wilson's plover		PIF-I				
Wilson's snipe						
Winter wren						
Wood thrush		PIF-I		MNBMCN		
Worm-eating warbler		PIF-I		MNBMCN		
Yellow-bellied sapsucker						
Yellow-crowned night-heron						Focal
Yellow-throated vireo		PIF-I				

GCN Birds – Part 3

COMMON NAME	NASWG	NAWCP	BCC-BCR	BCC-NE	NALCP-1	NALCP-2
Acadian flycatcher			BCC-BCR		RESP	STEW
Alder flycatcher						
American bittern		High				
American black duck						
American oystercatcher	High		BCC-BCR	BCC-NE		
American peregrine falcon			BCC-BCR	BCC-NE		
American redstart						
American woodcock	Imperiled					
Bachman's sparrow			BCC-BCR		IM ACT	WATCH
Bald eagle						
Bank swallow						
Barn owl						
Barred owl						
Bewick's wren			BCC-BCR	BCC-NE		
Bicknell's thrush				BCC-NE		
Black rail		High	BCC-BCR	BCC-NE		
Black skimmer		High	BCC-BCR	BCC-NE		
Black tern		Moderate				
Black-and-white warbler						
Black-bellied plover	Moderate					
Black-billed cuckoo						
Blackburnian warbler						
Black-crowned night-heron		Moderate				
Black-throated blue warbler						
Black-throated green warbler						

COMMON NAME	NASWG	NAWCP	BCC-BCR	BCC-NE	NALCP-1	NALCP-2
Blue-headed vireo						
Blue-winged warbler			BCC-BCR		MGMT	WATCH
Boat-tailed grackle						
Bobolink						
Brant						
Broad-winged hawk						
Brown creeper						
Brown pelican		Moderate				
Brown thrasher					MGMT	STEW
Brown-headed nuthatch					MGMT	WATCH
Canada warbler			BCC-BCR	BCC-NE		
Canvasback						
Cerulean warbler			BCC-BCR	BCC-NE	MGMT	WATCH
Chestnut-sided warbler						
Chuck-will's-widow			BCC_BCR		MGMT	STEW
Coastal plain swamp sparrow						
Common loon		Moderate				
Common moorhen		Not at risk				
Common nighthawk						
Common raven						
Common tern		Low	BCC-BCR	BCC-NE		
Dark-eyed junco						
Dickcissel					MGMT	WATCH
Dunlin	Moderate					
Eastern meadowlark						
Eastern towhee					MGMT	STEW
Field sparrow						
Forster's tern		Moderate				
Glossy ibis		Low				
Golden eagle						
Golden-crowned kinglet						
Golden-winged warbler			BCC-BCR	BCC-NE	IM ACT	WATCH
Grasshopper sparrow						
Great blue heron		Not at risk				
Great egret		Not at risk				
Greater yellowlegs	High					
Gull-billed tern		High				
Hairy woodpecker						
Harlequin duck						
Henslow's sparrow			BCC-BCR	BCC-NE	IM ACT	WATCH
Hermit thrush						
Hooded warbler					RESP	STEW
Horned grebe		High				
Kentucky warbler			BCC-BCR	BCC-NE	MGMT	WATCH
King rail		Moderate				
Laughing gull		Not at risk				

COMMON NAME	NASWG	NAWCP	BCC-BCR	BCC-NE	NALCP-1	NALCP-2
Least bittern		Moderate				
Least flycatcher						
Least tern		High	BCC-BCR	BCC-NE		
Little blue heron		High				
Loggerhead shrike				BCC-NE		
Long-eared owl						
Louisiana waterthrush			BCC-BCR		RESP	STEW
Magnolia warbler						
Marsh wren			BCC-BCR			
Mourning warbler						
Nashville warbler						
Northern bobwhite						
Northern gannet		Not at risk				
Northern goshawk						
Northern harrier						
Northern parula						
Northern saw-whet owl			BCC-BCR			
Northern waterthrush						
Olive-sided flycatcher			BCC-BCR	BCC-NE		
Ovenbird						
Pied-billed grebe		Not at risk				
Pileated woodpecker						
Piping plover	Imperiled					
Prairie warbler			BCC-BCR	BCC-NE	MGMT	WATCH
Prothonotary warbler			BCC-BCR		MGMT	WATCH
Purple sandpiper	Moderate		BCC-BCR	BCC-NE		
Red knot	Imperiled		BCC-BCR	BCC-NE		
Red-breasted nuthatch						
Red-cockaded woodpecker					IM ACT	WATCH
Red-eyed vireo						
Red-headed woodpecker			BCC-BCR	BCC-NE	MGMT	WATCH
Red-shouldered hawk					RESP	STEW
Red-throated loon		High				
Roseate tern		High				
Royal tern		Moderate				
Ruddy duck						
Ruddy turnstone	High					
Saltmarsh sharp-tailed sparrow			BCC-BCR	BCC-NE	IM ACT	WATCH
Sanderling	High					
Sandwich tern		Not at risk				
Savannah sparrow						
Scarlet tanager						
Seaside sparrow			BCC-BCR	BCC-NE	RESP	WATCH
Sedge wren			BCC-BCR	BCC-NE		
Semipalmated sandpiper	High					
Sharp-shinned hawk						

COMMON NAME	NASWG	NAWCP	BCC-BCR	BCC-NE	NALCP-1	NALCP-2
Short-billed Dowitcher	High					
Short-eared owl			BCC-BCR	BCC-NE		
Snowy egret		High				
Solitary sandpiper	High					
Summer tanager						
Swainson's thrush						
Swainson's warbler			BCC-BCR	BCC-NE	RESP	WATCH
Tricolored heron		High				
Upland sandpiper	High		BCC-BCR	BCC-NE		
Veery						
Vesper sparrow						
Wayne's black-throated green warbler						
Whimbrel	Imperiled		BCC-BCR	BCC-NE		
Whip-poor-will			BCC-BCR	BCC-NE		
Willet	High					
Willow flycatcher					MGMT	WATCH
Wilson's plover	High		BCC-BCR			
Wilson's snipe	Moderate					
Winter wren						
Wood thrush			BCC-BCR	BCC-NE	MGMT	WATCH
Worm-eating warbler			BCC-BCR	BCC-NE	MGMT	WATCH
Yellow-bellied sapsucker			BCC-BCR			
Yellow-crowned night-heron		Moderate				
Yellow-throated vireo					RESP	STEW

GCN Birds – Part 4

COMMON NAME	TNC Ecoregion	Audubon	Endemic	Responsibility
Acadian flycatcher				
Alder flycatcher				
American bittern	SECONDARY			
American black duck	SECONDARY	YELLOW		
American oystercatcher	SECONDARY	YELLOW		
American peregrine falcon				
American redstart				
American woodcock		YELLOW		
Bachman's sparrow	PRIMARY	RED		
Bald eagle				
Bank swallow				
Barn owl				
Barred owl				
Bewick's wren	PRIMARY			
Bicknell's thrush	SECONDARY	RED		

COMMON NAME	TNC Ecoregion	Audubon	Endemic	Responsibility
Black rail	SECONDARY	RED		
Black skimmer	SECONDARY			
Black tern				
Black-and-white warbler				
Black-bellied plover				
Black-billed cuckoo				
Blackburnian warbler				
Black-crowned night-heron				
Black-throated blue warbler	SECONDARY			
Black-throated green warbler				
Blue-headed vireo				
Blue-winged warbler	SECONDARY	YELLOW		
Boat-tailed grackle				
Bobolink	SECONDARY			
Brant		YELLOW		
Broad-winged hawk				
Brown creeper	SECONDARY			
Brown pelican				
Brown thrasher				
Brown-headed nuthatch	SECONDARY	YELLOW		
Canada warbler		YELLOW		
Canvasback				Responsibility
Cerulean warbler	SECONDARY	RED		
Chestnut-sided warbler				
Chuck-will's-widow				
Coastal plain swamp sparrow	PRIMARY			
Common loon				
Common moorhen				
Common nighthawk				
Common raven				
Common tern				
Dark-eyed junco				
Dickcissel		YELLOW		
Dunlin				
Eastern meadowlark				
Eastern towhee				
Field sparrow				
Forster's tern				
Glossy ibis				
Golden eagle				
Golden-crowned kinglet				
Golden-winged warbler	SECONDARY	RED		
Grasshopper sparrow				Responsibility
Great blue heron				
Great egret				
Greater yellowlegs				

COMMON NAME	TNC Ecoregion	Audubon	Endemic	Responsibility
Gull-billed tern				
Hairy woodpecker				
Harlequin duck				
Henslow's sparrow	SECONDARY	RED		
Hermit thrush				
Hooded warbler	SECONDARY			
Horned grebe				
Kentucky warbler	SECONDARY	YELLOW		
King rail				
Laughing gull				
Least bittern				
Least flycatcher				
Least tern				
Little blue heron				
Loggerhead shrike				
Long-eared owl				
Louisiana waterthrush	SECONDARY			
Magnolia warbler				
Marsh wren				
Mourning warbler				
Nashville warbler				
Northern bobwhite				
Northern gannet				
Northern goshawk				
Northern harrier	SECONDARY			
Northern parula				
Northern saw-whet owl	SECONDARY			
Northern waterthrush				
Olive-sided flycatcher		YELLOW		
Ovenbird				
Pied-billed grebe				
Pileated woodpecker				
Piping plover	PRIMARY	RED		
Prairie warbler	SECONDARY	YELLOW		
Prothonotary warbler	SECONDARY	YELLOW		
Purple sandpiper		YELLOW		
Red knot		YELLOW		
Red-breasted nuthatch				
Red-cockaded woodpecker	PRIMARY	RED		
Red-eyed vireo				
Red-headed woodpecker		YELLOW		
Red-shouldered hawk				
Red-throated loon				
Roseate tern				
Royal tern				
Ruddy duck				Responsibility

COMMON NAME	TNC Ecoregion	Audubon	Endemic	Responsibility
Ruddy turnstone				
Saltmarsh sharp-tailed sparrow		RED		
Sanderling				
Sandwich tern				
Savannah sparrow				
Scarlet tanager				
Seaside sparrow		YELLOW		
Sedge wren				
Semipalmated sandpiper				
Sharp-shinned hawk				
Short-billed Dowitcher				
Short-eared owl		YELLOW		
Snowy egret				
Solitary sandpiper				
Summer tanager				
Swainson's thrush				
Swainson's warbler	SECONDARY	RED		
Tricolored heron				
Upland sandpiper				
Veery				
Vesper sparrow				
Wayne's black-throated green warbler				
Whimbrel		YELLOW		
Whip-poor-will				
Willet				
Willow flycatcher		YELLOW		
Wilson's plover		YELLOW		
Wilson's snipe				
Winter wren				
Wood thrush	SECONDARY	YELLOW		
Worm-eating warbler	SECONDARY	YELLOW		
Yellow-bellied sapsucker				
Yellow-crowned night-heron				
Yellow-throated vireo				

GCN Reptiles – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
Atlantic hawksbill seaturtle	Eretmochelys imbricata	G3	SRN	E	E
Bog turtle	Clemmys muhlenbergii	G3	S2	T	T
Broad-headed skink	Eumeces laticeps	G5	S4		
Cornsnake	Elaphe guttata	G5	S4		
Eastern box turtle	Terrapene carolina	G5	S5		

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
Eastern hog-nosed snake	Heterodon platirhinos	G5	S5		
Eastern ribbonsnake	Thamnophis sauritus	G5	S5		
Eastern spiny softshell	Apalone spinifera	G5	S1	I	
Green seaturtle	Chelonia mydas	G3	S1N	T	T
Kemp's ridley seaturtle	Lepidochelys kempii	G1	S1N	E	E
Leatherback seaturtle	Dermochelys coriacea	G2	S1	E	E
Loggerhead seaturtle	Caretta caretta	G3	S1B,S1N	T	T
Mountain earthsnake	Virginia valeriae pulchra	G5T3T4	S2	E	
Northern coal skink	Eumeces anthracinus	G5	SU	E	
Northern diamond-backed terrapin	Malaclemys terrapin terrapin	G4T4	S4		
Northern map turtle	Graptemys geographica	G5	S1	E*	
Northern pinesnake	Pituophis melanoleucus	G4	SH		
Northern red-bellied turtle	Pseudemys rubriventris	G5	S5		
Northern scarletsnake	Cemophora coccinea	G5	S3		
Queen snake	Regina septemvittata	G5	S5		
Rainbow snake	Farancia erytrogramma	G5	S1	E	
Red-bellied watersnake	Nerodia erythrogaster erythrogaster	G5T5	S2S3		
Spotted turtle	Clemmys guttata	G5	S5		
Timber rattlesnake	Crotalus horridus	G4	S3		
Wood turtle	Glyptemys insculpta	G4	S4		

GCN Reptiles – Part 2

COMMON NAME	CITES	IUCN	NE_Reg	TNC Ecoregion	Endemic	Responsibility
Atlantic hawksbill seaturtle	1	CR				
Bog turtle	1	EN		PRIMARY		
Broad-headed skink			NE_Reg			
Cornsnake						
Eastern box turtle	2	LR	NE_Reg			
Eastern hog-nosed snake			NE_Reg			
Eastern ribbonsnake			NE_Reg			
Eastern spiny softshell						
Green seaturtle	1	EN				
Kemp's ridley seaturtle	1	CR				
Leatherback seaturtle	1	CR				
Loggerhead seaturtle	1	EN		PRIMARY		
Mountain earthsnake			NE_Reg			
Northern coal skink			NE_Reg			
Northern diamond-backed terrapin			NE_Reg			
Northern map turtle						
Northern pinesnake			NE_Reg			
Northern red-bellied turtle		LR	NE_Reg			
Northern scarletsnake						

COMMON NAME	CITES	IUCN	NE_Reg	TNC Ecoregion	Endemic	Responsibility
Queen snake			NE_Reg			
Rainbow snake						
Red-bellied watersnake						
Spotted turtle		VU	NE_Reg			
Timber rattlesnake			NE_Reg	PRIMARY		
Wood turtle	2	VU	NE_Reg	SECONDARY		

GCN Amphibians – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES
Allegheny Mountain dusky salamander	Desmognathus ochrophaeus	G5	S5			
Barking treefrog	Hyla gratiosa	G5	S1	E		
Carpenter frog	Rana virgatipes	G5	S2	I		
Common mudpuppy	Necturus maculosus	G5	S1	X		
Eastern hellbender	Cryptobranchus alleganiensis	G3G4	S1	E		
Eastern mud salamander	Pseudotriton montanus	G5	S2?			
Eastern narrow-mouthed toad	Gastrophryne carolinensis	G5	S1S2	E		
Eastern spadefoot	Scaphiopus holbrookii	G5	S4			
Eastern tiger salamander	Ambystoma tigrinum	G5	S2	E		
Green salamander	Aneides aeneus	G3G4	S2	E		
Jefferson salamander	Ambystoma jeffersonianum	G4	S3			
Long-tailed salamander	Eurycea longicauda	G5	S5			
Mountain chorus frog	Pseudacris brachyphona	G5	S2	T		
New Jersey chorus frog	Pseudacris triseriata kalmi	G5T4	S4			
Northern red salamander	Pseudotriton ruber	G5	S5			
Seal salamander	Desmognathus monticola	G5	S5			
Wehrle's salamander	Plethodon wehrlei	G5	S2	I		

GCN Amphibians – Part 2

COMMON NAME	IUCN	NE_Reg	MBSS	TNC Ecoregion	Endemic	Responsibility
Allegheny Mountain dusky salamander			MBSS			
Barking treefrog				SECONDARY		
Carpenter frog		NE_Reg		SECONDARY		
Common mudpuppy						
Eastern hellbender		NE_Reg				
Eastern mud salamander		NE_Reg				
Eastern narrow-mouthed toad						
Eastern spadefoot		NE_Reg				
Eastern tiger salamander		NE_Reg		SECONDARY		

COMMON NAME	IUCN	NE_Reg	MBSS	TNC Ecoregion	Endemic	Responsibility
Green salamander	LR	NE_Reg		PRIMARY		
Jefferson salamander		NE_Reg				
Long-tailed salamander			MBSS			
Mountain chorus frog		NE_Reg				
New Jersey chorus frog		NE_Reg				Responsibility
Northern red salamander			MBSS			
Seal salamander			MBSS			
Wehrle's salamander						

GCN Fishes – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
American brook lamprey	Lampetra appendix	G4	S1S2	T			
American shad	Alosa sapidissima	G5	S3	I			
Atlantic sturgeon	Acipenser oxyrinchus	G3	S1		C	2	LR
Banded sunfish	Enneacanthus obesus	G5	S2				
Blackbanded sunfish	Enneacanthus chaetodon	G4	S1	T			
Bluespotted sunfish	Enneacanthus gloriosus	G5	S3S4				
Bowfin	Amia calva	G5	S1?				
Bridle shiner	Notropis bifrenatus	G5	SH	E			
Brook trout	Salvelinus fontinalis	G5	S3S4				
Cheat minnow	Pararhinichthys bowersi	G1G2Q	SX	X			
Checkered sculpin	Cottus sp 7	G4Q	S1S2				
Comely shiner	Notropis amoenus	G5	S2	T			
Flier	Centrarchus macropterus	G5	S1S2	T			
Glassy darter	Etheostoma vitreum	G4G5	S1S2	T			
Greenside darter	Etheostoma blennioides	G5	S5				
Hickory shad	Alosa mediocris	G5	S3	I			
Ironcolor shiner	Notropis chalybaeus	G4	S1	E			
Johnny darter	Etheostoma nigrum	G5	S3				
Least brook lamprey	Lampetra aepyptera	G5	S4				
Logperch	Percina caprodes	G5	S1S2	T			
Longnose gar	Lepisosteus osseus	G5	S2?				
Longnose sucker	Catostomus catostomus	G5	SH	X			
Maryland darter	Etheostoma sellare	GH	SH	E	E		EX
Mottled sculpin	Cottus bairdi	G5	S3S4				
Mud sunfish	Acantharchus pomotis	G5	S2	I			
Northern hogsucker	Hypentelium nigricans	G5	S5				
Pearl dace	Margariscus margarita	G5	S1S2	T			
Redside dace	Clinostomus elongatus	G4	SX				
Rosyside dace	Clinostomus funduloides	G5	S5				
Shield darter	Percina peltata	G5	S3				
Shortnose sturgeon	Acipenser brevirostrum	G3	S1	E	E	1	VU
Silverjaw minnow	Ericymba buccata	G5	S4				

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
Spotfin killifish	Fundulus luciae	G4	S2?				
Stonecat	Noturus flavus	G5	S1	E			
Stripeback darter	Percina notogramma	G4	S1	E			
Striped shiner	Luxilus chrysocephalus	G5	S1S2	I			
Swamp darter	Etheostoma fusiforme	G5	S2	I			
Trout-perch	Percopsis omiscomaycus	G5	SX	X			
Warmouth	Lepomis gulosus	G5	S3?				
White catfish	Ameiurus catus	G5	SU				

GCN Fishes – Part 2

COMMON NAME	NE_Reg	MBSS	AFS	DNR Fisheries	TNC Ecoregion	Endemic	Responsibility
American brook lamprey	NE_Reg	SAS-I					
American shad				DAF			
Atlantic sturgeon	NE_Reg		AFS-E		PRIMARY		
Banded sunfish	NE_Reg						
Blackbanded sunfish	NE_Reg	SAS					
Bluespotted sunfish							
Bowfin							
Bridle shiner	NE_Reg	SAS					
Brook trout		MBSS					
Cheat minnow							
Checkered sculpin		SAS-M					
Comely shiner		SAS					
Flier		SAS-M					
Glassy darter		SAS-I					
Greenside darter		SAS-M					
Hickory shad				DAF			
Ironcolor shiner		SAS-I					
Johnny darter		SAS-M					
Least brook lamprey		SAS-I					
Logperch		SAS-M					
Longnose gar							
Longnose sucker		SAS					
Maryland darter			AFS-E			Endemic	Responsibility
Mottled sculpin							
Mud sunfish	NE_Reg	SAS-M					
Northern hogsucker		SAS-I					
Pearl dace		SAS-M					
Redside dace							
Rosyside dace		SAS-I					
Shield darter		SAS-I					
Shortnose sturgeon			AFS-E		PRIMARY		

COMMON NAME	NE_Reg	MBSS	AFS	DNR Fisheries	TNC Ecoregion	Endemic	Responsibility
Silverjaw minnow		SAS-M					
Spotfin killifish							
Stonecat		SAS-I					
Stripeback darter							
Striped shiner		SAS-M					
Swamp darter		SAS-I					
Trout-perch							
Warmouth							
White catfish							

INVERTEBRATES

GCN Insects: Dragonflies and Damselflies (Odonata) – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES
A snaketail	Ophiogomphus sp 1	G?	S1			
Allegheny river cruiser	Macromia alleghaniensis	G4	S2			
Allegheny snaketail	Ophiogomphus incurvatus	G3	S2			
Amber-winged spreadwing	Lestes eurinus	G4	S3			
American emerald	Cordulia shurtleffi	G5	S3			
Arrowhead spiketail	Cordulegaster obliqua	G4	S2			
Atlantic bluet	Enallagma doubledayi	G5	SH			
Attenuated bluet	Enallagma daeckii	G4	S3			
Aurora damsel	Chromagrion conditum	G5	S3S4			
Azure bluet	Enallagma aspersum	G5	S3S4			
Band-winged meadowhawk	Sympetrum semicinctum	G5	S3			
Bar-winged skimmer	Libellula axilena	G5	S3			
Beaverpond baskettail	Epitheca canis	G5	S3			
Big bluet	Enallagma durum	G5	S3			
Black-tipped darner	Aeshna tuberculifera	G4	S2			
Blackwater bluet	Enallagma weewa	G5	S1			
Blue-faced meadowhawk	Sympetrum ambiguum	G5	S3S4			
Brown spiketail	Cordulegaster bilineata	G5	S2			
Burgundy bluet	Enallagma dubium	G5	S1			
Canada darner	Aeshna canadensis	G5	S2			
Chalk-fronted skimmer	Libellula julia	G5	S2			
Cherry-faced meadowhawk	Sympetrum internum	G5	S2			
Cobra clubtail	Gomphus vastus	G5	S3			
Comet darner	Anax longipes	G5	S3			
Common sanddragon	Progomphus obscurus	G5	S3			
Crimson-ringed whiteface	Leucorrhinia glacialis	G5	S1			
Cyrano darner	Nasiaeschna pentacantha	G5	S3			
Delta-spotted spiketail	Cordulegaster diastatops	G5	S3			

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES
Dot-tailed whiteface	Leucorrhinia intacta	G5	S3			
Eastern red damsel	Amphiagrion saucium	G5	S3			
Eastern ringtail	Erpetogomphus designatus	G5	S2			
Elfin skimmer	Nannothemis bella	G4	S1			
Elusive clubtail	Stylurus notatus	G3	SU			
Emerald spreadwing	Lestes dryas	G5	SH			
Faded pennant	Celithemis ornata	G5	S1			
Fine-lined emerald	Somatochlora filosa	G5	S2			
Four-spotted pennant	Brachymesia gravida	G5	S3S4			
Golden-winged skimmer	Libellula auripennis	G5	S3			
Gray petaltail	Tachopteryx thoreyi	G4	S2			
Great spreadwing	Archilestes grandis	G5	S3			
Green-faced clubtail	Gomphus viridifrons	G3	S1			
Green-striped darner	Aeshna verticalis	G5	S2			
Hagen's bluet	Enallagma hageni	G5	S3S4			
Harlequin darner	Gomphaeschna furcillata	G5	S3			
Harpoon clubtail	Gomphus descriptus	G4	S1			
Hudsonian whiteface	Leucorrhinia hudsonica	G5	S1			
Lance-tipped darner	Aeshna constricta	G5	SH			
Laura's clubtail	Stylurus laurae	G4	S2			
Least clubtail	Stylogomphus albistylus	G5	S3S4			
Little blue dragonlet	Erythrodiplax minuscula	G5	S1			
Lyre-tipped spreadwing	Lestes unguiculatus	G5	SH			
Mantled baskettail	Epitheca semiaquea	G4	SH			
Marsh bluet	Enallagma ebrium	G5	SH			
Martha's pennant	Celithemis martha	G4	S2			
Midland clubtail	Gomphus fraternus	G5	S2			
Mocha emerald	Somatochlora linearis	G5	S3S4			
Northern pygmy clubtail	Lanthus parvulus	G4	S1			
Ocellated darner	Boyeria grafiana	G5	S1			
Pale bluet	Enallagma pallidum	G4	SH			
Petite emerald	Dorocordulia lepida	G5	SH			
Piedmont clubtail	Gomphus parvidens	G4	SH			
Rainbow bluet	Enallagma antennatum	G5	S1			
Rapids clubtail	Gomphus quadricolor	G3G4	S1			
River jewelwing	Calopteryx aequabilis	G5	S1			
Riverine clubtail	Stylurus amnicola	G4	SH			
Robust baskettail	Epitheca spinosa	G4	S1S2			
Royal river cruiser	Macromia taeniolata	G5	S3			
Russet-tipped clubtail	Stylurus plagiatus	G5	S3			
Rusty snaketail	Ophiogomphus rupinsulensis	G5	S2			
Sable clubtail	Gomphus rogersi	G4	S1	E		
Sedge sprite	Nehalennia irene	G5	S3			
Seepage dancer	Argia bipunctulata	G4	S3			
Selys' sunfly	Helocordulia selysii	G4	S2			
Skillet clubtail	Gomphus ventricosus	G3	SH			

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES
Ski-tailed emerald	Somatochlora elongata	G5	S1			
Slender bluet	Enallagma traviatum	G5	S3			
Smoky rubyspot	Hetaerina titia	G5	SH			
Southern pygmy clubtail	Lanthus vernalis	G4	S1			
Southern sprite	Nehalennia integricollis	G5	S1S2			
Sparkling jewelwing	Calopteryx dimidiata	G5	SH			
Sphagnum sprite	Nehalennia gracilis	G5	S2			
Spine-crowned clubtail	Gomphus abbreviatus	G3G4	SH			
Splendid clubtail	Gomphus lineatifrons	G4	SH			
Spotted spreadwing	Lestes congener	G5	S3			
Spring blue darner	Aeshna mutata	G3G4	S1	E		
Stripe-winged baskettail	Epitheca costalis	G4	S1			
Stygian shadowdragon	Neurocordulia yamaskanensis	G5	S2			
Superb jewelwing	Calopteryx amata	G4	S2			
Sweetflag spreadwing	Lestes forcipatus	G5	S3			
Taper-tailed darner	Gomphaeschna antilope	G4	S2			
Tiger spiketail	Cordulegaster erronea	G4	S2			
Treetop emerald	Somatochlora provocans	G4	S1			
Tule bluet	Enallagma carunculatum	G5	SH			
Turquoise bluet	Enallagma divagans	G5	S3S4			
Uhler's sundragon	Helocordulia uhleri	G5	S3			
Vesper bluet	Enallagma vesperum	G5	S3			
White corporal	Libellula exusta	G4	S1			
White-faced meadowhawk	Sympetrum obtrusum	G5	S3			
Yellow-sided skimmer	Libellula flavida	G5	S2			
Zebra clubtail	Stylurus scudderi	G4	S1			

GCN Insects: Dragonflies and Damselflies (Odonata) – Part 2

COMMON NAME	IUCN	TNC Ecoregion	Endemic	Responsibility
A snaketail			?	?
Allegheny river cruiser				
Allegheny snaketail	LR	SECONDARY		
Amber-winged spreadwing				
American emerald				
Arrowhead spiketail				
Atlantic bluet				
Attenuated bluet				
Aurora damsel				
Azure bluet				
Band-winged meadowhawk				
Bar-winged skimmer				
Beaverpond baskettail				
Big bluet				

COMMON NAME	IUCN	TNC Ecoregion	Endemic	Responsibility
Black-tipped darner				
Blackwater bluet		SECONDARY		
Blue-faced meadowhawk				
Brown spiketail				
Burgundy bluet		SECONDARY		
Canada darner				
Chalk-fronted skimmer				
Cherry-faced meadowhawk				
Cobra clubtail				
Comet darner		SECONDARY		
Common sanddragon				
Crimson-ringed whiteface				
Cyrano darner				
Delta-spotted spiketail				
Dot-tailed whiteface				
Eastern red damsel				
Eastern ringtail				
Elfin skimmer		SECONDARY		
Elusive clubtail				
Emerald spreadwing				
Faded pennant				
Fine-lined emerald				
Four-spotted pennant				
Golden-winged skimmer				
Gray petaltail		SECONDARY		
Great spreadwing				
Green-faced clubtail		PRIMARY		
Green-striped darner				
Hagen's bluet				
Harlequin darner				
Harpoon clubtail				
Hudsonian whiteface				
Lance-tipped darner				
Laura's clubtail		SECONDARY		
Least clubtail				
Little blue dragonlet				
Lyre-tipped spreadwing				
Mantled baskettail				
Marsh bluet				
Martha's pennant				
Midland clubtail				
Mocha emerald				
Northern pygmy clubtail		PRIMARY		
Ocellated darner				
Pale bluet		SECONDARY		
Petite emerald				

COMMON NAME	IUCN	TNC Ecoregion	Endemic	Responsibility
Piedmont clubtail	LR			
Rainbow bluet				
Rapids clubtail		PRIMARY		
River jewelwing				
Riverine clubtail		PRIMARY		
Robust baskettail		PRIMARY		
Royal river cruiser				
Russet-tipped clubtail				
Rusty snaketail				
Sable clubtail		SECONDARY		
Sedge sprite		SECONDARY		
Seepage dancer		SECONDARY		
Selys' sunfly				
Skillet clubtail		PRIMARY		
Ski-tailed emerald				
Slender bluet				
Smoky rubyspot				
Southern pygmy clubtail				
Southern sprite				
Sparkling jewelwing				
Sphagnum sprite				
Spine-crowned clubtail		PRIMARY		
Splendid clubtail				
Spotted spreadwing				
Spring blue darner		PRIMARY		
Stripe-winged baskettail				
Stygian shadowdragon				
Superb jewelwing		SECONDARY		
Sweetflag spreadwing				
Taper-tailed darner				
Tiger spiketail		SECONDARY		
Treetop emerald		PRIMARY		
Tule bluet				
Turquoise bluet				
Uhler's sundragon				
Vesper bluet				
White corporal				
White-faced meadowhawk				
Yellow-sided skimmer		SECONDARY		
Zebra clubtail		PRIMARY		

GCN Insects: Butterflies and Moths (Lepidoptera) – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
A noctuid moth	Zale curema	G3G4	S1?		
A noctuid moth	Apamea mixta	GU	S1		
A noctuid moth	Meropleon titan	G2G4	SU		
A noctuid moth	Hadena ectypa	G3G4	SU		
American chestnut nepticulid moth	Ectoedemia castaneae	GH	SH		
Appalachian blue	Celastrina neglectamajor	G4	S3S4		
Atlantis fritillary	Speyeria atlantis	G5	S1	T	
Baltimore checkerspot	Euphydryas phaeton	G4	S3		
Bog copper	Lycaena epixanthe	G4G5	S1	E	
Carolina satyr	Hermeuptychia sosybius	G5	S1S3		
Chermock's mulberry wing	Poanes massasoit chermocki	G4T1	S1	E	
Chestnut clearwing moth	Synanthedon castaneae	G3G5	SX		
Cobweb skipper	Hesperia metea	G4G5	S3		
Compton tortoiseshell	Nymphalis vaualbum	G5	S1B,SZN	E	
Cypress sphinx moth	Isoparce cupressi	G4	SU		
Dion skipper	Euphyes dion	G4	S3		
Dotted skipper	Hesperia attalus slossonae	G3G4T3	SH		
Dusky azure	Celastrina ebenina	G4	SH	E	
Early hairstreak	Erora laeta	G3G4	S1	E	
Edwards' hairstreak	Satyrium edwardsii	G4	S1	E	
Frosted elfin	Incisalia irus	G3	S1	E	
Giant swallowtail	Papilio cresphontes	G5	S2	I	
Golden-banded skipper	Autochton cellus	G4	SH	X	
Gray comma	Polygonia progne	G5	S1S3		
Great purple hairstreak	Atlides halesus	G5	S1S2	T	
Harris's checkerspot	Chlosyne harrisii	G4	S2	T	
Hessel's hairstreak	Mitoura hesseli	G3G4	SH	X	
Hickory hairstreak	Satyrium caryaevorum	G4	S1	E	
Hoary elfin	Callophrys polios	G5	S1		
Indian skipper	Hesperia sassacus	G5	S3		
King's hairstreak	Satyrium kingi	G3G4	S1	E	
Long dash	Polites mystic	G5	S3		
Marbled underwing	Catocala marmorata	G3G4	SH		
Mitchell's satyr	Neonympha mitchellii	G1G2	SR		E
Mottled duskywing	Erynnis martialis	G3G4	S1	E	
Northern crescent	Phyciodes cocyta	G5	SP		
Northern hairstreak	Fixsenia ontario	G4T4	S1S2	E	
Northern metalmark	Calephelis borealis	G3G4	S2	T	
Olympia marble	Euchloe olympia	G4G5	S2	I	
Palamedes swallowtail	Papilio palamedes	G5	S1	E	
Pepper and salt skipper	Amblyscirtes hegon	G5	S2	I	
Persius duskywing	Erynnis persius persius	G5T2T3	SH		
Phleophagan chestnut nepticulid moth	Ectoedemia phleophaga	GH	SH		

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
Pine barrens zanclognatha	Zanclognatha martha	G4	S1S3		
Pink-edged sulphur	Colias interior	G5	S1		
Precious underwing	Catocala pretiosa pretiosa	G4T2T3	SH		
Rare skipper	Problema bulenta	G2G3	S1	T	
Regal fritillary	Speyeria idalia	G3	SH	X	
Seaside goldenrod stem borer	Papaipema duovata	G4	SU		
Silver-bordered fritillary	Boloria selene	G5	S3		
Silvery blue	Glaucopsyche lygdamus	G5	S2	I	
Southern grizzled skipper	Pyrgus wyandot	G2	S1	E	
Tawny crescent	Phyciodes batesii batesii	G4T1	SH	X	
The buckmoth	Hemileuca maia maia	G5T5	SU		
Three-horned moth	Pachypolia atricornis	G3G4	SH		
Two-spotted skipper	Euphyes bimacula	G4	S1	E	
West virginia white	Pieris virginiensis	G3G4	S3		

GCN Insects: Butterflies and Moths (Lepidoptera) – Part 2

COMMON NAME	CITES	IUCN	TNC Ecoregion	Endemic	Responsibility
A noctuid moth			PRIMARY		
A noctuid moth					
A noctuid moth					
A noctuid moth					
American chestnut nepticulid moth					
Appalachian blue					
Atlantis fritillary					
Baltimore checkerspot					
Bog copper			PRIMARY		
Carolina satyr					
Chermock's mulberry wing			PRIMARY		
Chestnut clearwing moth		NE			
Cobweb skipper					
Compton tortoiseshell					
Cypress sphinx moth			SECONDARY		
Dion skipper					
Dotted skipper					
Dusky azure					
Early hairstreak					
Edwards' hairstreak					
Frosted elfin			PRIMARY		
Giant swallowtail					
Golden-banded skipper					
Gray comma					
Great purple hairstreak			SECONDARY		
Harris's checkerspot					

COMMON NAME	CITES	IUCN	TNC Ecoregion	Endemic	Responsibility
Hessel's hairstreak			PRIMARY		
Hickory hairstreak					
Hoary elfin					
Indian skipper					
King's hairstreak			PRIMARY		
Long dash					
Marbled underwing					
Mitchell's satyr					
Mottled duskywing			SECONDARY		
Northern crescent					
Northern hairstreak					
Northern metalmark			PRIMARY		
Olympia marble					
Palamedes swallowtail					
Pepper and salt skipper					
Persius duskywing			PRIMARY		
Phleophagan chestnut nepticulid moth					
Pine barrens zanclognatha					
Pink-edged sulphur					
Precious underwing					
Rare skipper			PRIMARY		
Regal fritillary			PRIMARY		
Seaside goldenrod stem borer			SECONDARY		
Silver-bordered fritillary					
Silvery blue					
Southern grizzled skipper			PRIMARY		
Tawny crescent					
The buckmoth			PRIMARY		
Three-horned moth					
Two-spotted skipper					
West virginia white					

GCN Insects: Beetles (Coleoptera) – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
A cave beetle	Pseudanophthalmus sp 15	G1	S1		
A coccinellid beetle	Nephus gordoni	G?	SU		
A dytiscid beetle	Hoperius planatus	G?	S2		
A hydrophilid beetle	Hydrochara occultus	G?	SU		
A hydrophilid beetle	Sperchopsis tessellatus	G?	S2		
A lampyrid firefly	Photuris bethaniensis	G1?	SP		
A tiger beetle	Cicindela ancocisconensis	G3	S1	E	
A tiger beetle	Cicindela purpurea	G5	S3		
A tiger beetle	Cicindela scutellaris	G5	S3		
A tiger beetle	Cicindela unipunctata	G4	S3		

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
A tiger beetle	Cicindela splendida	G5	S3		
A tiger beetle	Cicindela abdominalis	G5	S1	E	
American burying beetle	Nicrophorus americanus	G2G3	SX	X	E
Big sand tiger beetle	Cicindela formosa	G5	SU		
Giant stag beetle	Lucanus elephas	G3G5	S1		
Green-patterned tiger beetle	Cicindela patruela	G3	S1	E	
Little white tiger beetle	Cicindela lepida	G4	S1	E	
Northeastern beach tiger beetle	Cicindela dorsalis dorsalis	G4T2	S1	E	T
Puritan tiger beetle	Cicindela puritana	G1G2	S1	E	T
Schwarz' diving beetle	Laccophilus schwarzi	G?	SX		
Seth forest water scavenger beetle	Hydrochus spangleri	G1	S1	E	
Six-banded longhorn beetle	Dryobius sexnotatus	G?	S1	E	
White tiger beetle	Cicindela dorsalis media	G4T4	S1	E	
Crabtree cave springtail	Arrhopalites sp 1	G?	SU		

GCN Insects: Beetles (Coleoptera) – Part 2

COMMON NAME	CITES	IUCN	TNC Ecoregion	Endemic	Responsibility
A cave beetle			PRIMARY		
A coccinellid beetle					
A dytiscid beetle					
A hydrophilid beetle					
A hydrophilid beetle					
A lampyrid firefly			PRIMARY		
A tiger beetle			PRIMARY		
A tiger beetle			SECONDARY		
A tiger beetle					
A tiger beetle					
A tiger beetle					
A tiger beetle			SECONDARY		
American burying beetle		CR			
Big sand tiger beetle					
Giant stag beetle					
Green-patterned tiger beetle			PRIMARY		
Little white tiger beetle			SECONDARY		
Northeastern beach tiger beetle			PRIMARY		
Puritan tiger beetle		EN	PRIMARY		
Schwarz' diving beetle					
Seth forest water scavenger beetle			PRIMARY		
Six-banded longhorn beetle					
White tiger beetle			SECONDARY		
Crabtree cave springtail					

GCN Insects: Other Orders – Part 1

ORDER	COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
HOMOPTERA						
	A cicadellid leafhopper	Chlorotettix sp 1	G?	SU		
	Eastern sedge barrens planthopper	Limotettix minuendus	G1	S1		
EPHEMEROPTERA						
	Walker's tusked sprawler	Potamanthus walkeri	G5	SU		
DIPTERA						
	Pitcher-plant mosquito	Wyeomyia smithii	G5	S2		
COLLEMBOLA						
	Crabtree cave springtail	Arrhopalites sp 1	G?	SU		

GCN Insects: Other Orders – Part 2

ORDER	COMMON NAME	CITES	IUCN	TNC Ecoregion	Endemic	Responsibility
HOMOPTERA						
	A cicadellid leafhopper					
	Eastern sedge barrens planthopper					
EPHEMEROPTERA						
	Walker's tusked sprawler					
DIPTERA						
	Pitcher-plant mosquito					
COLLEMBOLA						
	Crabtree cave springtail					

GCN Other Arthropods – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
A crayfish	Cambarus acuminatus	G4	S3		
A crayfish	Orconectes obscurus	G5	S3		
A cyclopoid copepod	Diacyclops palustris	G?	SU		
A harpacticoid copepod	Attheyella spinipes	G?	SU		
Allegheny cave amphipod	Stygobromus allegheniensis	G4	S2S3	I	
An amphipod	Stygobromus sp 6	G?	S1		
An entocytherid ostracod	Dactylocythere scotos	G?	S1		
An entocytherid ostracod	Ankylocythere tridentata	G?	SU		
An isopod	Caecidotea sp 4	G?	S1		
An isopod	Caecidotea sp 5	G?	S1		
An isopod	Caecidotea sp 6	G?	S2		
An isopod	Caecidotea sp 1	G1	S1		

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US
An isopod	Caecidotea sp 2	G?	S1		
An isopod	Caecidotea sp 3	G3	S1		
Appalachian cave spider	Porhomma cavernicola	G4G5	S2		
Barrelville amphipod	Stygobromus sp 5	G?	S1		
Biggers' cave amphipod	Stygobromus biggersi	G2G4	S1	E	
Dearolf's cave amphipod	Crangonyx dearolfi	G2G3	S1	E	
Franz's cave amphipod	Stygobromus franzi	G2G3	S2S3	I	
Franz's cave isopod	Caecidotea franzi	G2G3	S1	E	
Greenbrier cave amphipod	Stygobromus emarginatus	G3	S1	E	
Horseshoe crab	Limulus polyphemus	G?	S?		
Pizzini's amphipod	Stygobromus pizzinii	G2G4	S1		
Potomac amphipod	Stygobromus tenuis potomacus	G4T3T4Q	S3		
Price's cave isopod	Caecidotea pricei	G3G4	S3		
Red-legged purse-web spider	Sphodros rufipes	G4	S1S2		
Roundtop amphipod	Stygobromus sp 14	G?	S1		
Shenandoah cave amphipod	Stygobromus gracilipes	G2G4	S1	E	
Snivelys cave spider	Oreonetides sp 1	G?	SU		
Tenuis amphipod	Stygobromus tenuis tenuis	G4G5T2T3Q	SU		
Tidewater amphipod	Stygobromus indentatus	G3	S1		

GCN Other Arthropods – Part 2

COMMON NAME	CITES	IUCN	DNR Fisheries	TNC Ecoregion	Endemic	Responsibility
A crayfish						
A crayfish						
A cyclopoid copepod						
A harpacticoid copepod						
Allegheny cave amphipod						
An amphipod						
An entocytherid ostracod						
An entocytherid ostracod						
An isopod						
An isopod						
An isopod						
An isopod				PRIMARY		
An isopod						
An isopod				PRIMARY		
Appalachian cave spider						
Barrelville amphipod						
Biggers' cave amphipod				PRIMARY		
Dearolf's cave amphipod		EN		PRIMARY		
Franz's cave amphipod				PRIMARY		
Franz's cave isopod				PRIMARY		

COMMON NAME	CITES	IUCN	DNR Fisheries	TNC Ecoregion	Endemic	Responsibility
Greenbrier cave amphipod		VU		PRIMARY		
Horseshoe crab		LR	DMI			
Pizzini's amphipod		VU		PRIMARY		
Potomac amphipod						
Price's cave isopod				PRIMARY		
Red-legged purse-web spider						
Roundtop amphipod						
Shenandoah cave amphipod				PRIMARY		
Snivelys cave spider						
Tenuis amphipod				PRIMARY		
Tidewater amphipod		VU		PRIMARY		

GCN Molluscs – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES	IUCN
Alewife floater	Anodonta implicata	G5	S3				
Angular disc	Discus catskillensis	G3G5	S1				
Appalachian spring snail	Fontigens bottimeri	G2	S2				
Atlantic spike	Elliptio producta	G4Q	S2S3				LR
Bear creek slitmouth	Stenotrema simile	G?	SU				
Blue ridge spring snail	Fontigens orolibas	G2G3	S1	E			
Brook floater	Alasmidonta varicosa	G3	S1	E			DD
Cherrydrop snail	Hendersonia occulta	G4	S2	I			
Creeper	Strophitus undulatus	G5	S2	I			
Cylindrically-ornate wood snail	Vertigo ventricosa	G3G4	SU				
Dwarf wedge mussel	Alasmidonta heterodon	G1G2	S1	E	E		EN
Eastern lampmussel	Lampsilis radiata	G5	SU				
Eastern pondmussel	Ligumia nasuta	G4G5	SU				LR
Green floater	Lasmigona subviridis	G3	S1	E			LR
Northern lance	Elliptio fisheriana	G4	S3				
Paper pondshell	Utterbackia imbecillis	G5	S3				
Rader's snail	Glyphyalinia raderi	G2	SH	X			
Spruce knob threetooth	Triodopsis picea	G3	S1				
Striped whitelip	Webbhelix multilineata	G?	S1				
Tidewater mucket	Leptodea ochracea	G4	SU				LR
Triangle floater	Alasmidonta undulata	G4	S1	E			
Yellow lampmussel	Lampsilis cariosa	G3G4	S1	X			EN
Yellow lance	Elliptio lanceolata	G2G3	SU				LR

GCN Molluscs – Part 2

COMMON NAME	NE_Reg	MBSS	AFS	TNC Ecoregion	Endemic	Responsibility
Alewife floater			CS			
Angular disc						
Appalachian spring snail				PRIMARY		
Atlantic spike			SC			
Bear creek slitmouth						
Blue ridge spring snail				PRIMARY		
Brook floater	NE_Reg		T	PRIMARY		
Cherrydrop snail						
Creeper			CS			
Cylindrically-ornate wood snail						
Dwarf wedge mussel			E	PRIMARY		
Eastern lampmussel			CS	SECONDARY		
Eastern pondmussel	NE_Reg		SC	SECONDARY		
Green floater	NE_Reg		T	PRIMARY		
Northern lance			SC			
Paper pondshell			CS			
Rader's snail						
Spruce knob threetooth				PRIMARY		
Striped whitelip						
Tidewater mucket	NE_Reg		SC	SECONDARY		
Triangle floater			SC	SECONDARY		
Yellow lampmussel	NE_Reg		T	PRIMARY		
Yellow lance				PRIMARY		

GCN Planaria – Part 1

COMMON NAME	SCIENTIFIC NAME	G-RANK	S-RANK	MD	US	CITES
A planarian	Phagocata virilis	G?	S1			
A planarian	Planaria dactyligera	G?	S2			
A planarian	Procotyla typhlops	G1G2	S1	E		
A planarian	Sphalloplana sp 1	G?	S1S2			
Hoffmaster's cave planarian	Sphalloplana hoffmasteri	G2G3	S1	E		

GCN Planaria – Part 2

COMMON NAME	IUCN	TNC Ecoregion	Endemic	Responsibility
A planarian				
A planarian				

COMMON NAME	IUCN	TNC Ecoregion	Endemic	Responsibility
A planarian		PRIMARY		
A planarian				
Hoffmaster's cave planarian		PRIMARY		

RARE OR UNIQUE NATURAL COMMUNITIES OF MARYLAND	S-RANK
TERRESTRIAL	
HIGH ELEVATION MOUNTAIN COMMUNITIES	
Central Appalachian Northern Hardwood Forests	S3
Central Appalachian Red Spruce Forests	S1
LOW ELEVATION MESIC FORESTS	
Acidic Cove Forests	S3
Basic Mesic Forests	(S4)
Acer saccharum - Fraxinus americana - Tilia americana / Cimicifuga racemosa Forest	S3
Fagus grandifolia - Liriodendron tulipifera Forest	S3?
Eastern Hemlock Forests	S2
Rich Cove and Slope Forests	S3
LOW ELEVATION DRY AND DRY-MESIC FORESTS AND WOODLANDS	
Basic Oak-Hickory Forests	S3
Chestnut Oak Forests	(S5)
Quercus prinus / Deschampsia flexuosa - Solidago bicolor Coastal Plain Terrace Forest	S2
Coastal Plain Dry Calcareous Forests and Woodlands	S1
Dry-Mesic Calcareous Forests	S3
Eastern White Pine-Hardwood Forests	S3
Low Elevation Boulderfield Forests and Woodlands	S2
Montane Acidic Woodlands	S3
Montane Dry Calcareous Forests and Woodlands	S2
Piedmont/Mountain Basic Woodlands	S1
Pine-Oak/Heath Forests and Woodlands	S3
Sand Ridge/Dune Woodlands	S3
BARRENS AND ROCK OUTCROPS	
Central Appalachian Shale Barrens	S2
Piedmont/Mountain Cliffs	S1
Riverside Outcrop Barrens	S1
Sandstone Glades	S2
Serpentine Barrens	S1
MARITIME ZONE COMMUNITIES	
Maritime Dune Grasslands	S3
Maritime Dune Woodlands	S2
Maritime Loblolly Pine Forests	S3
Maritime Scrub	S2
PALUSTRINE	
ALLUVIAL FLOODPLAINS	

RARE OR UNIQUE NATURAL COMMUNITIES OF MARYLAND	S-RANK
Coastal Plain Semipermanent Impoundments	(S5)
Chamaecyparis thyoides / Alnus maritima Woodland	S?
Coastal Plain/Piedmont Bottomland Forests	(S4)
Acer rubrum - Fraxinus pensylvanica / Saururus cernuus Forest	S2?
Acer rubrum - Nyssa sylvatica - Betula nigra Forest	S2?
Liriodendron tulipifera - Acer rubrum - Liquidambar styraciflua / Medeola virginiana Forest	S3
Platanus occidentalis - (Liquidambar styraciflua, Liriodendron tulipifera) / Asimina triloba Forest	S3?
Quercus (palustris, phellos) - Acer rubrum / Cinna arundinacea Forest	S2?
Floodplain Ponds and Pools	S2
Piedmont/Mountain Swamp Forests	S3
River-Scour Woodlands	S3
Riverside Prairies	S1
Rocky Bars and Shores	(S4)
Carex torta Herbaceous Vegetation	S3
NON-ALLUVIAL WETLANDS	
Appalachian Bogs/Fens	S1
Atlantic White Cedar Wetlands	S1
Coastal Plain Ponds	S2S3
Coastal Plain Seepage Bogs/Fens	S1
Coastal Plain/Piedmont Acidic Seepage Swamps	S3
High Elevation Seepage Swamps	S2
Interdunal Swales	S1
Mountain/Piedmont Acidic Seepage Swamps	S3
Mountain/Piedmont Basic Seepage Swamps	S3
Upland Depression Swamps	(S4)
Liquidambar styraciflua - Acer rubrum - Nyssa biflora / Carex joorii Forest	S1
Quercus palustris - Quercus bicolor / Carex spp. Forest	S?
Quercus phellos / Smilax rotundifolia / Carex (albolutescens, festucacea) Woodland	S?
NON-TIDAL MARITIME WETLANDS	
Estuarine Fringe Loblolly Pine Forests	S1
Maritime Shrub Swamps	S3
Sea-Level Fens	S1
ESTUARINE	
TIDAL WETLANDS	
Intertidal Mud/Sand/Gravel Flats	S3
Tidal Bald Cypress Woodlands/Forests	S1S2
Tidal Freshwater and Oligohaline Aquatic Beds	(S5)
Nelumbo lutea Herbaceous Vegetation	S3
Tidal Freshwater Marshes	(S5)
Zizania aquatica Tidal Herbaceous Vegetation	S3
Tidal Freshwater Shrublands	(S4)
Alnus maritima / Acorus calamus Tidal Shrubland	S3.1
Tidal Hardwood Swamps	(S4)
Fraxinus pennsylvanica - Acer rubrum / Polygonum spp. Tidal Woodland	S2
Tidal Oligohaline Marshes	(S4)

RARE OR UNIQUE NATURAL COMMUNITIES OF MARYLAND	S-RANK
Carex hyalinolepis Tidal Herbaceous Vegetation	S2
Elecoharis (fallax, rostellata) Tidal Herbaceous Vegetation	SR
Tidal Oligohaline Shrublands	(S4)
Morella cerifera - Baccharis halimifolia / Eleocharis fallax Tidal Shrublands	S3
Morella cerifera – Rosa palustris / Thelypteris palustris var. pubescens Tidal Shrubland	S3S4
RIVERINE	
RIVERINE COMMUNITIES	
Riverine Aquatic Beds	(S5)
Vallisneria americana Riverine Herbaceous Vegetation	S?
MARINE	
COASTAL BEACHES	
Coastal Beaches and Overwash Flats	S3

EXPLANATION OF THE ACRONYMS USED IN APPENDIX 3b

AFS	American Fisheries Society priority species
BCI	Bat Conservation International species of concern, with USFWS
BCC-NE	Birds of Conservation Concern, 2002, USFWS, for Region 5
BCC-BCR	Birds of Conservation Concern, 2002, USFWS, for BCR #28, 29, or 30
BCR	Bird Conservation Regions developed by the North American Bird Conservation Initiative coalition
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
DAF	Depleted Anadromous Fish of concern to the Fisheries Service, DNR
DMI	Depleted Marine Invertebrates of concern to the Fisheries Service, DNR
IUCN	Red List of Threatened Species, World Conservation Union
MANEM	Mid-Atlantic/New England/Maritimes Regional Working Group; MANEM list or draft focal species for the Mid-Atlantic
MBSS	Species of concern to the Maryland Biological Stream Survey, DNR

MNBMCN	Migratory Nongame Birds of Management Concern in the Northeast, 1995, USFWS Region 5
NABCI	North American Bird Conservation Initiative: A coalition of government agencies, private organizations and industries, and academic institutions; begun in 1999.
NALCP-1	North American Landbird Conservation Plan, Eastern Avifaunal Biome Action Category: Immediate Action, Management, or Responsibility, 2004, Partners in Flight
NALCP-2	North American Landbird Conservation Plan, Eastern Avifaunal Biome: Watchlist or Stewardship, 2004, Partners in Flight
NASWG	North Atlantic Shorebird Working Group; includes US Shorebird Conservation Plan, NABCI
NAWCP	North American Waterbird Conservation Plan conservation status, 2002, NABCI
NAWMP	North American Waterfowl Management Plan, 2003 update, breeding or nonbreeding, USFWS, for BCR #28, 29, or 30
NE_Reg	Wildlife of Regional Conservation Concern in the Northeast, 1999, NE Association of Fish and Wildlife Agencies
PIF	Partners in Flight – Breeding (B) and wintering (W) status
SAS	Sensitive Aquatic Species of concern to the Maryland Biological Stream Survey, DNR

Appendix 3c. Plants Species (Scientific Names) mentioned in this WDCP

Vascular Plants

COMMON NAME	SCIENTIFIC NAME
American basswood	*Tilia americana*
American beachgrass	*Ammophila breviligulata*
American beech	*Fagus grandifolia*
American bladdernut	*Staphylea trifolia*
American chestnut	*Castanea dentata*
American elm	*Ulmus americana*
American holly	*Ilex opaca var. opaca*
American mountain-ash	*Sorbus americana*
American waterwort	*Elatine americana*
annual saltmarsh aster	*Aster subulatus var. subulatus*
arrow-arum	*Peltandra virginica*
Atlantic white-cedar	*Chamaecyparis thyoides*
awl-leaf arrowhead	*Sagittaria subulata*
bald cypress	*Taxodium distichum*
barren bromegrass	*Bromus sterilis*
bayberry	*Morella pensylvanica*
beach heather	*Hudsonia tomentosa*
beach panic grass	*Panicum amarum var. amarulum*
beaked spikerush	*Eleocharis rostellata*
bear oak	*Quercus ilicifolia*
bird's-foot violet	*Viola pedata*
bitter seabeach grass	*Panicum amarum*
bitternut hickory	*Carya cordiformis*
black chokeberry	*Aronia melanocarpa*
black gum	*Nyssa sylvatica*
black huckleberry	*Gaylussacia baccata*
black locust	*Robinia pseudoacacia*
black needlerush	*Juncus roemerianus*
black oak	*Quercus velutina*
black willow	*Salix nigra*
blackjack oak	*Quercus marilandica*
bog goldenrod	*Solidago uliginosa var. uliginosa*
Bosc's panic grass	*Dichanthelium boscii*
bottlebrush grass	*Elymus hystrix var. hystrix*
boxelder	*Acer negundo*
bracken fern	*Pteridium aquilinum*
broad-leaved meadowsweet	*Spiraea alba var. latifolia*

COMMON NAME	SCIENTIFIC NAME
brown bog sedge	*Carex buxbaumii*
brownfruited rush	*Juncus pelocarpus*
brownish beaksedge	*Rhynchospora capitellata*
Canada burnet	*Sanguisorba canadensis*
Carolina rose	*Rosa carolina*
cheat grass	*Bromus tectorum*
cherrybark oak	*Quercus pagoda*
chestnut oak	*Quercus montana*
chinkapin oak	*Quercus muhlenbergii*
christmas fern	*Polystichum acrostichoides*
cinnamon fern	*Osmunda cinnamomea*
coastal carrionflower	*Smilax pseudochina*
coinleaf	*Centella erecta*
common buttonbush	*Cephalanthus occidentalis*
common dittany	*Cunila origanoides*
common elderberry	*Sambucus canadensis*
common greenbrier	*Smilax rotundifolia*
common hackberry	*Celtis occidentalis*
common prickly-ash	*Zanthoxylum americanum*
common reed	*Phragmites australis*
common St. John's-wort	*Hypericum punctatum*
common threesquare	*Schoenoplectus pungens var. pungens*
common water-willow	*Justicia americana*
common wild yam	*Dioscorea villosa*
cypress panicgrass	*Dichanthelium dichotomum var. ensifolium*
dangleberry	*Gaylussacia frondosa*
deerberry	*Vaccinium stamineum*
dotted smartweed	*Polygonum punctatum*
downy woodmint	*Blephilia ciliata*
dwarf sumac	*Rhus copallina*
early lowbush blueberry	*Vaccinium pallidum*
eastern hemlock	*Tsuga canadensis*
eastern hop-hornbeam	*Ostrya virginiana*
eastern larch	*Larix laricina*
eastern lilaeopsis	*Lilaeopsis chinensis*
eastern redbud	*Cercis canadensis var. canadensis*
eastern redcedar	*Juniperus virginiana var. virginiana*
eastern rose-mallow	*Hibiscus moscheutos ssp. moscheutos*
eastern white pine	*Pinus strobus*
Eaton's witchgrass	*Dichanthelium spretum*
false nettle	*Boehmeria cylindrica*
fetterbush	*Leucothoe racemosa*
flowering dogwood	*Cornus florida*

COMMON NAME	SCIENTIFIC NAME
fragrant sumac	*Rhus aromatica*
garlic-mustard	*Alliaria petiolata*
giant beardgrass	*Saccharum giganteum*
giant cane	*Arundinaria gigantea*
giant cordgrass	*Spartina cynosuroides*
great-laurel	*Rhododendron maximum*
green ash	*Fraxinus pennsylvanica*
greenfruit clearweed	*Pilea pumila*
halberd-leaf tearthumb	*Polygonum arifolium*
high-tide bush	*Baccharis halimifolia*
hoary mountain-mint	*Pycnanthemum incanum*
hoary puccoon	*Lithospermum canescens*
Indian cucumber-root	*Medeola virginiana*
Indian grass	*Sorghastrum nutans*
Japanese bromegrass	*Bromus japonicus*
Japanese honeysuckle	*Lonicera japonica*
Japanese stiltgrass	*Microstegium vimineum*
Kate's-mountain clover	*Trifolium virginicum*
kidneyleaf mudplantain	*Heteranthera reniformis*
large cranberry	*Vaccinium macrocarpon*
leatherleaf	*Chamaedaphne calyculata*
little bluestem	*Schizachyrium scoparium*
lizard's-tail	*Saururus cernuus*
loblolly pine	*Pinus taeda*
Long's rush	*Juncus longii*
low false bindweed	*Calystegia spithamaea ssp. purshiana*
maidencane	*Panicum hemitomon*
maple-leaf viburnum	*Viburnum acerifolium*
marsh blue violet	*Viola cucullata*
marsh dewflower	*Murdannia keisak*
marsh fern	*Thelypteris palustris var. pubescens*
marsh-elder	*Iva frutescens*
mountain holly	*Ilex montana*
mountain-laurel	*Kalmia latifolia*
mudwort	*Limosella australis*
multiflora rose	*Rosa multiflora*
narrow-leaved cattail	*Typha angustifolia*
narrow-leaved loosestrife	*Lythrum lineare*
narrow-leaved meadowsweet	*Spiraea alba var. alba*
northern arrow-wood	*Viburnum recognitum*
northern lowbush blueberry	*Vaccinium angustifolium*
northern moss phlox	*Phlox subulata*
northern red oak	*Quercus rubra*

COMMON NAME	SCIENTIFIC NAME
old-field broomstraw/broom-sedge	*Andropogon virginicus*
overcup oak	*Quercus lyrata*
Parker's pipewort	*Eriocaulon parkeri*
partridge-berry	*Mitchella repens*
pawpaw	*Asimina triloba*
Pennsylvania sedge	*Carex pensylvanica*
perennial saltmarsh aster	*Symphyotrichum tenuifolium*
persimmon	*Diospyros virginiana*
pickerel weed	*Pontederia cordata*
pignut hickory	*Carya glabra*
pin oak	*Quercus palustris*
pink lady's-slipper	*Cypripedium acaule*
pitch pine	*Pinus rigida*
poison ivy	*Toxicodendron radicans*
poison sumac	*Toxicodendron vernix*
pond pine	*Pinus serotina*
possum-haw	*Viburnum nudum*
post oak	*Quercus stellata*
poverty oat-grass	*Danthonia spicata*
primrose-leaved violet	*Viola primulifolia*
purple three-awn grass	*Aristida purpurascens*
purple-stem cliff-brake	*Pellaea atropurpurea*
rattlesnake-weed	*Hieracium venosum*
red chokeberry	*Aronia arbutifolia*
red maple	*Acer rubrum*
red milkweed	*Asclepias rubra*
red spruce	*Picea rubens*
rice cutgrass	*Leersia oryzoides*
river birch	*Betula nigra*
Robin's plantain	*Erigeron pulchellus var. pulchellus*
rose pogonia	*Pogonia ophioglossoides*
roundleaf fameflower	*Talinum teretifolium*
roundleaf sundew	*Drosera rotundifolia var. rotundifolia*
royal fern	*Osmunda regalis var. spectabilis*
sallow sedge	*Carex lurida*
saltgrass	*Distichlis spicata*
saltmarsh bulrush	*Schoenoplectus robustus*
saltmarsh cordgrass	*Spartina alterniflora*
salt-marsh false foxglove	*Agalinis maritima var. maritima*
saltwort	*Salsola kali*
sand blackberry	*Rubus cuneifolius*
sand hickory	*Carya pallida*
sanddune sandbur	*Cenchrus tribuloides*

COMMON NAME	SCIENTIFIC NAME
sassafras	*Sassafras albidum*
sea oats	*Uniola paniculata*
sea rose-pink	*Sabatia stellaris*
sea-lavender	*Limonium carolinianum*
sea-oxeye	*Borrichia frutescens*
seashore mallow	*Kosteletzkya virginica*
seaside goldenrod	*Solidago sempervirens var. sempervirens*
seaside spurge	*Chamaesyce polygonifolia*
serpentine aster	*Symphyotrichum depauperatum*
shagbark hickory	*Carya ovata*
shale-barren evening-primrose	*Oenothera argillicola*
shale-barren pussytoes	*Antennaria virginica*
shale-barren ragwort	*Packera antennariifolia*
sheep-laurel	*Kalmia angustifolia*
shortleaf pine	*Pinus echinata*
shrubby St. John's-wort	*Hypericum prolificum*
side-oats grama	*Bouteloua curtipendula var. curtipendula*
silky dogwood	*Cornus amomum ssp. amomum*
silver maple	*Acer saccharinum*
single-vein sweetflag	*Acorus calamus*
skunk-cabbage	*Symplocarpus foetidus*
slender fimbry	*Fimbristylis autumnalis*
slender spikegrass	*Chasmanthium laxum*
slender wild rye	*Elymus villosus*
small saltmeadow cordgrass	*Spartina patens*
smooth alder	*Alnus serrulata*
smooth winterberry	*Ilex laevigata*
soft rush	*Juncus effusus*
southern arrow-wood	*Viburnum dentatum*
southern bayberry	*Morella cerifera*
southern red oak	*Quercus falcata*
spatterdock	*Nuphar advena*
spatulate-leaved sundew	*Drosera intermedia*
speckled alder	*Alnus incana ssp. rugosa*
spicebush	*Lindera benzoin*
spotted jewelweed	*Impatiens capensis*
spotted knapweed	*Centaurea biebersteinii*
spotted wintergreen	*Chimaphila maculata*
striped maple	*Acer pensylvanicum*
sugar maple	*Acer saccharum var. saccharum*
swamp azalea	*Rhododendron viscosum*
swamp chestnut oak	*Quercus michauxii*
swamp loosestrife	*Decodon verticillatus*

COMMON NAME	SCIENTIFIC NAME
swamp rose	*Rosa palustris*
swamp tupelo	*Nyssa biflora*
swamp white oak	*Quercus bicolor*
sweet fern	*Comptonia peregrina*
sweet pepper-bush	*Clethra alnifolia*
sweetbay magnolia	*Magnolia virginiana*
sweetgum	*Liquidambar styraciflua*
switchgrass	*Panicum virgatum var. virgatum*
sycamore	*Platanus occidentalis*
table-mountain pine	*Pinus pungens*
tawny cotton-grass	*Eriophorum virginicum*
ten-angled pipewort	*Eriocaulon decangulare*
tree-of-heaven	*Ailanthus altissima*
tulip-tree	*Liriodendron tulipifera*
tussock sedge	*Carex stricta*
twig rush	*Cladium mariscoides*
Virginia chain fern	*Woodwardia virginica*
Virginia creeper	*Parthenocissus quinquefolia*
Virginia meadow-beauty	*Rhexia virginica*
Virginia pine	*Pinus virginiana*
Walter's sedge	*Carex striata var. brevis*
warty panicgrass	*Panicum verrucosum*
water-hemlock	*Cicuta maculata var. maculata*
wavy hairgrass	*Deschampsia flexuosa var. flexuosa*
white ash, American ash	*Fraxinus americana*
white beak-rush	*Rhynchospora alba*
white oak	*Quercus alba*
whiteleaf greenbrier	*Smilax glauca*
wild black cherry	*Prunus serotina var. serotina*
wild rice	*Zizania aquatica var. aquatica*
willow oak	*Quercus phellos*
winterberry	*Ilex verticillata*
wintergreen	*Gaultheria procumbens*
witch-hazel	*Hamamelis virginiana*
woolgrass bulrush	*Scirpus cyperinus*
yellow birch	*Betula alleghaniensis*

Non-vascular Plants

COMMON NAME	SCIENTIFIC NAME
cladonia	*Cladonia spp.*
haircap mosses	*Polytrichum spp.*
sphagnum mosses	*Sphagnum spp.*

Submerged Aquatic Vegetation

COMMON NAME	SCIENTIFIC NAME
curly pondweed	*Potamogeton crispus*
Eurasian watermilfoil	*Myriophyllum spicatum*
horned pondweed	*Zannichellia palustris*
hydrilla	*Hydrilla verticillata*
muskgrass	*Chara spp.*
naiads	*Najas spp.*
redhead grass	*Potamogeton perfoliatus*
sago pondweed	*Stuckenia pectinatus*
sea lettuce	*Ulva lactuca*
slender pondweed	*Potamogeton pusillus*
spiny naiad	*Najas minor*
water stargrass	*Heteranthera dubia*
widgeon grass	*Ruppia maritima*
wild celery	*Vallisneria americana*

Appendix 4a. Compilation of Conservation Actions from Existing Plans

This appendix lists the conservation actions compiled after a review of existing relevant local, state, regional, national, and international conservation plans for this WDCP effort (**Element #4**). These matrices present an initial list of actions developed to address the threats identified by MD DNR and its partners (Appendix 1b). This compilation was then used to develop the more refined list of actions presented in Chapter 4. There are three sets of actions and needs associated with each of the four broad habitat grouping – Forests, Non-forests, Wetlands, and Estuarine/Marine. The first set of actions are conservation actions that apply to key wildlife habitats, the next set of needs list the existing inventory, monitoring and research needs that apply to each key habitat, and the last set identifies taxa or species specific conservation actions AND inventory, monitoring, and research needs for GCN species found in those broad habitat groupings.

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Conservation Actions for Forested Habitats								
Develop forest habitat management guidelines for use by foresters, land managers, and private landowners	X	X	X	X	X	X	X	
Work with partners to incorporate forest management guidelines into existing management plans of state forest service, MFA, TNC, state parks, state forests, USDA, USDI, NPS, etc.	X					X	X	
Work with foresters and land managers to promote best management practices and manage this habitat conducively for GCN species		X		X	X	X	X	

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Work with local, state, and federal agencies to incorporate forest management guidelines into land use and land planning efforts, especially to reduce/remove road impacts and fragmentation	X		X	X	X	X		X
Incorporate appropriate forest management practices into forest stewardship plans					X			
Develop and work with partners to implement invasive species control protocols to reduce impacts to GCN species	X				X	X	X	X
Develop and work with partners to implement deer population control protocols to reduce effects of deer overbrowsing	X	X			X	X	X	X
Develop and work with partners to implement beaver management protocols to maintain openings		X						X
Develop and work with partners to implement non-native herbivore population control protocols to reduce impacts			X					
Utilize existing (e.g. Farm bill programs) and develop new incentives for private landowners to conserve forest habitat on their properties	X	X						
Collaborate with private and public landowners to maintain and restore a mosaic of suitable habitat		X	X					
Limit access to and educate public about value of this forest habitat and its conservation	X		X					
Work with regulatory agencies and Public Service Commission for proper placement of wind turbines to reduce impact of wind farms on GCN species	X					X	X	

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Limit use of pesticides, such as gypsy moth management, such that GCN species are not adversely affected, especially on state lands	X		X	X	X	X	X	X
Work with farming community to conserve, manage, restore and protect this habitat on marginal croplands		X						X
Work with sportsman organizations, such as Quail Unlimited, to promote and manage this forest habitat		X						
Work with National Park Service to conserve this habitat on Assateague Island			X					
Work with utilities to manage rights-of-ways compatibility with shrubland GCN species		X						
Implement appropriate IPM practices to minimize effects of serious forest pests and pathogens, such as gypsy moth and sudden oak death			X		X	X		
Collaborate with TNC to implement Nanticoke River bioreserve strategy in conjunction with their ecoregional plan						X		X
Work with partners to re-establish natural fire regimes						X		
Collaborate with Watershed based Initiatives to restore and protect watersheds								X
Work with watershed groups to encourage forest conservation as a strategy for water conservation								X
Work with foresters and land managers to avoid/minimize timber harvesting impacts								X

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Work with land managers to improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts								X
Enforce and modify, as needed, nontidal wetland protection regulations especially as they relate to Wetlands of special state concern								X
Inventory, Monitoring, and Research Needs for Forested Habitats								
Initiate long-term monitoring studies of GCN species, including forest interior birds, invertebrate	X		X	X	X	X	X	
Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians, invertebrates, and boreal mammals	X		X	X	X	X	X	X
Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians, invertebrates, and boreal mammals	X		X	X	X	X	X	X
Conduct species surveys and determine distribution and abundance of GCN species	X		X	X	X	X	X	X
Conduct research to determine movement patterns and dispersal of GCN species	X		X	X	X	X	X	X
Conduct research to determine forest matrix requirements	X							
Monitor forest health and pests	X							

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Continue old growth forest inventory on public and private lands throughout the state	X							
Conduct a thorough inventory of existing shrub habitat to determine the most important sites for breeding		X						
Conduct research to determine precise habitat characterizations and needs, including area sensitivity, habitat quality, and habitat availability		X						
Conduct studies on the factors limiting species abundance, such as predation rates, reproductive success, parasitism rates, and causes of mortality		X						
Conduct research to determine management needs and best management practices for populations, especially effects of various habitat management practices on species productivity and on long-term habitat suitability		X						
Establish monitoring programs that accompany management activities to assess long-term effects on GCN species		X						
Conduct research to determine the frequency of natural disturbance regimes and their locations in Maryland's landscape		X						
Conduct research to assess the effects of development activities on GCN species, including Delmarva fox squirrel			X	X		X		
Conduct research to assess the effects of timber harvest practices on GCN species, including forest interior birds, reptiles, amphibians, and Delmarva fox squirrel			X	X	X			

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Conduct research to determine historical range of this key habitat and target priority sites for monitoring and research				X				
Conduct research to assess effects of gypsy moth spraying on GCN species					X		X	
Conduct research to assess effects of invasive species and deer overbrowsing on GCN species							X	
Conduct research to assess impacts of wooly adelgid							X	
Conduct surveys to determine population strongholds and status of GCN species, especially odonates, southern water shrew, bats, reptiles, amphibians, butterflies, and forest interior birds								X
Conduct research to determine effective buffer widths as it relates to development, timber harvesting and farming practices; include upland life zone requirements of reptiles and amphibians, foraging areas for bats, and area-sensitive species like forest interior birds and bobcat								X
Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed								X
Taxa or Species Specific Conservation Actions and Inventory, Monitoring, and Research Needs for GCN Species found in Forested Habitats								
Promote woodcock management in moist soil areas and riparian areas		X						

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Implement regional and national bobwhite and woodcock management plans		X						
Implement PIF BCR and physiographic area plans for this habitat type		X		X	X	X	X	
Enforce existing state regulations on possession and trade of amphibians and reptiles and promote changes to increase protection for these GCN species			X	X	X	X	X	X
Protect breeding colonies of waterbirds from disturbance				X				
Develop a range wide Habitat Conservation Plan (HCP) for Delmarva fox squirrels and timber management				X				
Implement federal recovery plan for Delmarva fox squirrel, including reintroduction to unoccupied sites								X
Implement aspects of the federal recovery plan for red-cockaded woodpecker				X				
Evaluate feasibility of reintroduction of snowshoe hare, American marten, and northern flying squirrel							X	
Modify federal recovery plan for Indiana Bat so that protection and research needs in Maryland are adequately addressed								X
Implement well targeted education campaign to reduce illegal collecting and killing of reptiles and amphibians								X
Conduct research to determine effects of American woodcock and bobwhite habitat management techniques on other GCN early-successional bird species		X						

Forested Habitats	Old Growth Forests	Early successional Forests	Maritime Forests and Shrublands	Loblolly Pine – Oak Forests	Mesic Deciduous Forests	Dry Oak - Pine Forests	Northern Conifer- Hardwood	Floodplain Forests
Develop appropriate survey method for assessing populations of nightjars and other nocturnal birds			X	X				
Conduct surveys of roost locations and identify specific habitat requirements of the bats to produce specific management guidelines for the species				X				
Conduct research to assess population trends of GCN birds					X			
Coordinate monitoring of GCN birds at the regional level					X			
Conduct research to determine the requirements of wooly adelgid in an effort to establish appropriate control measures							X	
Conduct research to determine competition/displacement effects of Meadow vole on Southern Bog Lemming populations and factors that contribute to these effects								X
Conduct research to determine larval host plant requirements of certain GCN Lepidoptera								X

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Conservation Actions for Non-Forested Terrestrial Habitats					
Develop habitat management guidelines for use by foresters and land managers		X	X		
Work with partners to incorporate management guidelines into existing management plans		X	X	X	X
Work with foresters and land managers to promote best management practices and manage this habitat conducively for GCN species		X			X
Work with local, city, county and state agencies to incorporate habitat management guidelines into land use and land planning efforts			X		X
Work with farming community to encourage beneficial agricultural practices such as late mowing, involvement in Conservation Reserve programs, including grass forb buffers in agricultural settings, etc.	X				
Limit access on state lands to minimize human caused disturbance and mortality and direct mortality from off-road vehicles, pets, recreational activities and farming practices	X	X	X		X
Work with partners to convert exotic pasture/hayland to native warm-season grasses on private and public lands	X				
Work with partners to restore savannah conditions on private and public lands	X				
Work with partners to implement effective best management practices for GCN grassland species	X				
Focus land preservation efforts on protecting large tracts of open grassland and minimize edge effects for area dependent grassland species	X				

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Encourage management for grassland species, including upland sandpipers, on airport lands and reclaimed mine lands	X				
Conduct prescribed burns using appropriate best management practices and restore natural fire regimes	X	X			
Develop and work with partners to implement invasive species control protocols to reduce impacts to GCN species	X	X			
Develop and work with partners to implement deer population control protocols to reduce effects of deer overbrowsing		X			
Utilize existing (e.g. Farm Bill programs) and develop new incentives for private landowners to develop and maintain this habitat type, especially greater than 50 to 100 ha grassland habitat	X				
Collaborate with private and public landowners to maintain suitable habitat, including use of a private lands registry program		X			X
Work with conservation funding partners and programs		X			
Work with sportsman organizations, such as Quail Unlimited, to promote and manage this habitat	X				
Work with farming community to conserve and manage this habitat on marginal croplands	X				
Limit use of pesticides such that GCN species are not adversely affected	X	X	X	X	
Encourage the use of native seed stock for warm season grass plantings	X				
Create and distribute educational materials to general public, land owners and managers			X		X
Develop and implement shore erosion control practices that are compatible with cliff maintenance			X		
Work with regulatory agencies and Public Service Commission for proper placement of wind turbines to reduce impact of wind farms on GCN species			X		

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Add sites to Maryland Natural Areas Registry				X	
Uses registry or acquisition to restore and protect groundwater aquifers				X	
Install and maintain appropriate gates at entrances to caves and mines that support GCN species				X	
Minimize or eliminate soil disturbance in estimated catchment basin				X	
Determine recharge areas to calculate how large an area is needed to protect GCN species				X	
Work with Bureau of Mines to protect mines supporting GCN species				X	
Protect known sites from future strip mining or development of surrounding forests through acquisition or easement				X	
Initiate measures to prevent pollution of first and second order streams by surrounding habitat with adequate buffers through acquisition or easement				X	
Educate spelunkers about impacts of disturbance to caves and mines supporting GCN species				X	
Develop and work with partners to implement non-native herbivore population control protocols to reduce impacts (e.g. feral horses on Assateague Island)					X
Minimize risk of oil spills and respond immediately to contain spills when they occur					X
Utilize Coastal Bays Program to influence land use decisions and educate the public					X
Develop and work with partners to implement shore erosion control practices that are compatible with beach and dune maintenance					X
Inventory, Monitoring and Research Needs for Non-Forested Terrestrial Habitats					

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Initiate long-term monitoring studies of GCN species, including grassland birds, woodrats, Puritan tiger beetles, bats, invertebrates, piping plover, least tern, and shorebirds	X	X	X	X	X
Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially insects, bats and invertebrates	X		X	X	
Conduct research on habitat use and requirements of GCN species, including bobwhite, grassland birds, and insects, bats and invertebrates	X		X	X	
Conduct species surveys and determine distribution and abundance of GCN species, especially invertebrates	X	X	X	X	
Conduct research to determine movement patterns and dispersal of GCN species, including woodrats, bats, reptiles and Puritan tiger beetles	X	X	X	X	X
Develop standardized regional monitoring protocols for GCN species	X				
Identify agricultural practices beneficial to GCN species, especially grassland species, including mowing regimes	X				
Implement accurate and standardized survey methods to determine regional population trends	X				
Monitor success of populations in different habitat types, including restoration efforts	X				
Conduct studies on the limiting factors and management needs of GCN populations	X				
Conduct a comprehensive survey of appropriate habitat	X				
Determine historical extent, range, and condition of native grassland communities	X				
Assess extent of regional grassland habitats and determine how they can be preserved	X				
Conduct research on effects of pesticide use on GCN species, especially invertebrates		X			
Conduct research to determine natural fire regime		X			

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Determine forest matrix requirements to sustain functionality of habitats			X		
Conduct research to determine best management practices for GCN species			X		
Establish a habitat monitoring program				X	
Assess and monitor water quality				X	
Conduct targeted inventories of certain GCN species, especially invertebrates		X			X
Conduct research on habitat requirements to gain a better understanding of threats in general and area sensitivity needs of certain GCN species					X
Taxa or Species Specific Conservation Actions and Inventory, Monitoring, and Research Needs for GCN Species found in Non-Forested Terrestrial Habitats					
Implement PIF physiographic area plans for this habitat	X				
Discourage birds from nesting in population sinks	X				
Protect and manage both breeding and wintering habitats for GCN grassland birds	X				
Mow roadsides in early spring or late summer to protect nesting habitat for vesper sparrows and retain roadside fence lines	X				
Study nest timing of savannah sparrows and bobolinks	X				
Monitor trends in bobwhite populations	X				
Determine effects of agricultural practices on bobwhite reproduction	X				
Identify native insect species that are obligates of grasslands	X				
Research habitat needs for area sensitive species	X				
Enforce existing state regulations on possession and trade of amphibian and reptiles			X	X	

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Coordinate conservation efforts for woodrats at a regional level			X	X	
Control raccoon populations near woodrat sites			X	X	
Protect and maintain food source trees for woodrats from mast tree harvesting operations and further gypsy moth defoliation			X	X	
Coordinate conservation efforts for timber rattlesnake at a regional level			X		
Educate public to reduce killing of timer rattlesnakes and disturbance of den sites			X		
Implement Puritan tiger beetle federal recovery plan			X		
Restore degraded cliff sites for Puritan tiger beetles by removing encroaching vegetation			X		
Determine metapopulation requirements of GCN species, especially Alleghany woodrats, green salamander, timber rattlesnake, long-tailed shrew			X		
Research the link with raccoons and baylisascaris in hopes of preventing infection			X	X	
Monitor select woodrat populations rangewide			X	X	
Conduct research on the life history, movement patterns, habitat requirements, mortality factors and basic ecology of woodrats			X	X	
Implement the Indiana bat recovery plan if populations are found and provide technical assistance and outreach				X	
Manage habitat around hibernacula and foraging sites to protect GCN bat species				X	
Determine distribution, status, trends and locations of winter and summer roosts of GCN bat species				X	
Officially name and describe the numerous undescribed subterranean invertebrate species				X	
Monitor and survey for rare aquatic subterranean invertebrates				X	

Non-Forested Terrestrial Habitats	Grasslands	Barrens and Dry Glades	Cliffs and Rock Outcrops	Caves, Mines and Springs	Coastal Beaches, Dunes, and Mudflats
Inventory terrestrial subterranean invertebrate fauna in caves				X	
Implement piping plover federal recovery plan					X
Prohibit boat access to mudflats on the north end of Assateague Island to minimize disturbance to piping plovers					X
Minimize disturbance to colonial waterbird colonies by restricting access during the nesting season					X
Assess predation of piping plovers and least terns by gulls					X

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Conservation Actions for Wetland Habitats									
Work with partners through acquisition and easements to protect and restore best remaining examples of these wetland types and adjacent watersheds and provide sufficient	X	X		X		X	X	X	X

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
landscape connectivity and movement corridors within an extensive forest matrix									
Enforce and modify, as needed, wetland protection regulations especially as it relates to Nontidal Wetlands of Special Concern	X			X		X	X		
Work with partners to establish and maintain effective buffers along wetlands by restoring natural communities where possible	X			X				X	
Work with farming community to restore and protect wetlands through NRCS, FSA, USFWS, and MDA programs and farm bill and conservation reserve incentives	X			X		X	X	X	
Work with local, city, county and state agencies to incorporate conservation actions into land use and land planning efforts	X		X	X		X	X	X	
Work with partners to incorporate conservation actions into public land management plans	X		X	X	X	X	X	X	X
Regulate mosquito control and gypsy moth control in upland depressional wetlands and surrounding landscape, ensuring adequate buffer in spraying	X						X	X	X
Develop and work with partners to implement native and non-native invasive species control protocols, especially phragmites, purple loosestrife, woody vegetation and nutria	X	X		X	X	X	X	X	

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Develop and disseminate public education materials to address human disturbance and conservation value issues	X		X				X		
Identify forest management practices that would improve habitat suitability		X							
Implement prescribed burn programs to control woody vegetation		X						X	
Restore hydrology through ditch plugging and other appropriate practices		X							
Delineate habitat boundaries and sensitive management areas for all populations and metapopulations of GCN species			X						
Amend state wetlands laws to protect all GCN vernal pool habitats			X						
Promote BMP's to appropriate public and private land managers, agencies and industries that have the greatest potential to influence protection of vernal pool habitat and buffers			X						
Eliminate human disturbance and off-road vehicles in and around vernal pools and other wetlands			X				X		
Maintain or restore forest connectivity between vernal pool habitats			X						
Create or restore vernal pools			X						
Work with private property owners to protect known sites			X						

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Coordinate conservation with farm bill programs, DNR, SHA, MDA, and local jurisdiction			X						
Coordinate conservation with NE PARC			X						
Implement BMPs for nutrients on agricultural lands to reduce sources of groundwater contamination			X						
Restore and protect forested theses wetland type and establish and maintain effective buffers along these wetlands, by restoring natural communities where possible				X	X				
Work with DOT and local roads departments to construct roads in such a way that minimizes effects on movement patterns of GCN species, especially for amphibians and reptiles that use upland depressional wetlands year-round or seasonally as breeding habitat; construct safe crossings to minimize road mortality	X			X			X	X	
Work with partners to minimize runoff from roads, including silt, salt, nutrients and contaminants by improving stormwater management practices and emergent control measures							X	X	
Work with state agencies to minimize mosquito control and gypsy moth control in forested seepage wetland sites and surrounding landscape				X		X			

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Develop forest habitat management guidelines for use by foresters, land managers, and private landowners				X					
Work with foresters and land managers to promote best management practices and manage this habitat conducively for GCN species				X			X		X
Conduct prescribed burns using appropriate best management practices and restore natural fire regimes on certain wetlands that require such				X		X	X		
Actively participate in review of burning plans and "open marsh water management" activities					X				X
Initiate coordinated efforts to conserve habitat and maintain the integrity of wetland systems across wide geographic areas, including targeting the highest quality areas					X				
Work with partners to protect wetlands from drainage, ditching, filling and other damaging practices by implementing best management practices and adaptive management methods					X				X
Restore and enhance breeding and nonbreeding habitats of high priority GCN species					X				X
Utilize U.S. Army Corps of Engineers and MDE regulatory processes to protect habitat					X				X

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Restore wetlands affected by acid mine drainage							X		
Restore northern conifer component of bog-fen wetland complexes on Allegheny Plateau and Atlantic white-cedar component on Coastal Plain including working with TNC to accomplish this task							X		
Develop and work with partners to implement deer population control protocols to reduce effects of deer overbrowsing							X		
Work with watershed groups, federal programs, regulatory agencies, and watershed based initiative to protect wetland habitats							X	X	
Mange or control livestock grazing within wetlands							X		
Conduct watershed-level stream restoration and protection efforts (e.g. water source)								X	
Consider making minor alterations of existing management schemes on wetlands managed for waterfowl by state and federal agencies to improve habitat for GCN species								X	
Promote the establishment and growth of floating-leaved and submergent vegetation								X	
Restore-semi-permanent and permanent open water habitats and flats within wetlands where appropriate								X	

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Restore prior converted and other degraded wetlands								X	
Work with landowners to encourage retention of emergent wetlands (e.g. DO NOT impound)								X	
Limit the use of non-native fish as BMPs for mosquito control and vegetation management								X	
Acquire habitat through the North American Wetland Conservation Act (NAWCA)									X
Collaborate with the implementation of North American Waterfowl Plan									X
Work with partners to reduce impacts of water pollution from boats and other sources									X
Develop and implement methods to restore hydrology to wetlands degraded by ditching									X
Develop new technologies to accelerate tidal marsh accretion									X
Inventory, Monitoring, and Research Needs for Wetland Habitats									
Conduct surveys to better determine the distribution, characteristics and condition of these wetlands	X	X	X	X					

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Conduct surveys to better determine the distribution, abundance, population strongholds and status of GCN species, especially odonates, reptiles, amphibians, butterflies, subterranean/groundwater invertebrates, bats and other small mammals (e.g. southern water shrew, southern bog lemming), birds	X	X	X	X		X	X		
Conduct research on life history, habitat requirements, metapopulation dynamics and movement/dispersal patterns of GCN species	X			X		X	X		
Determine effective buffer widths as it relates to development, timber harvesting, and farming practices; include upland life zone requirements of reptiles, amphibians, foraging areas for bats and American woodcock, and area-sensitive species like forest-nesting birds and bobcat	X			X		X	X		
Monitor habitat conditions and GCN species, especially those that serve as effective indicator, umbrella or keystone species, and species for which population trend data are most urgently needed	X			X		X	X		
Conduct studies on the factors limiting species abundance, such as predation rates, reproductive success, contamination and prey availability		X			X				X

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Determine landscape attributes and preserve designs that will allow the persistence of populations		X							
Determine management needs and best management practices for GCN species, especially effects of various habitat management practices on species' productivity and long-term habitat suitability		X			X				X
Design and implement monitoring programs to accompany management activities to assess effects of techniques on GCN species and long-term habitat suitability		X			X				X
Determine and monitor hydrologic conditions, including impacts of irrigation		X	X						
Initiate long-term monitoring studies of GCN species, including reptiles, amphibians and invertebrates			X				X	X	
Conduct research on basic ecology, breeding parameters, and life histories of GCN species, especially reptiles, amphibians and invertebrates			X				X		
Conduct research on habitat use and requirements of GCN species, especially reptiles, amphibians and invertebrates			X				X		
Determine beneficial long-term management needs and practices			X						
Research the impact of fire/burning					X				
Research the successional process					X				

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Monitor and assess the impact of phragmites control on GCN species					X				
Develop regional, standardized methodologies for effective assessment of population abundance, trends, distribution, and movement patterns and for improved monitoring of Maryland populations, especially for marshbirds					X			X	X
Determine precise habitat characterizations and needs, including area sensitivity, habitat quality, and habitat availability					X				X
Establish habitat monitoring on a periodic basis									X
Taxa or Species Specific Conservation Actions and Inventory, Monitoring, and Research Needs for GCN Species found in Wetland Habitats									
Implement bog turtle federal recovery plan	X			X		X	X	X	
Implement well targeted I&E campaign to reduce illegal herptile collecting and killing	X			X		X			
Enforce and modify to increase protection for certain species , as needed, regulations regarding possession and trade of herptiles, especially for painted turtle, especially painted turtle	X	X	X	X		X	X	X	

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Investigate competition/displacement effects of meadow vole on southern bog lemming populations and factors that contribute to these effects	X						X		
Implement planning efforts that examine core populations and linkages between them from a landscape perspective		X							
Establish buffers of 400-750 feet radius of quality upland habitat around GCN amphibian breeding habitat		X	X						
Establish buffers of 100-200 meters forest buffers around GCN invertebrate habitat that do not provide habitat for GCN amphibians		X	X						
Research the effects of bullfrogs and green frogs on abundance and viability of GCN amphibian populations		X							
Conduct research on the effects of acid deposition on egg and larval survival of GCN amphibian species			X						
Determine the landscape requirements for viable populations of GCN amphibian and invertebrate species			X						
Conduct inventory work on invertebrates			X						
Encourage neighboring states to conduct vernal pool inventories for GCN invertebrates			X						
Conduct studies on the effect of habitat fragmentation and amphibian movement corridors			X						

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Control erosion and restore islands with colonial waterbird colonies					X				X
Prevent or minimize disturbance of colonial waterbird colonies					X				
Implement regional conservation strategy for American woodcock						X			
Determine larval host plant requirements of certain GCN Lepidoptera						X	X		
Modify Federal Recovery Plans for Indiana bat and northern flying squirrel so that recovery and reintroduction in Maryland are given adequate attention							X		
Determine feasibility of reintroducing snowshoe hare, American marten and northern flying squirrel							X		
Cooperate with a coordinated regional conservation plan for GCN species								X	
Research spotted turtle use of terrestrial habitats								X	
Study the effects of introduced non-native crayfish on queen snake populations and other GCN species								X	
Implement long-term monitoring studies to track population trends of crayfish and queen snakes									
Develop standardized methodologies for effective monitoring of marshbird populations									
Identify major migration stop-over areas of marshbirds								X	

Wetland Habitats	Upland Depressional Swamps	Carolina Bays	Vernal Pools	Forested Seepage Wetlands	Tidal Shrub Wetlands	Nontidal Shrub Wetlands	Bog and Fen Wetland Complexes	Nontidal Emergent Wetlands	Tidal Marshes
Determine impact of marsh manipulation on breeding success of marshbirds								X	
Determine host plants for GCN insects								X	
Implement regional black duck conservation strategies for habitat management									X
Determine effects of mosquito control practices on black rails and GNC Lepidoptera									X
Determine the habitat requirements of black rails									X
Assess the impacts of nesting barn owls on black rail populations									X
Determine the effects of periodic marsh burning on black rails, marshbirds, coastal plain swamp sparrow, and GCN Lepidoptera									X
Implement a long-term monitoring program for marshbirds (e.g. rails, bitterns, moorhen)									X
Assess the population status of breeding king rails in Maryland									X
Cooperate in regional conservation efforts for the northern harrier and short-eared owl									X

Estuarine and Marine Habitats	Oligohaline, Mesohaline and Polyhaline Estuaries	Ocean
Conservation Actions for Estuarine and Marine Habitats		
Coordinate efforts with various programs, especially the Chesapeake Bay Program, to initiate measures to protect, maintain and improve all species habitats and populations	X	
Develop watershed management plans that review the totality of inputs and outputs of aquatic systems to preserve ecosystem functions	X	
Work with partners to implement BMP's to reduce non-point source impacts and erosion control measures and promote the protection and preservation/restoration of aquatic/riparian communities	X	
Work with partners to increase the number of pumpout stations	X	
Work with partners to reduce deleterious contaminant concentrations and upgrade wastewater treatment plants to improve water quality	X	
Work with partners to maintain buffer zones to block siltation, pesticide and fertilizer runoff to wetlands	X	
Develop regional strategies to reduce and restrict the flow of pesticides and other toxic contaminants into aquatic systems	X	
Reestablish submerged aquatic vegetation beds in areas where they formerly occurred and where water quality has improved since their disappearance	X	
Develop and work with partners to implement invasive species control protocols	X	
Work with partners to implement compatible shore-erosion techniques	X	
Develop and disseminate public educational materials and improve public outreach efforts, especially about recreational impacts and ways to minimize them	X	X
Improve capacity to respond quickly and efficiently to toxic and oil spills; implement contingency planning	X	X
Seek policies that reduce likelihood of spills (e.g. vessel mandates)	X	X
Utilize the Chesapeake Bay Critical Area program	X	
Work with NGOs, including Chesapeake Bay Foundation and Alliance for the Chesapeake Bay	X	
Encourage citizens to donate to the Chesapeake Bay and Endangered Species Fund	X	
Utilize Coastal Zone Management programs	X	

Estuarine and Marine Habitats	Oligohaline, Mesohaline and Polyhaline Estuaries	Ocean
Utilize the Coastal Bays Program	X	
Develop land management plans which incorporate conservation measures into the local planning processes	X	X
Coordinate conservation efforts between various interest groups and across state boundaries, including state agencies	X	X
Work with partners to reduce the presence of aquatic contaminants	X	X
Develop a cooperative management protection plan for Assateague Island that addresses GCN species seasonal needs		X
Inventory, Monitoring, and Research Needs for Estuarine and Marine Habitats		
Conduct quantitative surveys identifying all populations, habitats and critical resources of GCN species	X	
Initiate long-term monitoring on population trends and assessment of mortality factors for GCN species	X	
Establish coordinated habitat and population monitoring programs on a regional level using standardized surveying techniques designed to have minimal impacts on populations	X	
Develop monitoring programs to accompany all management activities to assess effectiveness of techniques	X	
Monitor effects of environmental contaminants	X	
Identify sources of aquatic contaminants to reduce their impact	X	X
Conduct research on movements, mortality rates, causes of mortality, and feeding habitat of GCN species	X	
Determine the effects of dredging on GCN species	X	
Conduct quantitative surveys on distribution, demographics, recruitment, and reproductive ecology, thoroughly document known populations of GCN species	X	
Taxa or Species Specific Conservation Actions and Inventory, Monitoring, and Research Needs for GCN Species found in Estuarine and Marine Habitats		
Implement the seaturtle conservation plan and the recovery plan for each seaturtle species	X	X
Work with fishing industry to reduce fishing gear impacts to GCN species	X	X

Estuarine and Marine Habitats	Oligohaline, Mesohaline and Polyhaline Estuaries	Ocean
Implement federal recovery plan for shortnose sturgeon	X	
Implement regional conservation strategies for diamond-backed terrapin	X	
Implement regional conservation strategies for colonial nesting waterbirds	X	
Identify, document, and minimize impacts of commercial, recreational, and military activities on seaturtles	X	X
Conduct field research (mark-recapture, telemetry, survey, sampling, etc.) to document shortnose sturgeon seasonal distribution and map concentration areas to characterize essential habitat	X	
Determine abundance, age structure, recruitment and minimal population size below which restoration may be considered of shortnose sturgeon populations	X	
Assess the need for augmenting shortnose sturgeon populations with stocked fish	X	
Conduct quantitative studies of Atlantic sturgeon to assess life history and ecological characteristics, including migration, spawning stock status, bycatch fishing mortality, habitat suitability, and populations dynamics	X	
Conduct quantitative harvest studies for diamond-backed terrapin to determine harvest size and seasonal limits	X	
Promote, improve and increase cooperative interstate research, monitoring, law enforcement, and regulation efforts		X
Enhance commercial fisheries and fisheries/marine mammal and seaturtle interactions data in Maryland waters		X
Enhance seaturtle stranding network efforts		X
Continue working with commercial pound netters to release and tag captured turtles		X
Reduce or eliminate human-caused injury and mortality of marine mammals, including detrimental effects of directed vessel interactions		X
Implement regional conservation strategies for horseshoe crab		X
Identify offshore movement corridors for loons and gannets		X
Work with National Park Service to conduct routine monitoring and stranding surveys of Assateague Island beach for seaturtles and marine mammals		X
Monitor parasite load, biotoxins and anthropogenic contaminant level in tissues of whales and their prey		X

Estuarine and Marine Habitats	Oligohaline, Mesohaline and Polyhaline Estuaries	Ocean
Conduct economic studies to determine the value of the commercial horseshoe crab fishery, biomedical, and ecotourism industries and the impact of regulatory management on these industries		X
Determine stock structure and population discreteness of marine mammals and assess relationship to other North Atlantic populations		X
Determine and minimize any detrimental effects of directed vessel interactions to marine mammals and maximize efforts to acquire scientific information from dead, stranded and entangled or entrapped whales		X

Appendix 4b: Compilation of Existing Governmental Programs in Maryland to Support Conservation Actions and Improve Data Acquisition and Sharing

The following is a compilation of some of the numerous governmental agencies and programs that have direct and indirect influences on the conservation of Maryland's wildlife species and the key wildlife habitats that support them. Many of the conservation actions provided in Chapter 4 of this document will rely on the cooperation and partnership of these governmental programs to be successful. This appendix provides supporting information for **Element #7**.

OVERVIEW

State Agencies and Programs

Department of Natural Resources
Department of the Environment
Department of Agriculture
Department of Planning
Department of Transportation
University of Maryland

Federal Agencies and Programs

U.S. Fish and Wildlife Service
National Park Service
U.S. Geological Survey
National Oceanic and Atmospheric Administration
U.S. Environmental Protection Agency
U.S. Department of Agriculture
U.S. Department of Defense

Local Agencies and Programs

Planning and Zoning
Maryland-National Capital Park and Planning Commission

Multi-Agency Programs

Chesapeake Bay Program
Coastal Bays Program
Multi-Resolution Land Characteristics Consortium
National Wetlands Mitigation Action Plan

STATE AGENCIES AND PROGRAMS

Maryland Department of Natural Resources (DNR)

The mission of the MD Department of Natural Resources (DNR) is to preserve, protect, enhance and restore Maryland's natural resources for the wise use and enjoyment of all citizens. This includes the management and wise use of the living and natural resources of the Maryland portion of the Chesapeake Bay and its tributaries. The resources of the Maryland portion of the watershed include its state forests and parks, fisheries, wildlife and the recreation of citizens engaged in boating, fishing, hunting and other outdoor enjoyment of our natural resources.

DNR-wide objectives include:

1. Sustainable Populations of Living Resources and Aquatic Habitat
2. Healthy Maryland Watershed Lands, Streams and Non-Tidal Rivers
3. Natural Resources Stewardship Opportunities for Maryland's Urban and Rural Citizens
4. Conserved and Managed Statewide Network of Ecologically Valuable Private and Public Lands
5. Diverse Outdoor Recreation Opportunities for Maryland Citizens and Visitors
6. Diverse Workforce and Efficient Operations

The numerous monitoring, research, planning, protection, and restoration programs are detailed on the MD DNR website at www.dnr.state.ms.us. Below is a compilation of some of these programs related to the conservation of wildlife and key wildlife habitats.

Wildlife and Heritage Service (WHS)

The mission of the Wildlife and Heritage Service (WHS) is to conserve Maryland's diverse native wildlife, plants, and the natural communities that support them, using scientific expertise and informed public input. The WHS oversees the management of 41 Wildlife Management Areas (WMAs) statewide, totaling 104,000 acres; sponsors several conservation education programs; manages game species and regulates hunting and trapping activities within Maryland's Game Program; and conserves habitat on private land, as well as managing invasive non-native species statewide, through the Habitat Conservation Program. The Natural Heritage Program is also housed within this unit.

The Maryland Natural Heritage Program (NHP) is the lead state agency responsible for the identification, ranking, protection, and management of nongame, rare and endangered species and their habitats in Maryland. Data collected by NHP ecologists, contractors and cooperators provide a majority of the scientific foundation for the Threatened and Endangered Species lists mandated by the Act.

Natural Heritage Program researchers conduct inventory and monitoring activities on nongame wildlife, rare species populations and natural communities, documenting trends in population and habitat health and viability. Information gathered through this research guides land management decisions and regulations designed to protect and conserve our state biological diversity. One important tool for biodiversity conservation is a state statute modeled after the federal Endangered Species Act. The General Assembly, when creating Maryland's Nongame and Endangered Species Conservation Act*, recognized the importance of plants and animals to human existence. The Act reads:

> (1) It is the policy of the State to conserve species of wildlife for human enjoyment, for scientific purposes, and to insure their perpetuation as viable components of their ecosystems;
>
> (2) Species of wildlife and plants normally occurring within the State which may be found to be threatened or endangered within the State should be accorded the protection necessary to maintain and enhance their numbers.

The Act mandates the Department of Natural Resources to list species that are in danger of extinction within the State; requires that State agencies use their authority to maintain and enhance nongame wildlife and endangered species populations; and directs the Secretary of the Department to set up programs to conserve these species. Maryland's Act has led to the successful development of programs, policies, and partnerships that conserve rare and endangered species.

* For full text of the Act and guiding regulations please see the Nongame and Endangered Species Conservation Act, Natural Resources Article, Sections 4-2A-01 -- 10-2A-01 -- 4-2A-08, 10-2A-09, Annotated Code of Maryland at the following websites, and search through Maryland Statutes: **www.mlis.state.md.us** or **www.dsd.state.md.us** .

Maryland Biological Stream Survey

The Maryland Biological Stream Survey (MBSS) was designed to take periodic snapshots of our streams, identify our best and worst areas, find out what caused them to become bad or stay healthy, and help target streams and watersheds for protection, restoration, or both. The MBSS uses random sampling to determine the status of wadeable streams and rivers in Maryland. Since 1994, biologists have collected water samples, biological, and habitat data for over 1000 streams.

Fisheries Service

The Fisheries Service is responsible for managing commercial and recreational fishing in Maryland waters. Freshwater, estuarine, and migratory fish stocks are managed for sustainable fisheries, to enhance and restore fish or shellfish species in decline; to promote ethical fishing practices, and to ensure public involvement in the fishery management process. Their mission of the Fisheries Service in part is to develop a management framework for the conservation and equitable use of fishery resources. This is done with attempts to manage fisheries in balance with the ecosystem for the present and future generations. Monitoring and assessing status and trends of fisheries resources are activities taking place which directly impact wildlife diversity conservation.

Park Service

The Park Service manages over 100,000 acres of MD DNR properties and is committed to the preservation and protection of the lands we hold in trust for future generations. Land management activities and acquisitions, and stewardship and conservation goals, help MD DNR protect wetlands, forest corridors and habitat of threatened species; enhance biological diversity of native plants and animals; and preserve historical and cultural resources while supporting responsible growth.

Forest Service

The mission of the Forest Service is to restore, manage, and protect Maryland's trees, forests, and forested ecosystems to sustain our natural resources and connect people to the land. This is done in part by attempting to retain Maryland's existing forest land base by the promotion and establishment of new forests to support healthy populations of native plants and animals across diverse and ecologically functional landscapes. The programmatic goals and objective used to achieve this can be seen to aid in the conservation of wildlife diversity. The Forest Service also works toward minimizing negative impacts to the State's forest and tree resources from wildlife, insects and disease, land conversion, and other natural disturbance agents.

Program Open Space

Program Open Space (POS) is a nationally recognized program providing dedicated funds for Maryland's state and local parks and conservation areas. Established under the Department of Natural Resources in 1969, POS symbolizes Maryland's long-term commitment to conserving our natural resources while providing exceptional outdoor recreation opportunities for our citizens. Almost all of the land purchased by the MD DNR in the last 32 years was funded at least in part through POS. Today there are more than 4,000 individual county and municipal parks and conservation areas that exist because of the program.

Rural Legacy Program

Established in 1997, the Rural Legacy Program provides the focus and funding necessary to protect large, contiguous tracts of land and other strategic areas from sprawl development and to enhance natural resource, agricultural, forestry and environmental protection through cooperative efforts among state and local governments and land trusts. Protection is provided through the acquisition of easements and fee estates from willing landowners and the supporting activities of Rural Legacy Sponsors and local governments. The Program encourages local governments and private land trusts to identify Rural Legacy Areas and to competitively apply for funds to complement existing land preservation efforts or to develop new ones. Easements or fee estate purchases are sought from willing landowners in order to protect areas vulnerable to sprawl development that can weaken an area's natural resources, thereby jeopardizing the economic value of farming, forestry, recreation and tourism.

Resource Planning

Resource Planning ensures that public lands owned by DNR are used in ways that are economically and environmentally sustainable. The responsibilities of this program include strategic planning for the public use and protection of statewide natural resources and recreational lands that total 446,103 acres in the State of Maryland owned by the Department of Natural Resources. Additional responsibilities include support to local jurisdictions for open space and recreational planning; survey and property control of over 3000 miles of boundary lines; assessment of the impacts of different human activities on the environments of MD DNR's lands; and development of recommendations and policies to acquire, develop and manage the resources on these public lands.

Critical Area Commission for Chesapeake Bay and Atlantic Coastal Bays
The Critical Area Act, passed in 1984, created a statewide Critical Area Commission to oversee the development and implementation of local land use programs directed towards the Critical Area. This Act marked the first time that the State and local governments jointly addressed the impacts of land development on habitat and aquatic resources. The Department of Natural Resources is the lead State agency for the Commission. The "Critical Area" was identified as all land within 1,000 feet of the Mean High Water Line of tidal waters or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and its tributaries.

The Commission developed criteria that were used by local jurisdictions to develop individual Critical Area programs and amend local comprehensive plans, zoning ordinances, and subdivision regulations. The goals were to minimize adverse impacts on water quality that result from pollutants that are discharged from structures or conveyances or that have run off from surrounding lands; conserve fish, wildlife, and plant habitat in the Critical Area; and establish land use policies for development in the Critical Area which accommodate growth and also address the fact that, even if pollution is controlled, the number, movement, and activities of persons in the Critical Area can create adverse environmental impacts.

The programs that have subsequently been adopted by local governments are specific and comprehensive. They are designed to address the unique characteristics and needs of each county and municipality and together they represent a comprehensive land use strategy for preserving and protecting Maryland's most important natural resource, the Chesapeake Bay. Today the Commission's primary responsibilities are review and approve State projects on State-owned land in the Critical Area; review and approve State or local agency actions resulting in major development on private lands or lands owned by local jurisdictions; and review and approve all changes to a jurisdiction's Critical Area Program, including changes to ordinances, regulations, and maps.

Coastal Zone Management Program
The National Coastal Zone Management Program is a federal-state partnership dedicated to comprehensive management of the nation's coastal resources, ensuring their protection for future generations while balancing competing national economic, cultural and environmental interests. The Department of Natural Resources is the lead state agency for

this program. The Coastal Zone Management Program (CZMP) is authorized by the Coastal Zone Management Act of 1972 and administered at the federal level by the Coastal Programs Division (CPD) within the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (OCRM). The CPD is responsible for advancing national coastal management objectives and maintaining and strengthening state and territorial coastal management capabilities. It supports states through financial assistance, mediation, technical services and information, and participation in priority state, regional, and local forums. State and federal coastal zone management efforts are guided by the CZMP's Strategic Framework, which is organized around three major themes: Sustain Coastal Communities, Sustain Coastal Ecosystems, and Improve Government Efficiency.

Maryland's Coastal Program, established by executive order and approved in 1978, is a network of state laws and policies designed to protect coastal and marine resources. The program strives to achieve a balance between development and protection in the coastal zone. Maryland's coastal zone includes the Chesapeake Bay, coastal bays, and Atlantic Ocean, as well as, the towns, cities and counties that contain and help govern the coastline. It encompasses two-thirds of the state's land area and is home to 67.83% of Maryland's residents. Through partnerships and funding to local governments, state agencies, non-profit organizations, and universities, the Coastal Program addresses a variety of coastal issues including provision of public access, nonpoint source pollution reduction, coastal hazards mitigation, habitat and living resources protection and growth management.

Nonpoint Source Management Program – This program helps provide financial, technical and outreach assistance to control nonpoint source pollution. To help build local capacity for watershed planning and implementation of nonpoint source pollution controls, the program provides grants to state and local governments, and institutions of higher learning to implement nonpoint source pollution control projects and programs. Maryland’s Nonpoint Source Management Plan, developed by the Maryland Department of Natural Resources (DNR) Nonpoint Source Program, combines the State’s NPS Program (CWA Section 319) and Coastal NPS Program (CZARA Section 6217). Maryland’s NPS Program is a multi-disciplinary program providing financial assistance, nonpoint source related policy, and technical and educational assistance. CZARA has focused on strengthening the links between federal and state coastal zone management and water quality programs.

Evolving since its original inception in 1987 and is operated in an integrated fashion with Maryland’s Coastal Zone Program. The Management Plan is a comprehensive guide to the State’s nonpoint source problems, pollution control programs, and future steps for nonpoint source pollution control and prevention. In 2000, EPA approved a revised Management Plan that identified a number of priorities as long-term, statewide nonpoint source goals, including watershed programs and initiatives, and educational and financial assistance programs.

The backbone of the Management Plan is the application of management measures, i.e., economically achievable activities to control the addition of NPS pollution to coastal waters. There are 56 management measures that the State is required to implement on all applicable land uses within the coastal boundary. Each management measure has associated enforceable policies and mechanisms to insure implementation. The following programs provide specific requirements that the modal administrations must follow to ensure that management measures are conducted: Stormwater Management Program; Sediment and Erosion Control Program, Nontidal Wetlands and Waterways Programs, Tidal Wetlands Program, and Chesapeake Bay Critical Areas Program.

Funding for the development of individual watershed management plans and strategies was made available in 2001 under two mechanisms: CWA Section 319 – Nonpoint Source Program planning funds; and Coastal Zone Management Act (CZMA) Section 309 – Coastal Enhancement Strategy funds. In addition, the Coastal Nonpoint Source funds are currently being used within the coastal zone (comprising 66 percent of Maryland's area) to address septic systems, fund clean marina programs, and track progress.

Federal Consistency Process - "A Guide to Maryland's Coastal Zone Management Program Federal Consistency Process" provides assistance in understanding the federal consistency requirements established by the federal Coastal Zone Management Act and how those requirements are administered through the Maryland Coastal Program. All federal activities, licenses, permits, and assistance which may affect coastal resources or uses are subject to review for consistency with those enforceable policies pertaining to the Forest Conservation Act, Reforestation Act, oil pollution control, stormwater management, and marine sanitation devices.

Aquatic Sensitive Areas Initiative - Since 1999, the Maryland Coastal Program has been partnering with the Maryland Coastal Bays Program (MCBP) and other stakeholders on the Aquatic Sensitive Areas Initiative. The Maryland Coastal Bays Aquatic Sensitive Areas Initiative stems from the Comprehensive Conservation and Management Plan (CCMP) goal to "balance resource protection with recreational use." The initiative has three primary components: (1) identify sensitive estuarine resources, (2) evaluate the risks from specific water-use activities and (3) develop appropriate management and educational tools.

Clean Water Action Plan (CWAP) - As part of the federal Clean Water initiative, the State of Maryland, in cooperation with local governments, watershed organizations and other stakeholders, developed a Maryland Clean Water Action Plan (CWAP) to help guide the State's watershed management efforts. Fifty-eight watersheds in Maryland need restoration according to the 1998 Clean Water Action Plan. Maryland's CWAP includes a list of priority watersheds needing restoration. Restoration strategies are being developed for these priority watersheds that will include an action plan for restoration. The State's long-term objective is to have Watershed Restoration Action Strategies (WRAS) that are comprehensive, and address all aspects of watershed condition and water quality, including public health; aquatic living resources; physical habitat and the landscape.

The strategies may be drawn from existing assessment and targeting efforts such as a county's comprehensive plan, stormwater and sewer plans, capital budgets, greenways and open space plans, watershed stewardship programs, site design standards/best management practices, erosion and sediment control plans, soil conservation district watershed work plans and other efforts. A comprehensive strategy includes the following: a watershed-wide assessment of existing and anticipated future conditions that significantly affect water quality and natural resources, identifying the principal sources and relative contributions of point and nonpoint source pollution; major sources of habitat loss; and threats to drinking water; aquatic life, and natural resources critical to maintaining the integrity of the watershed; measurable environmental and programmatic goals and a timeframe for achieving significant milestones/accomplishments.
A public involvement process that provides mechanisms for informing the public and incorporating their concerns and priorities; a process for targeting individual projects for preventive or remedial activities (e.g. identifying appropriate areas to implement best management practices and buffer strips that will maximize the achievement of clean water and other natural resource goals; a water quality and natural resources monitoring element that utilizes existing and supplemental data sources to document current and future changes occurring in the watershed, and a process to routinely evaluate the effectiveness of projects and/or systems and their progress toward achieving environmental and programmatic goals.

Watershed restoration strategies will be encouraged to: coordinate restoration strategies with total maximum daily loads (TMDLs); address locally defined geographic priorities at smaller scales than the 134 watersheds evaluated in the Assessment; address an issue of statewide concern, such as nutrient reduction; rely on a partnership approach, including work with Tributary Teams and the Coastal Bays Program; and use Coastal Zone Management Act Section 6217 management measures. Key Maryland Clean Water Action Plan Agencies are: MD Dept of Natural Resources, MD Dept of Environment, MD Department of Agriculture, and MD Office of Planning. Key Federal Clean Water Action Plan Agencies are: US Environmental Protection Agency, US Natural Resources Conservation Service.

Unified Watershed Assessment (UWA) - Maryland developed a Unified Watershed Assessment to assess the conditions of its watersheds. The UWA identified smaller watersheds at scales that, for the most part, fall inside or nest within the large federal USGS basins. There are 138 of these State-defined "8-digit" watersheds in Maryland. Watershed Restoration Action Strategies are being developed in these 8-digit watersheds with priority waters identified under the UWA for both the Chesapeake and Coastal Bays watersheds. This program’s goals include: assessment of the condition of each State's watersheds, identification of watersheds in need of restoration, identification of watersheds that need preventive action to sustain water quality and aquatic resources, and identification pristine or sensitive watersheds that need extra protection.

Watershed Restoration Priorities – Based on the assessment, States establish watershed restoration priorities, selecting those watersheds not meeting clean water and other natural resource goals that are most in need of restoration actions.

Watershed Restoration Action Strategies – Identification of the most important causes of water pollution and resource degradation, detailing of the actions needed to address these problems, and setting milestones by which to measure progress.

Maryland Environmental Trust (MET)

MET is a statewide local land trust governed by a citizen Board of Trustees whose goal is the preservation of open land, such as farmland, forest land, and significant natural resources. The primary approach utilized by MET is to work toward securing conservation easements. This is used as a tool for landowners to protect natural resources and preserve scenic open space. The landowner who gives an easement limits the right to develop and subdivide the land, now and in the future, but still remains the owner. Properties eligible for easements, which must be considered to be in the public interest, typically involve woodlands, wetlands, farmland, scenic areas, historic areas, wild and scenic rivers, and undisturbed natural areas. Wildlife diversity interests in general are served when open space is protected in this manner.

Maryland Department of the Environment (MDE)

MDE has three media-specific administrations and two other major administrations that provide administrative and technical support to the air, water and waste management administrations. The Department's primary services include permitting/licensing and inspections for 89 functions and different regulatory facilities, financial assistance, environmental clean-up oversight, technical assistance for compliance and pollution prevention, public education and outreach, and environmental emergency response.

Environmental Programs -MDE’s mission is to protect and restore the quality of Maryland’s air, water, and land resources, while fostering smart growth, economic development, safe communities, and quality environmental education, for the benefit of the environment, public health, and future generations. The Department accomplishes its mission by assessing, preventing, and controlling sources of pollution to foster an excellent quality of life for all Marylanders.

Water Programs - The Department of the Environment (MDE) implements a diversity of regulatory and planning programs to reduce the input of pollutants to surface and ground waters of the State. Reduction of nutrients from both point- and non-point sources is the focus of the permit requirements, along with control of bacterial pollution from sewage treatment plants and toxic materials from any source.

Dam Safety - This section provides an overview of how the State assures that all dams in Maryland are designed, constructed, operated and maintained safely to prevent dam failures and the consequences of failures.

Mining in Maryland - This section provides an information on mining in Maryland from regulatory permitting to abandoned mine reclamation. It provides data on water quality and historical perspectives on mining in Maryland.

Stormwater Management Program - The Sediment and Stormwater program concentrates on controlling runoff increases and mitigating water quality degradation associated with new development. This section provides detailed guidance on how to prevent sediment and stormwater runoff or nonpoint source pollution.

Total Maximum Daily Load Program - Total Maximum Daily Loads (TMDLs), a requirement of the Clean Water Act (CWA) Section 303(d), are a tool for implementing State water quality standards. They are based on the relationship between pollution sources and in-stream water quality conditions. A TMDL establishes the maximum amount of an impairing substance or stressor that a waterbody can assimilate and still meet Water Quality Standards (WQSs) and allocates that load among pollution contributors. A TMDL, that addresses a single pollutant or stressor for each waterbody, is the sum of the allowed pollutant loads for point sources, non-point sources, projected growth and a margin of safety, as follows: TMDL = Point Sources + Nonpoint Sources + Projected Growth + Margin of Safety. Load allocations are determined through the review of monitoring data and watershed modeling.

A TMDL represents an upper limit, or "cap”, on pollutant loads to a waterbody, and, as a result there must be mechanisms to ensure that the cap is not exceeded. These mechanisms include state and local permitting and regulatory authority, and voluntary efforts under the Chesapeake Bay Agreement that are supported by technical and financial assistance. Maryland has one of the most comprehensive, multi-level, community-based estuary restoration programs in the country.

Many of Maryland’s existing efforts to protect and restore water quality will help the State meet its TMDL goals. In particular, the waters identified for TMDLs are also at the core of Maryland’s Clean Water Action Plan. In many ways, Maryland’s ongoing effort to reduce nutrients entering the Chesapeake Bay has been very similar to a TMDL process. Stakeholders and researchers recognized water quality problems, set an achievable goal, and then identified specific controls for point and nonpoint pollution sources intended to achieve the goal. This is the essence of a TMDL.

Wastewater Permits - The Wastewater Permits program works to protect Maryland's waters by controlling wastewater discharges. The program regulates wastewater discharges to surface and to groundwater. Surface water discharges are regulated through a combined state and federal permits under the National Pollutant Discharge Elimination System (NPDES). Groundwater discharges are regulated through state issued groundwater permits.

Water Conservation - With an increasing demand for water and the lack of adequate water supply due to persistent drought conditions in the state, MDE is working to help meet water conservation goals by encouraging water utilities to take steps to reduce water consumption, and developing and implementing an outreach campaign to educate Maryland citizens about the importance of water conservation.

Water Supply - MDE protects drinking water by implementing various programs that protect groundwater and surface water supplies from contaminants, establishes criteria for well construction, inspects facilities that treat and provide public drinking water, and assures compliance with all safe drinking water standards.

Water Quality Financing - The mission of the Water Quality Financing Administration (WQFA) is to assist in the financing of capital infrastructure costs for wastewater and drinking water projects.

Water Quality Infrastructure Program - This program manages federal capital funds consisting of federal EPA construction grants, special federal appropriations grants, and State revolving loan funds for water quality and drinking water projects.

Wetlands and Waterways - MDE's Wetlands and Waterways Program seeks to conserve valuable aquatic systems; providing for the environmental, economic and resource needs of Maryland.

Fish and Shellfish - MDE's fish and shellfish programs put a strong emphasis on monitoring the quality of shellfish harvesting waters, and testing edible fish tissue to certify that fish are safe for human consumption.

Flood Hazard Mitigation - MDE's flood mitigation program works with communities in finding ways to reduce or even eliminate risks to safety and property. Most importantly, MDE assists communities in establishing sustainable floodplain management programs to prevent flooding risks from occurring in the future.

Emergency Response - The Maryland Department of the Environment (MDE) has been heavily involved in response to the threat of terrorist attack, in the wake of the September 11, 2001 attacks. MDE's Emergency Response Team is called into action as frontline experts in dealing with hazardous materials spills, chemical fires and other environmental disasters.

Environmental Justice - Environmental justice seeks equal protection from environmental and public health hazards for all people regardless of race, income, culture and social class.

Noise Pollution Control - Noise has become an increasingly contentious "Quality of Life" issue as the State's population increases and urban sprawl progresses. The Noise Program operates on a complaint driven basis addressing specific requests from individual citizens as well as governmental entities.

Pollution Prevention - Pollution Prevention (P2) offers a proactive approach to environmental management. As defined by the Pollution Prevention Act of 1990, P2 is the reduction or elimination of pollution at the source rather than through control or treatment technologies at the end of the pipe or stack.

Maryland Department of Agriculture (MDA)

The mission of the MDA is to provide leadership and support to agriculture and the citizens of Maryland by conducting regulatory, service, and educational activities that assure consumer confidence, protect the environment, and promote agriculture. As shown below, two of the three current operating units within MDA are performing conservation work that augments wildlife diversity.

Office of Resource Conservation

The Maryland Department of Agriculture's Office of Resource Conservation (RC) works closely with Maryland farmers and soil conservation districts to plan and implement conservation practices and programs that balance crop and livestock production with the need to protect natural resources. RC provides a range of educational, financial, technical assistance and regulatory programs to support Maryland agriculture and protect natural resources for future generations. The Office works with a number of local, state, and federal agencies, while implementing policies established by the State Soil Conservation Committee. Four key areas-Program Planning and Development, Conservation Grants, the Nutrient Management Program, and Conservation Operations comprise the Office of Resource Conservation.

Office of Plant Industries and Pest Management

The goal of the forest pest management section is to serve the citizens of Maryland by protecting the rural and urban forest landscape tree resources from adverse effects of insects, diseases and other pests through environmentally sound pest management. This will be accomplished by protecting high value forest and landscape trees in urban and rural areas from losses due to insects and diseases.

The primary goal of the plant protection and weed management section is to conduct regulatory, inspection, and educational programs that protect the health of plants and honey bees in Maryland. Personnel in this section serve as the State's authorities on plant pests and agricultural quarantines, and provide liaison for the Department with other state and federal regulatory officials regarding these issues.

Maryland Department of Planning (MDP)

The Maryland Department of Planning (MDP) promotes growth that fosters vibrant, livable communities, preserves and protects the environment, and makes efficient use of State resources. MDP provides data, trend analysis, research assistance, and policy development and implementation support for local governments, communities, businesses, and organizations. The Department provides technical assistance, local program review and planning design services for Maryland's counties and municipalities. MDP also monitors and forecasts changes in development and land use throughout the state, as well as creating and producing research tools and resources to assist in planning for Maryland’s future. Information on demographic, socio-economic, political, cultural, geographic and land-use trends is collected, analyzed, and distributed in multiple formats. With computer mapping and geographic information systems, MDP supports map display and analysis of census data, satellite imagery, aerial photography, land-use and parcel data to enhance and assist growth management and land-use planning across the State.

Office of Smart Growth

The Office of Smart Growth works directly with local governments, businesses, and organizations to coordinate the implementation of proven planning strategies. The office helps developers and local officials produce well-planned projects and to educate and inform the public on land-use issues. Smart Growth has four straightforward goals: support existing communities by targeting resources to support development in areas where infrastructure exists;· save our most valuable natural resources before they are forever lost; save taxpayers from the high cost of building infrastructure to serve development that has spread far from our traditional population centers; and provide Marylanders with a high quality of life, whether they choose to live in a rural community, suburb, small town, or city. The State has over 80 programs that help to further Smart Growth, including the Rural Legacy Areas program.

Comprehensive Planning and Zoning

Comprehensive Planning and Zoning are some of the most basic tools of land use planning. Comprehensive Plans, also known as Master Plans, capture how people want their communities to function and grow. In Maryland, local jurisdictions are required to review and, if necessary, to update their Comprehensive Plans every six years, and the Maryland Department of Planning offers technical assistance for these updates. Zoning is the primary tool jurisdictions use to help implement the comprehensive plan. Zoning regulations, which are always accompanied by a map, typically govern the type of land uses permitted and how they can be configured on the land. Most jurisdictions also have subdivision or development regulations that provide further guidance for the development of land. MDP works with local jurisdictions to revise their zoning codes and subdivision regulations.

Maryland Department of Transportation (DOT)

As part of the Maryland Department of Transportation (MDOT), the State Highway Administration (SHA) is one of the most visible arms of state government. Today, SHA is responsible for more than 16,000 lane miles of interstate, primary and secondary roads and more than 2,500 bridges. During the preliminary planning process we ensure that proposed projects are compatible to local conditions and are environmentally friendly. SHA has updated its Guidelines to better address the preparation and review of Secondary Cumulative Effects Analysis (SCEAs).

MDOT will achieve its mission through responsible stewardship of the Chesapeake Bay and all Maryland waters and through the implementation of proactive water quality programs. MDOT will integrate water quality considerations into all applicable aspects of its strategic planning and business decision-making. In addition to specific Water Quality Requirements, MDOT also must adhere to policies, programmatic initiatives, and directives that are not implemented by specific legislative or other requirements.

MDOT will actively seek resolutions of water quality issues by endeavoring to achieve the following goals: comply fully and promptly with all applicable laws, regulations, executive orders and MDOT policies, including the commitments of the Chesapeake 2000 Agreement; integrate costs, impacts, continuing maintenance and public concerns relating to water quality into operating decisions and facility development planning; minimize adverse impacts on natural resources while carrying out MDOT projects; minimize pollution and waste though source reduction, reuse and recycling; communicate this tool and its requirements to all levels of the Department and deliver the training, tools, and resources to implement this policy; promote cooperative working relationships with regulatory agencies and the Bay Program and promote development of sound legislation and regulations on water quality; provide community outreach and leadership on water quality issues, and respond in a timely fashion to inquiries or expressions of concern regarding water quality issues related to the activities of MDOT modals and their tenants; improve MDOT's performance by developing approaches to ensure the proper function and long-term effectiveness of the Department's water quality practices, and; continuously improve the effectiveness of MDOT's water quality programs through the MFR program.

Planning and Natural Resource Management Policy - MDOT will integrate water quality concerns into the facility development planning process. When developing projects, impacts a project might have on water quality, including erosion and siltation of streams, realignment or relocation of a waterway, filling or draining of wetlands, and changes in quality or quantity of runoff from increases in impervious surface or removal of forests will be considered. In planning redevelopment projects, MDOT will plan for the possibility that aforestation, reforestation, reduction in impervious surface, water quality treatment, water quantity control or some form of mitigation will be required.. As local governments develop watershed management plans, MDOT will participate in the planning process to ensure coordination with the plan when adopted.

Water Pollution Prevention and Stormwater Management Policy -_MDOT will seek reductions from stormwater pollutant sources by promoting aggressive pollution prevention activities and innovative management technologies. Pollution prevention and stormwater management practices will be integrated into standard operating procedures with the goal of eliminating the discharge of nutrients, toxics and hazardous substances to surface or ground waters. MDOT will continue to investigate and share new technologies and products to improve the reduction and control of contaminants and to recycle waste products to the extent feasible. MDOT/SHA received an April 2003 award from FHWA for Excellence in Wetlands and Water Quality for their Stormwater Management Facilities and National Pollutant Discharge Elimination System Program. The award cites the example of the Stormwater Management Facilities Program as showing how to go beyond compliance as part of doing business. This comprehensive maintenance program is used to locate, inspect, evaluate, remediate, and enhance all of SHA's stormwater management facilities.

Management Commitment Policy - MDOT will communicate water quality policies and their requirements to all levels of staff. Resources, staff and training necessary to implement these policies will be supported on a par with established programs for air quality, safety, system capacity and system preservation.

Community Relations Policy – MDOT will provide information and, when appropriate, actively solicit input regarding the impacts of their operations on water quality, and will consider public input in their planning and business decision-making.

University of Maryland Center for Environmental Science (UMCES)

The University of Maryland Center for Environmental Science is one of 13 constituent institutions of the University of Maryland. The Center's programs are carried out at three laboratories located across the state: the Appalachian Laboratory in western Maryland, the Chesapeake Biological Laboratory, in southern Maryland and the Horn Point Laboratory on the Delmarva Peninsula. UMCES is also responsible for the administration of the Maryland Sea Grant College program. The Center's research and science application activities emphasize the Chesapeake Bay and its watershed.

Appalachian Laboratory - AL was founded in 1962 and its faculty conduct research in aquatic ecology, landscape and watershed ecology, conservation biology and restoration ecology, behavioral and evolutionary ecology, and study both freshwater and terrestrial ecosystems of Maryland and other locations in the United States and the world. AL is a member of the **Association of Ecosystem Research Centers**. Appalachian Laboratory is the headquarters and administrative lead of the **Chesapeake Watershed Cooperative Ecosystem Studies Unit (CW CESU)**, a partnership among 11 university/research institutions and 6 federal agencies whose members strive to understand and protect the natural and cultural resources of the region. The CW CESU is part of the **CESU national network** of 17 similar partnerships. The primary objective of the network is to foster stewardship of the environment through collaborative research, technical assistance and education that support integrated ecosystem management. Environmental education is an important part of the mission of the Appalachian Laboratory, aimed at motivating future generations to be environmentally literate and to understand the importance of an ecologically healthy environment. Through this effort, the Lab educates teachers, students, and other members of our western Maryland community how to be wise stewards of our valuable natural resources.

Chesapeake Biological Laboratory - CBL is a marine research facility founded in 1925 at the mouth of the Patuxent River, within easy reach of the diverse aquatic and terrestrial habitats of one of the world's largest estuarine ecosystems. CBL is a charter member of the National Association of Marine Laboratories and it houses the UMCES research fleet. Areas of research emphasis include aquatic environmental toxicology, environmental chemistry, ecosystem studies, and fisheries science.

Horn Point Laboratory - HPL is located on the banks of the Choptank River, a tributary of the Chesapeake Bay on Maryland's Eastern Shore. The Laboratory is interdisciplinary with faculty engaged in research on the biology, chemistry, physics, and ecology of organisms and ecosystems from wetlands and estuarine waters of the Chesapeake Bay to the continental shelf and open waters of the world's oceans. Areas of scientific expertise include oceanography, plankton dynamics, marine macrophyte and wetland ecology, systems ecology, nutrient dynamics and eutrophication, physiological ecology of benthic invertebrates, benthic-pelagic interactions, and aquaculture. HPL is a member of the **Southern Association of Marine Laboratories (SAML)** and the **National Association of Marine Laboratories (NAML)**.

Maryland Sea Grant College - supports innovative marine research and education, with a special focus on the Chesapeake Bay. With funding from the National Oceanic and Atmospheric Administration and the State of Maryland, Sea Grant-supported research targets practical problems, with the aim of promoting wise decision-making. By serving as a gateway to relevant and reliable scientific information, Sea Grant helps assure that individuals can make informed choices about their use and stewardship of marine resources.

First established in 1977, Maryland Sea Grant is part of a network of 30 university-based Sea Grant program around the country. Hosted by the University of Maryland's College Park campus, Maryland Sea Grant is administered by the University of Maryland Center for Environmental Science, on behalf of the thirteen campus University System of Maryland. We support scientific research using an interactive and innovative approach to program management.

To help return the Chesapeake Bay to a condition that more closely resembles its original productivity, where underwater grasses and oyster reefs lined the Bay's shallow edges, scientists and resource managers alike must explore new ways to improve water quality, to experiment with grass planting and oyster reef construction, to explore better ways of spawning and raising oysters and finfish in hatcheries and other facilities. The Maryland Sea Grant College helps to support activities in all these areas.

FEDERAL PROGRAMS

U.S. Fish and Wildlife Service (FWS)

The Fish and Wildlife Service, within the U.S. Department of the Interior, is the principal federal agency responsible for conserving, protecting, and enhancing fish and wildlife, plants and their habitats for the continuing benefit of the American people. The Service manages the 93-million acre National Wildlife Refuge System comprised of more than 540 national wildlife refuges and thousands of waterfowl production areas. It also operates 65 national fish hatcheries and 78 ecological services field stations. The agency enforces federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid Program which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

Chesapeake Bay Field Office

The mission of the Chesapeake Bay Field Office is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. Chesapeake Bay Field Office biologists work to protect endangered and threatened species, migratory birds, freshwater and anadromous fish, and wildlife habitats in the District of Columbia, Delaware, Maryland and Virginia. CBFO staff work with many other private and public partners to preserve and protect living resources of the Chesapeake Bay and Delaware Bay ecosystems.

Maryland Fishery Resources Office

Maryland Fishery Resources Office coordinates fish tagging programs in cooperation with federal and state agencies along the eastern seaboard. The Cooperative Tagging Program has provided critical information for striped bass restoration, and will likely be as important to sturgeon, shad, and horseshoe crab conservation. Information from these tagging programs can be used to monitor the status of stocks, restore fish populations, and set seasons on harvest. The Cooperative Tagging Program has provided essential information for striped bass restoration, and conservation. However, our understanding of migration, mortality, and spawning behavior is far from complete for these species.

National Wildlife Refuge System

The Chesapeake Marshlands National Wildlife Refuge Complex comprises the Blackwater National Wildlife Refuge (NWR), Eastern Neck NWR, and the Chesapeake Island Refuges, consisting of Martin NWR and Susquehanna NWR, which collectively includes the Barren Island, Watts Island, Bishops Head, and Spring Island Divisions. A planning team consisting of representatives from all divisions within the Fish and Wildlife Service initially developed a draft Comprehensive Conservation Plan (CCP) and

Environmental Analysis (EA), with input and assistance from numerous partner agencies. A separate CCP/EA will be developed for Eastern Neck NWR. The purpose of the CCP is to provide management guidance for achieving the highest and best contribution to wildlife resources for which the Service is responsible for managing on the Refuge Complex. The CCP will identify the role that units of the Refuge Complex will play in fulfilling the mission of the Fish and Wildlife Service, the mission of the National Wildlife Refuge System, and the purposes for which the units of the Refuge Complex were established. The Environmental Assessment (EA) identifies three alternatives for managing the Refuge Complex, and discusses how each of those actions will affect the physical, biological, archaeological, historical, and socioeconomic environments.

Established in 1936 by executive order of President Franklin D. Roosevelt, the Patuxent Research Refuge is the Nation's only National Wildlife Refuge established to support wildlife research. This property houses the facilities for the USGS's Patuxent Wildlife Research Center (PWRC), as well as the National Wildlife Visitor Center. This Center is the largest science and environmental education center in the Department of the Interior. Designed to accommodate one million visitors per year, this unique facility seeks to impart to young and old alike an increased knowledge of and appreciation for the earth's vital resources. It highlights the work of professional scientists who strive to improve the condition of wildlife and their habitats.

National Park Service (NPS)

Within the U.S. Department of the Interior, the National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. The NPS owns and manages a wide variety of properties across Maryland. Its 23 holdings within the state include National Scenic Trails, National Seashore, National Historic Sites, and National Battlefields.

U.S. Geological Survey (USGS)

Also housed within the U.S. Department of the Interior, the USGS serves the nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. As the nation's largest water, earth, and biological science and civilian mapping agency, the USGS collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. The diversity of scientific expertise enables the implementation large-scale, multi-disciplinary investigations and the provision of impartial scientific information to resource managers, planners, and other customers.

Chesapeake Science Program

The USGS Chesapeake Science Program depends on the coordination of multiple USGS Programs that have a scientific interest in the Bay restoration. Over forty USGS scientists located in offices throughout the Bay watershed and at the CBP, are involved in scientific studies and information dissemination. Where possible, the USGS is planning and executing integrated efforts among USGS National Programs to enhance interdisciplinary approaches to technical issues. View some recent accomplishments of USGS Chesapeake Bay Science Studies.

Biology Program - area missions related to fisheries and aquatic resources, contaminants, wildlife, invasive species, and ecosystems are met through investigations carried out at the Leetown Science Center and PWRC addressing submerged aquatic vegetation, wetlands, fisheries and water birds.

Coastal and Marine Geology Program - mission is met through research on sediment sources and dynamics affecting water clarity and submerged aquatic vegetation. Visit the home page for the Coastal and Marine Geology Program

Cooperative Geologic Mapping Program - mission is met through creation of maps of geologic and geomorphic characteristics of sediment transport and deposition history in watersheds and adjacent tidal. The National Cooperative Geologic Mapping Program site contains more information.

Cooperative Topographic Mapping Program - program mission is met through information management, access, and retrieval of GIS- based data through the WWW.

Earth Surface Dynamics Program - mission is met through research on effects of land-cover change and climate variability on sediment deposition and subsequent effects on water clarity and SAV.

Eastern Region Place-Based Studies - goal of coordinating and integrating science of the USGS National Programs and to meeting customer needs in the Mid-Atlantic Focus area is carried out through investigations in Chesapeake Bay and its watershed. Visit the Place-based Studies Program site or fact sheet for more information.

Geographic Analysis and Monitoring Program (GAM) - mission is met through research and application to document the land-cover characterizations, land-cover and land-use changes, and relate to water quality and habitat changes through process models.

Hydrology National Research Program - mission is met through research of sediment sources, transport, and delivery in the selected watersheds and adjacent tidal systems and their relation to shallow-water habitats for SAV. Research on nutrient cycling in surface-water and ground-water systems. Research characterizing abundance and extent of SAV coverage in relation to sediment, seasonal water quality, and hydroclimatology. The National Research Program conducts basic and problem oriented hydrologic research.

Hydrology State-Federal Cooperative Program - mission is met through enhanced surface-water monitoring and modeling efforts to document sediment and nutrient loads, trend analysis, and factors affecting loads and trends.

National Water-Quality Assessment (NAWQA) Program - mission is met through work under Delmarva/Potomac study to understand nutrient and contaminant relation to land use and processes affecting geochemical cycling.

Toxic Substances Hydrology Program - the mission of this program is met through research on the influence of nutrients, sediments, and contaminants on the environmental health of the Chesapeake Bay and its watershed.

Support for Chesapeake Bay Program - Restoration of living resources and vital habitat is the highest priority of Chesapeake 2000. The CBP is developing plans to restore vital habitats and living resources including submerged aquatic vegetation and fisheries. Also, the Department of Interior is developing conservation measures to protect water birds in the Atlantic Flyway. To develop the strategies to conserve and restore the ecosystem, scientific information is needed to understand the complex relation of living resources and associated habitats to environmental factors in the Bay and its watershed. The USGS will focus on documenting the factors affecting the health of fish and water birds and their habitats: Submerged Aquatic Vegetation, Wetlands, Stream Corridors, Invasive Species, Fish Health, and Water Birds.

Land-use change is the primary factor causing water-quality and habitat degradation in the Bay and its watershed. There is a need for enhanced land-use and watershed data to explain changes in water quality, habitat, and living resources and improve associated CBP models and decision-support systems. The USGS is producing land-cover, land-use, and watershed data needed to understand changes in water quality and living resources. Efforts are focused on documenting the sediment, nutrient, and toxic sources associated with urban, suburban, and agricultural lands.

National Biological Information Infrastructure (NBII)

Part of the USGS, NBII is a broad, collaborative program to provide increased access to data and information on the nation's biological resources. The NBII links diverse, high-quality biological databases, information products, and analytical tools maintained by NBII partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry. NBII partners and collaborators also work on new standards, tools, and technologies that make it easier to find, integrate, and apply biological resources information. Resource managers, scientists, educators, and the general public use the NBII to answer a wide range of questions related to the management, use, or conservation of this nation's biological resources. One of Maryland's links to NBII is through the Mid-Atlantic Information Node (MAIN), the regional node encompassing Pennsylvania, Maryland, Delaware, Virginia, and West

Virginia. The mission of the MAIN is to encourage accessibility and appropriate use of such biological resource information throughout the Mid-Atlantic Region. The MAIN philosophy for addressing the problem focuses heavily upon coordination, cooperation, and communication among the community of professionals that deal with data collection and management in the region.

National Oceanic and Atmospheric Administration (NOAA)

Situated within the U.S. Department of Commerce, NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs.

<u>Habitat Program</u> - Works to improve the quality and increase the quantity of coastal habitat restoration. In addition to planning, funding, and implementing on-the-ground restoration projects, the Habitat Program advances the science underlying coastal habitat restoration and develops improved technology with which to achieve successful restoration. The Program also transfers restoration technology and the results of research and monitoring to the private and public sectors through extension, outreach, and education efforts.

<u>Damage Assessment and Restoration Program</u> -Conducts natural resource damage assessments and restoration of coastal and marine resources injured as a result of oil spills, releases of hazardous materials and ship groundings. Composed of NOAA Restoration Center, NOAA Damage Assessment Center, and NOAA Office of General Counsel.

<u>Community-based Restoration Program</u> - A financial and technical assistance program that promotes strong partnerships at the national, regional, and local level to restore fisheries habitat with the help of volunteer support, and other in-kind services. Administered by NOAA Restoration Center.

<u>Coastal Wetlands Planning, Protection and Restoration Act Program</u> - Funds and supports restoration, protection, conservation and enhancement of threatened wetlands on the Gulf of Mexico. Administered by NOAA Restoration Center.

<u>Coastal Protection and Restoration Division</u> - Implements the Secretary of Commerce's natural resource trusteeship by protecting and restoring coastal habitats and resources affected by hazardous materials releases. Office of Response and Restoration within the NOAA Ocean Service.

<u>Estuary Restoration Act (ERA)</u> - This Act formed a federal interagency council to make restoring our nation's estuaries a top priority. NOAA is assigned primary data coordination responsibilities under the ERA, including the establishment of monitoring protocols for restoration projects and the development and maintenance of a national

inventory of restoration projects (National Estuary Restoration Inventory). NOAA is also working to assess habitat trends and fill gaps in restoration planning in key coastal areas.

Oyster Recovery Partnership - Provides a focus for NOAA's multiple capabilities and activities in Chesapeake Bay along with the multi-state/Federal partnership that comprises the Chesapeake Bay Program. A component of the NOAA Chesapeake Bay Office.

NOAA Hydropower Program - Implements provisions of the Federal Power Act to prescribe fishways and other protection, mitigation, and enhancement measures at hydropower projects licensed by the Federal Energy Regulatory Commission.
A component of the NOAA Fisheries Service Office of Habitat Conservation.

NOAA Habitat Collaborating Programs - These programs are involved in NOAA restoration activities, but restoration is not their primary mission: NOAA Research (OAR), National Sea Grant College Program (OAR), National Marine Sanctuary Program (NOS), Special Projects (NOS/MB), National Geodetic Survey (NOS), Landscape Characterization and Restoration Program (NOS/CSC), Center for Operational Oceanographic Products and Services (NOS), Center for Coastal Fisheries and Habitat Research (NOS/NCCOS), Center for Sponsored Coastal Ocean Research (NOS/NCCOS), Cooperative Institute for Coastal and Estuarine and Environmental Technologies CICEET (NOS/OCRM), National Estuarine Research Reserve System (NOS/OCRM), Coastal Zone Management Program (NOS/OCRM), Office of Protected Resources (NMFS), NOAA Fisheries Labs (NMFS), National Fish and Wildlife Foundation (NOAA Partnership Program), Pribilof Islands Environmental Restoration Project (NOAA Program), Southern Florida Ecosystem Restoration Program (NOAA Program).

Coastal Services Center - supports the environmental, social and economic well being of the coast by linking people, information and technology.

NOAA CoastWatch Great Lakes Program - The NOAA Great Lakes Environmental Research Lab obtains, produces and delivers environmental data and products for near real-time monitoring of the Great Lakes to support environmental science, decision making and supporting research. This is achieved by providing access to near real-time and retrospective satellite observations.

The Marine Geology & Geophysics Division of the NOAA National Geophysical Data Center and the collocated World Data Center for Marine Geology & Geophysics, in Boulder, Colo., compiles and maintains extensive bathymetric, marine sediment and trackline geophysical databases in both coastal and open ocean areas.

Coast Survey - a component of the NOAA Ocean Service with a long history as the oldest scientific organization in the United States, having its foundation as far back as 1807. Today the Office of Coast Survey is known for the useful and necessary navigational products, which are required for the safe and efficient maritime commerce in and out of the nation's ports.

Coastal Zone Management - is a unique federal-state partnership that provides a proven basis for protecting, restoring and responsibly developing the nation's important and diverse coastal communities and resources.

Estuarine Reserve Research - The NOAA National Estuarine Research Reserve System protects and studies estuarine areas through a network of 25 reserves. We hope you will use this Web site to learn more about the importance of estuaries, national programs, reserves in your state and critical issues, such as polluted runoff, restoration science, invasive species and environmental stewardship.

Great Lakes Environmental Research Lab - The NOAA Great Lakes Environmental Research Laboratory (GLERL) conducts high-quality research and provides scientific leadership on important issues in both Great Lakes and marine coastal environments leading to new knowledge, tools, approaches, awareness and services.

Integrated Coastal Management - a cooperative undertaking among the Intergovernmental Oceanographic Commission, UNESCO, the NOAA Ocean Service, National Oceanic and Atmospheric Administration, the Center for the Study of Marine Policy (University of Delaware), the World Bank, and the UNEP Global Program of Action for the Protection of the Marine Environment from Land-based Activities in conjunction with a number of other partners around the world.

National Centers for Coastal Ocean Science - The National Centers for Coastal Ocean Science (NCCOS) conducts and supports research, monitoring, assessment and technical assistance to people managing coastal ecosystems and society's use of them. Formed within the NOAA Ocean Service in March 1999, it puts all of NOAA's coastal research centers in one group. Each Center has specific capabilities and research expertise in important ocean and coastal issues: Center for Sponsored Coastal Ocean Research, Center for Coastal Monitoring and Assessment, Center for Coastal Fisheries and Habitat Research.

Ocean Prediction Center - issues marine warnings, forecasts and guidance in text and graphical format for maritime users. Also, the OPC quality controls marine observations globally from ship, buoy and automated marine observations for gross errors prior to being assimilated into computer model guidance. The Ocean Prediction Center also provides forecast points in coordination with the NOAA National Hurricane Center for Tropical Cyclones in the Atlantic Ocean E of 65W.

Ocean and Coastal Resource Management - administers the Coastal Zone Management Act and a leader on the Nation's coastal, estuarine and ocean management issues.

Sea Grant - network of Sea Grant Colleges and research institutions. Headquartered at many of the nation's premier universities, Sea Grant programs are located in coastal and

Great Lake states, Hawaii and Puerto Rico. A national network of 30 Sea Grant Colleges and institutional programs shares research, outreach and education to solve old problems and explore new uses for the world's marine, Great Lakes and coastal resources.

Office of Habitat Conservation - The Office of Habitat Conservation is located in the National Oceanic and Atmospheric Administration (NOAA) Headquarters complex in Silver Spring, Maryland. It interacts with the NOAA Fisheries Regional Offices to manage, conserve and enhance habitats for fishery resources, protected species and other living marine resources.

National Marine Fisheries Service (NOAA Fisheries Service) is dedicated to protecting and preserving the nation's living marine resources through scientific research, fisheries management, enforcement and habitat conservation. NOAA Fisheries is a leading voice for commercial and recreational fisheries and continues to focus its efforts on sustaining marine resources. Marine fisheries (which extend from state waters to 200 miles from USA shores) provide an important source of food for the nation, as well as thousands of jobs and a traditional way of life for many coastal communities. From the Gulf of Maine, to the Gulf of Mexico and to the Gulf of Alaska, NOAA Fisheries scientists and managers work to ensure sustainable fish harvests; they are the stewards of marine resources and their habitats.

Marine Mammals — NOAA Fisheries works to protect marine mammals under its jurisdiction, including whales, dolphins, porpoises, seals and sea lions.

Sea Turtle Protection and Conservation - All six species of sea turtles in the U.S. are protected under the Endangered Species Act of 1973. One of the most important ways NOAA Fisheries acts to protect sea turtles is by requiring trawl fishermen to use Turtle Excluder Devices or TEDs while fishing.

Essential Fish Habitat — The conservation of essential fish habitat for federally managed fish species is an important component of building and maintaining sustainable fisheries.

U.S. Environmental Protection Agency

The mission of the Environmental Protection Agency is to protect human health and the environment. One of the numerous programs coordinated by EPA is the Environmental Monitoring and Assessment Program (EMAP), which is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to our natural resources. EMAP aims to advance the science of ecological monitoring and ecological risk assessment, guide national monitoring with improved scientific understanding of ecosystem integrity and dynamics, and demonstrate multi-agency monitoring through large regional projects. EMAP develops indicators to monitor the condition of ecological resources. EMAP also investigates designs that address the acquisition, aggregation, and analysis of multiscale and multitier data.

U.S. Department of Agriculture

Among the varied responsibilities of USDA are the stewardship of our nation's 192 million acres of national forests and rangelands, as well as working with private landowners to encourage voluntary efforts to protect soil, water, and wildlife on the 70 percent of America's lands that are in private hands.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) coordinates numerous natural resources conservation programs help people reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. Public benefits include enhanced natural resources that help sustain agricultural productivity and environmental quality while supporting continued economic development, recreation, and scenic beauty. As an example, the Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP, USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

U.S. Department of Defense

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (Baltimore & Pittsburg Districts for Maryland) has many projects and programs that are helping to meet the Bay restoration goals. The Army Corps of Engineers carries out environmental and natural resource management programs at its projects, managing thousands of square miles as forest and wildlife habitat, monitoring water quality at its dams, operating fish hatcheries in cooperation with State wildlife agencies, and in some cases restoring the environment at projects built in earlier days.

Ecosystem Restoration Programs- Since passage of the National Environmental Policy Act of 1969, environmental protection has been an important component of the civil works planning process. Legislation passed in 1990 established environmental protection as one of the primary missions of water resources projects-- along with navigation and flood control. This new direction has allowed us to expand our traditional environmental activities and enhance or restore natural resources at our projects

Poplar Island Environmental Restoration Site - Poplar Island, in Talbot County, MD, is a national model for habitat restoration and the beneficial use of dredged material. The U.S. Army Corps of Engineers, Baltimore District has teamed with the Maryland Port Administration and other Federal and State agencies to restore Poplar Island. Six different habitat types are being created as part of the Poplar Island Environmental Restoration Project: upland habitat, salt marshes, tidal flats, nesting islands, rocky shorelines, and shallow water habitats. Not only will these habitats support a diverse assemblage of plants and animals, but some of the habitat types to be created include those that are most sorely needed in the Bay. The five restoration goals of Poplar Island Environmental Restoration Project are: create bare/sparsely vegetated islands to provide nesting habitat for birds; create/enhance vegetated islands to provide nesting habitat for birds; create/enhance tidal wetlands to provide fish and wildlife habitat; restore quiescent water habitat in Poplar Harbor to promote submerged aquatic vegetation recovery, and; create remote and diverse island habitat

Smith Island, Maryland Environmental Restoration and Protection Project -
The Baltimore District, in partnership with the Maryland DNR and Somerset County, has developed a plan for environmental restoration on Smith Island. The restoration efforts are focused on the northern half of the island that comprises the Martin National Wildlife Refuge. During the feasibility study, it was determined that the tremendous loss of submerged aquatic vegetation (SAV) around parts of Smith Island could be stopped and, to an extent, reversed by protecting and restoring lost wetlands in the Martin National Wildlife Refuge. Over a 50-year project life, these projects will restore or protect approximately 1,900 acres of SAV and restore or protect 240 acres of wetlands.

Environmental Stewardship Programs - includes compliance measures to ensure that our projects must meet Federal, state, and local environmental requirements. Prevention, meanwhile, focuses on eliminating pollution to the greatest extent possible. This includes reducing hazardous materials use and hazardous waste generation.

Civil Works Program - The civil works program enables the Corps, with support from non-federal sponsors, to plan, design, and construct projects related to ecosystem restoration, navigation and flood protection. Working toward a national goal of "no net loss of wetlands," the Civil Works program is undertaking projects to restore existing wetlands, or to create new ones.

International and Interagency Services Programs (IIS) - The Corps assists many non-Department of Defense federal, state and local government agencies to supplement their technical resources. We provide a full range of support services including engineering, construction, real estate acquisition, contracting and construction management functions.

Regulatory Program - The Corps' regulatory program is charged with protecting waterways and wetlands. We regulate the discharge of dredged or fill material into all waters of the Unites States, as well as construction activities and dredging within traditionally navigable waters.

Operations and Maintenance (O&M) - The Corps' Operations and Maintenance Program includes navigation actions, stewardship on Corps lands, and special initiatives such as the Baltimore Harbor Dredged Material Management Plan. The Corps continuously looks for ways to beneficially use material dredged from the federal navigation channels, such as wetland and island restoration. We also protect and restore the valuable environmental resources within our lakes and reservoirs.

Chesapeake Bay Model - The Chesapeake Bay Environmental Model Package (CBEMP), developed by the Engineer Research and Development Center (ERDC) of the Corps and supported by the Environmental Protection Agency (EPA), has been used for a variety of management purposes since its initial delivery in 1992. The most recent upgrade of the model is guiding management efforts to remove the bay from an EPA list of impaired water bodies. The model is being used to help determine nutrient and solids load reductions necessary to restore the bay. ERDC is initiating innovative model developments to investigate the impact of a ten-fold increase in oyster population and is in the initial stages of adding a sediment transport component to the bay model.

U. S. Service Branches (Army, Navy, Air Force, Marine, Coast Guard) The Environmental Management System policy of our nation's Department of Defense (DOD) calls for systematic integration of environmental management into all missions, activities, and functions that are carried out by the various service branches. In taking this step, the DOD is emphasizing its commitment to the environment and its position that simply complying with environmental laws and regulations is not enough. Examples of this approach in practice would be the completion and implementation of Integrated Natural Resource Management Plans (INRMP's) for base facilities in Maryland, as well as commitments by Maryland's National Guard to combat invasive species on training facilities leased from the state.

LOCAL AGENCIES AND PROGRAMS

Planning and Zoning

There are Planning and Zoning agencies within each of Maryland's 23 counties, as well as Baltimore City. Coordination at the local level also includes contact with county staff related to environmental protection and resource management. Maryland has more than 150 municipalities and coordination at this level is frequently accomplished through the county agencies or via the Department of Planning. Local agencies coordinate with various state agencies in the development of their Comprehensive Plans, Land Preservation and Recreation Plans, and other planning activities.

Maryland-National Capital Park and Planning Commission

The Maryland-National Capital Park and Planning Commission is a bi-county agency empowered by the State of Maryland in 1927 to acquire, develop, maintain and administer a regional system of parks within Montgomery and Prince George's Counties, and to prepare and administer a general plan for the physical development of the two counties. In addition, the Commission gained responsibility for the public recreation program in Prince George's County in 1970. The Commission administers a park system of more than 52,000 acres. It is composed of stream valley parks, large regional parks, neighborhood parks and park-school recreation areas.

MULTI-AGENCY PROGRAMS

Chesapeake Bay Program

The Chesapeake Bay Program is a unique regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983. The Chesapeake Bay Program partners include the states of Maryland, Pennsylvania and Virginia; the District of Columbia, the Chesapeake Bay Commission, a tri-state legislative body; the Environmental Protection Agency, representing the federal government; and participating citizen advisory groups. Since the signing of the Chesapeake 2000 agreement, Delaware, New York and West Virginia have joined the Bay Program partnership to improve the quality of the waters flowing into the Bay. As headwaters partners, each of those states will work with the Bay Program to reduce the amount of nutrients and sediments flowing into rivers from their jurisdictions. The Chesapeake Executive Council leads the Bay Program. The members of the Executive Council are the governors of Maryland, Virginia, and Pennsylvania; the Mayor of the District of Columbia; the Administrator of the US Environmental Protection Agency, and the Chair of the Chesapeake Bay Commission. The Executive Council meets annually to establish the policy direction for the Bay Program.

Since its inception in 1983, the Bay Program's highest priority has been the restoration of the Bay's living resources- its finfish, shellfish, Bay grasses and other aquatic life and wildlife. Improvements include fisheries and habitat restoration, recovery of Bay grasses, nutrient and toxic reductions, and significant advances in estuarine science.

<u>Tributary Strategies Program</u> - Maryland’s Tributary Strategies’ primary goal is to meet nutrient reduction goals in each of the ten major tributaries of the Chesapeake Bay. The Strategies recommend implementation targets for urban, agricultural, and resource protection best management practices that, along with implementation of biological nutrient removal at large wastewater treatment plants, are designed to meet nutrient reduction goals. Maryland's Tributary Teams—comprised of local citizens, farmers, business leaders, and government officials appointed by the Governor—work to formulate the Strategies. The Tributary Teams meet regularly to help implement pollution prevention measures to address local water quality problems.

Under the guidance of the Tributary Teams, major cleanup actions are underway in the ten key Chesapeake Bay tributaries. The Tributary Teams work to develop a pollution control plan unique to each watershed, its population and its land-use patterns. Examples of pollution control options being implemented in each tributary basin include: Upgrades to wastewater treatment plants, Planting of stream-side forests to absorb nutrient runoff, Best management practices to reduce agricultural runoff, and "Smart growth" plans.

Watershed Assistance Program - The Watershed Assistance workgroup is action-oriented with a mission to provide on-the-ground technical assistance to local watershed planning initiatives. In partnership with Maryland, Virginia, West Virginia, and Pennsylvania, the group: Provides assistance to local groups on watershed planning by facilitating the integration of watershed management and land use planning through meaningful dialogue and technical support; Plans, coordinates, and conducts, training for state and local government staff and interested organizations on local watershed planning; Provides outreach and education assistance through information, tools, and resources to enable and encourage local governments to do watershed planning in collaboration with community stakeholders.

The Chesapeake Bay Small Watershed Grants Program - Administered by the National Fish and Wildlife Foundation in partnership with the U.S. Environmental Protection Agency, Chesapeake Bay Program, the program is primarily funded by the Environmental Protection Agency's Chesapeake Bay Program Office. Additional funding partners include: National Oceanic and Atmospheric Administration, USDA Natural Resources Conservation Service, Chesapeake Bay Trust, Keith Campbell Foundation for the Environment, and Western Pennsylvania Watershed Program.

The program promotes community-based efforts to protect and restore the natural resources of the Chesapeake Bay and its watershed. The program provides grants to organizations working to improve the condition of their local watershed while building citizen-based resource stewardship. Many of the grants awarded are modest; however, they are often combined with the contributions of other partners, making possible projects that can make a measurable contribution to communities.

While the overall goal of the Program is to assist local communities with watershed protection, specific goals include: Supporting communities in developing and implementing watershed management plans; Encouraging innovative local programs or projects that improve water quality and restore important habitats within the Chesapeake Bay basin; Developing the capacity of local governments, citizen groups and other organizations to promote community-based stewardship and enhance local watershed management; Promoting a greater understanding of the Chesapeake Bay and the connection between the health of the Bay and condition of local watersheds, and; Strengthening the links between communities and the Chesapeake Bay Program.

Community Legacy Grants - The Community Legacy Grants initiative, begun in 2002, is intended to encourage the establishment of partnerships that will create a conservation legacy in communities throughout the Chesapeake Bay watershed. As envisioned under the Chesapeake 2000 Agreement, this legacy includes abundant, diverse populations of fish, wildlife and plants, fed by healthy streams and rivers, sustaining strong local and regional economies, and our unique quality of life. Through the Community Legacy Grants initiative grants will be awarded to truly innovative projects that either restore vital fish and wildlife habitats, develop locally-supported watershed management plans, or promote environmentally-sensitive development.

Community Watershed Dialogue - The watershed assistance staff, in collaboration with Maryland, Pennsylvania, Virginia and West Virginia, organize and conduct Dialogues to engage community leaders and key stakeholders in managing watersheds. The Dialogues are a collaborative approach for community engagement, consensus building, and commitment to comprehensive resource management. Participants learn to integrate watershed management into sound land use decisions and practices.

The first Community Watershed Dialogue took place at the Wye Institute on Maryland's Eastern Shore. Community leaders and stakeholders from the Maryland DNR Watershed Restoration Action Strategy (WRAS) watersheds joined for two days to discuss watershed management and the "how to" of initiating local watershed planning. The Maryland Dialogue contained sessions on visioning and goal setting, building stakeholder networks to support watershed preservation and restoration, implementing a locally developed watershed plan, and using resource data to make decisions. Participants from each watersheds met together to outline steps necessary for initiating planning efforts in their watershed. The watersheds included: Lower Patapsco, Upper Chester, Upper Monocacy, Chincoteague Bay, Anacostia, and the South Branch of the Potomac River, West Virginia

Builders for the Bay Roundtables - Many times, conservation of open space, forests and farms provide benefits to new developments. These cost saving benefits include natural infrastructure retention and the higher market value of homes adjacent to protected lands. At the Roundtables, representatives from the Center for Watershed Protection, The National Home Builders Association and the Alliance for the Chesapeake Bay lead a discussion between builders and environmentalist. They are working together to revise local codes and ordinances, so that new developments can conserve open space and protect water quality while meeting market demand and builders' needs.

The Resource Lands Assessment - The Resource Lands Assessment (RLA) provides a regional multi-state look at the most important remaining resource lands in the Chesapeake Bay Watershed. The RLA uses GIS models and expert knowledge to assess the value of resource lands within the watershed, providing guidance to state and local government in land protection strategy development, serving as an information resource for the land trust community, suggesting conservation focus areas to complement watershed restoration plans, and identifying areas important to maintain for the forest products industry. These models can inform growth management and land preservation planning at multiple spatial scales.

The Bay Program partners are conducting an assessment of the resource lands in the watershed. This assessment will be used to advise future land acquisition and analyze protected lands for habitat value, water quality/watershed integrity protection, cultural value, economic value (forest/farm production), and vulnerability to development.

The Chesapeake Bay Program developed analytical approaches for assessing the value of forests, farms and wetlands within the Chesapeake Bay Watershed using Geographic Information Systems (GIS) to manipulate and combine data from a variety of sources. The resulting assessment models can be utilized individually or in combination. The composite data sets can be reclassified and applied at different geographic scales based on the needs of the user. Each of the six assessment models uses a series of GIS data layers that were selected to represent ecological, cultural or socioeconomic phenomena. Data layers were selected based on their importance in assigning "value" to the landscape, and were weighted using input from resource experts within and outside of the Chesapeake Bay Program. Each assessment model contains different assumptions for appropriate data, the use of weights, and the limitations regarding display and interpretation of the composite results.

Maryland Coastal Bays Program

The Maryland Coastal Bays Program is one of 28 National Estuary Programs. The National Estuary Program was established in 1987 by amendments to the Clean Water Act (CWA Section 320) to identify, restore, and protect nationally significant estuaries of the US. The US Environmental Protection Agency administers the National Estuary Program, but program decisions and activities are carried out by committees of local government officials, private citizens, and representatives from other federal agencies, academic institutions, industry, and estuary user-groups.

The Maryland Coastal Bays include the Isle of Wight, Assawoman, Sinepuxent, Newport, and Chincoteague bays as well as other smaller bays and estuaries within the watershed. Maryland's Coastal Bays Program began as a planning effort that assessed the coastal bays' conditions and trends. The Chesapeake Bay is protected under its own federally mandated program, separate but related to the National Estuary Program. In fact, the approach and methods of the National Estuary Program were developed from the foundation laid by earlier efforts to protect the Chesapeake Bay.

The Maryland Coastal Bays Program is a partnership among the towns of Ocean City and Berlin, National Park Service, Worcester County, U.S. Environmental Protection Agency, and the Maryland Departments of Natural Resources, Agriculture, Environment, and Planning, who have come together to produce the first ever management plan for the coastal bays. This led to the development of a Comprehensive Conservation and Management Plan (CCMP) that addresses environmental restoration and protection and has evolved into an integrated effort to implement restoration and protection efforts. The effort is a partnership of federal, state, and local governments, citizens, environmental organizations, businesses, agricultural interest, and scientists. The CCMP identifies major problems in the coastal bays and action plans to address the problems. A policy committee of high level EPA, state, and local officials and citizen representatives establishes policies and priorities for the protection of the coastal bays and serves as an advocate for the implementation of the CCMP.

Created by representatives from the development, farming, golf, tourism, and fishing industries, the plan represents a consensus of the best means needed to preserve the economic and ecological prosperity of the coastal bays in the next century. With help from local, state and federal planners and scientists, the strategies in this plan include reachable scientific goals and the most effective means for implementing them. An Implementation and Finance Plan shows how each strategy will be funded.

Grants of the Maryland Coastal Bays Program - Coastal Bays awards $130,000 for local projects School projects, boating safety, organic agriculture, breeding bird studies, wetland restoration highlight winners

Committees of the Maryland Coastal Bays Program - The Maryland Coastal Bays Program is extremely fortunate highly qualified and dedicated people serving on several committees working to help achieve the mission and goals of the foundation. These include committees on policy, implementation, science and technology, and a citizen's advisory committee.

Maryland Coastal Bays Program Initiatives - The following is a list of the people we work with and provide various educational initiatives for the benefit of the coastal bay community: Homeowners; Farmers/Foresters; Developers; Fishermen/boaters; Businesses.

Multi-Resolution Land Characteristics (MRLC)

The Multi-Resolution Land Characteristics (MRLC) Consortium is a group of federal agencies who first joined together in 1993 (MRLC 1992) to purchase Landsat 5 imagery for the conterminous U.S. and to develop a land cover dataset called the National Land Cover Dataset (NLCD 1992). In 1999, a second-generation MRLC consortium of nine federal agencies, including EPA, NOAA, and USGS, was formed to purchase three dates of Landsat 7 imagery for the entire United States (MRLC 2001) and to coordinate the production of a comprehensive land cover database for the nation called the National Land Cover Database (NLCD 2001).

National Wetlands Mitigation Action Plan

In response to independent critiques of the effectiveness of wetlands compensatory mitigation for authorized losses of wetlands and other waters under Section 404 of the Clean Water Act (CWA), the Environmental Protection Agency, the Army Corps of Engineers, and the Departments of Agriculture, Commerce, Interior, and Transportation released the National Wetlands Mitigation Action Plan on December 26, 2002. The Plan includes 17 tasks that the agencies will complete by the end of 2005 to improve the ecological performance and results of compensatory mitigation.

Reports published in 2001 by the National Academy of Sciences (NAS) and the General Accounting Office (GAO) provided a critical evaluation of the effectiveness of wetlands compensatory mitigation for authorized losses of wetlands and other waters under Section 404 of the CWA. Section 404 regulates discharges of dredged and fill materials into waters of the United States and requires compensatory mitigation for unavoidable impacts. The independent analyses and other commentaries highlighted a number of shortfalls and identified a variety of technical, programmatic, and policy recommendations for the Federal agencies, States, and other involved parties.
An interagency team drafted the National Mitigation Action Plan endorsing the goal of no net loss of wetlands and outlining specific action items that address the concerns of the NAS, GAO, and other independent evaluations. The 17 actions, with various agency leads, address areas of concern, including data collection and availability, clarifying performance standards, improving accountability, and integrating mitigation into the watershed approach.

Completing the actions in the Plan will enable the agencies and the public to make better decisions regarding where and how to restore, enhance, and protect wetlands; improve their ability to measure and evaluate the success of mitigation efforts; and expand the public's access to information on these wetland mitigation activities.

Stakeholder Forums - In 1999, the Federal agencies began hosting a series of stakeholder forums to gather information and opinions on the concerns and challenges of compensatory mitigation. These forums have brought together a diverse group of individuals representing the regulated community, environmental organizations, academia, non-governmental organizations, and mitigation providers. The first forum was held in Washington, DC, in 1999, to discuss draft guidance on in-lieu-fee mitigation. The second forum was held in Baltimore, Maryland, in 2001. This meeting helped lead to the formulation of the Action Plan. Additional forums were held in Portland, Oregon, in 2003, and Tampa, Florida, in 2004, to discuss progress on Action Plan tasks and solicit input on future Action Plan tasks.

Components of the National Wetlands Mitigation Action Plan - Completion of the first task in the Plan, release of a revised Army Corps of Engineers Mitigation Regulatory Guidance Letter (RGL 02-2) occurred concurrent with the Plan. The remaining 16 actions, which will be completed by the end of 2005, will address areas of concern including integrating mitigation into the watershed approach, improving accountability, clarifying performance standards, and improving data collection and availability. These actions are: Develop guidance on the use of on-site vs. off-site and in-kind vs. out-of-kind compensatory mitigation; Develop guidance on the use of vegetated buffers as a potential component of compensatory mitigation; Develop guidance on the appropriate use of preservation for compensatory mitigation; Using the guidance developed above, conduct an analysis with Tribes and States on the use of compensatory mitigation within a watershed context and identify criteria for making mitigation decisions in this context; Develop guidance that clarifies implementation of TEA-21 preference for mitigation banking; Continue to provide financial assistance through EPA's wetlands grants program to encourage Tribes, States and others to increase the success of mitigation in their jurisdictions; Develop guidance for those wetlands for which mitigation, restoration, or creation is not feasible or scientifically viable; Clarify considerations for mitigation impacts to streams in the Section 404 program; Develop a model mitigation plan checklist for permit applicants; Develop guidance adapting the National Research Council's recommended guidelines for creating or restoring self-sustaining wetlands to the Section 404 program; Analyze existing research to determine the effectiveness of using biological indicators and functional assessments for evaluating mitigation performance; Building upon the biological indicators and functional assessments research, develop performance standards guidance on monitoring and adaptive management of mitigation sites; Clarify key concepts related to performance standards; Compile and disseminate information regarding existing mitigation-tracking database systems; Building upon the analysis of existing mitigation database systems, develop a shared mitigation database, and; Utilizing the shared database, provide an annual public report card on compensatory mitigation to complement reporting of other wetland programs.

Landowner Incentive Programs and Partnership Opportunities to Implement the WDCP

The following table represents an example of Conservation Programs available to Private landowners; Partnership Opportunities to implement the WDCP in Maryland through USDA partner programs.

Table 4b.1. USDA Conservation Program Opportunities for Landowner Incentives.

Agency	Program	Description	Financial Assistance	Technical Assistance
Farm Service Agency (FSA), U.S. Dept. of Agriculture (USDA)	Conservation Reserve Program (CRP)	Voluntary program for farmers and ranchers to assist in compliance with environmental laws and regulations, establish vegetative cover on highly erodible cropland, improve water quality, establish wildlife habitat, and enhance wetlands and forests.	Yes	Yes
Natural Resources Conservation Service (NRCS), USDA	Agricultural Management Assistance (AMA)	Voluntary program that provides cost-share assistance to farms for watershed management or irrigation structures, tree planting for windbreaks or water quality improvement, soil erosion control measures, integrated pest management or conversion to organic farming.	Yes	
	Conservation Partnership Initiative (CPI)	Voluntary program that provides grants to states, communities, tribes, and NGOs for planning conservation projects in terrestrial and aquatic habitat, coastal resources, livestock nutrient management, and/or minor/specialty crop pest management.	Yes	Yes
	Conservation Security Program (CSP)	Voluntary conservation program that rewards farmers and ranchers in high priority watersheds (including the Scituate Reservoir and Pocasset watersheds) that maintain and enhance the highest standards of environmental stewardship on their lands.	Yes	Yes

Agency	Program	Description	Financial Assistance	Technical Assistance
	Environmental Quality Incentive Program (EQIP)	Voluntary program that provides cost sharing for agricultural improvements that will help meet water quality and other environmental objectives.	Yes	Yes
	Farm and Ranch Lands Protection Program (FRPP)	Voluntary program that provides matching funds to state, tribal or local governments, and non-governmental organizations to purchase development rights to maintain existing farms and/or ranches.	Yes	
	Farmland Protection Program	Voluntary program that provides matching funds to states, communities, tribes and nonprofit organizations for the purchase of conservation easements to protect productive farmland.	Yes	
	Grassland Reserve Program (GRP)	Voluntary program that allows landowners to protect, enhance or restore grasslands, pastures, shrublands, and ranges on their properties.	Yes	Yes
	Resource Conservation and Development (RC&D) Program	Localized program that assists state, tribal and local governments and NGOs in rural areas in conservation planning and management, sustainable development and quality of life improvements.	Yes	Yes

Agency	Program	Description	Financial Assistance	Technical Assistance
	Soil and Water Conservation Assistance (SWCA)	Voluntary program to provide cost-share incentives to farms and ranches for soil and water conservation measures, related natural resource conservation, and compliance with environmental laws and regulations.	Yes	
	Watershed Protection and Flood Prevention Program	Voluntary program that assists landowners and local organizations to develop and implement watershed plans, conduct river basin studies, flood hazard analyses, floodplain management practices, and water and land conservation measures.	Yes	Yes
	Watershed Surveys and Planning	Voluntary program that assists states, communities, tribes and others to survey and plan watershed protection, sediment and erosion control, water quality, flood prevention, fish and wildlife enhancement, wetland restoration and creation, and other water needs projects.	Yes	Yes
	Wetlands Reserve Program (WRP)	Voluntary conservation program that protects, enhances and restores wetlands and their wildlife resources on private lands.	Yes	Yes
	Wildlife Habitat Incentives Program (WHIP)	Voluntary program that assists landowners to create high quality aquatic, riparian, wetland and upland habitat areas that support wildlife populations of local, state, national or tribal significance.	Yes	Yes

Agency	Program	Description	Financial Assistance	Technical Assistance
U.S. Forest Service, USDA	Forest Inventory and Analysis Program	Tracks the status, distribution and health of forestland throughout the country.		Yes
	National Resources Inventory (NRI) Program	Monitors the status and trends of non-federal land use throughout the country.		Yes
	Stewardship Incentives Program (SIP)	Voluntary program that encourages private forest landowners to maintain productive and healthy forests.	Yes	Yes
	State and Private Forestry Programs	Assists private landowners, businesses, states, tribes and communities to sustain and manage forestlands, control invasive species, restore urban trees and greenspace, and manage the impacts of wildland fires on communities and the environment.	Yes	Yes

Appendix 5. Compilation of Existing Monitoring Plans and Programs

This appendix lists the relevant monitoring plans in Maryland that monitor GCN species, habitats or action parameters that may become part of Maryland's broad monitoring framework. This list represents many partner programs and an important implementation and coordination part of this WDCP effort to adaptively manage incorporate and communicate goals and data as each plan is revised and updated. Since monitoring will occur at the state, local, regional, national and international levels, it will require the establishment of this broad framework for monitoring at all of these levels. This will also allow partners to incorporate select components of this WDCP into their plans, as appropriate. This directly addresses **Element #5** as well as **Elements # 6 and #7**.

Although this list is fairly comprehensive, additional monitoring programs may exist and will be incorporated into this list when discovered and as appropriate. Also, this list of 196 programs includes different aspects of related projects or separate parts of the same multi-agency projects that are being conducted by a different implementation lead, usually at a more local level.

Summary of Existing Monitoring Actions

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Project Owlnet (no. saw-whet owl migration, band/release)	Project Owlnet	X		
Alliance Citizen Monitoring Program (water quality, nutrients; 135 stations)	Alliance for the Chesapeake Bay			X
American Chestnut Land Trust Water Quality Monitoring Program (2 stations on Parkers Creek, Calvert County)	American Chestnut Land Trust			X
The Water Quality Flagging Project (fecal coliform, 4 stations on Anacostia River)	Anacostia Watershed Society			X
Anne Arundel County Volunteer Water Quality Monitoring Program (streams and rivers in Anne Arundel County)	Anne Arundel County			X
Diamondback Terrapin Project (sightings, tag/release; Assateague Is.)	Assateague Coastal Trust	X		X
Assateague Coastkeeper (Coastal Bays health)	Assateague Coastal Trust			X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	**Guild**	**Habitat**
Audubon Naturalist Society Water Quality Monitoring Program (water quality, benthic macroinvertebrates)	Audubon Naturalist Society	X		X
Butterfly Counts	Washington Area Butterfly Club, N.A. Butterfly Assoc.	X		X
Christmas Bird Count	MOS & National Audubon Society	X		X
Bird Counts (Winter, Spring Migration, Breeding, Fall Migration)	MD Ornithological Society	X		X
Chesapeake Bay Monitoring Program: o Nutrients o Sediment o Toxicants o Plankton o Benthos o Finfish and shellfish o Bay grasses (SAV) o Freshwater flows o Water temperature o Salinity o Circulation o Oxygen	Chesapeake Bay Program	X	X	X
Non-Indigenous Aquatic Species Monitoring	Chesapeake Bay Program	X		X
Annual Chester River Watershed Snapshot (conditions at 80+ streams)	Chester Riverkeeper – Chester River Association			X
Water Treatment and Western Boundary Study Area Monitoring (ground-water, water quality, contaminants)	Dept. of Defense -- U.S. Army Aberdeen Proving Ground			X
Michaelsville Landfill Monitoring (groundwater, water quality, contaminants)	Dept. of Defense -- U.S. Army Aberdeen Proving Ground			X
Installation Restoration Program monitoring (groundwater, water quality, streams, contaminants)	Dept. of Defense -- U.S. Army Aberdeen Proving Ground			X
Air quality monitoring (prescribed burns, range fire emissions)	Dept. of Defense -- U.S. Army Aberdeen Proving Ground			X
Honeybee Biomonitoring Program	Dept. of Defense -- U.S. Army Aberdeen Proving Ground			X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Post Construction Survey Monitoring Program for J- Field Shoreline Protection Project (shoreline erosion)	Dept. of Defense -- U.S. Army Aberdeen Proving Ground			X
Threatened and Endangered Species Monitoring (Aberdeen Proving Ground, Adelphi Army Research Laboratory)	Dept. of Defense -- U.S. Army	X		X
Fort Meade Environmental Monitoring (groundwater, contaminants)	Dept. of Defense -- U.S. Army Environmental Center			X
Estuarine Water Quality and SAV Monitoring (Aberdeen Proving Ground; 40 stations)	Dept. of Defense -- U.S. Army Environmental Center	X		X
Wetland Restoration Monitoring near Town Branch, Monacacy River watershed (vegetation, macroinvertebrates, birds)	Ducks Unlimited	X		X
Environmental Monitoring and Assessment Program (EMAP) (coastal ecosystem health)	EPA		X	X
Multi-Resolution Land Characteristics (land cover)	EPA			X
National Water Quality Monitoring Day (water quality, macroinvertebrates; 3 stations on Sligo Creek, Montgomery Co.)	Friends of Sligo Creek	X		X
Water Monitoring Stream Teams (41 sections of Herring Run stream system)	Herring Run Watershed Association			X
Baltimore Ecosystem Study – Long-term Ecological Research (LTER) project	Institute of Ecosystem Studies, National Science Foundation, U.S. Forest Service, etc.	X	X	X
Stream Watch Program (benthic macroinvertebrates, water quality at 25-30 sites in Jones Falls watershed)	Jones Falls Watershed Association	X		X
The Magothy River Index (water quality, vital habitats)	Magothy River Association	X		X
Volunteer Water Quality monitoring in Coastal Bays	Maryland Coastal Bays Program			X
SAV Citizens Monitoring program in	Maryland Coastal	X		X

Monitoring Plans/ Programs	**Implementation Lead**	**Level of Monitoring**		
		Species	**Guild**	**Habitat**
Coastal Bays	Bays Program			
Dredged material monitoring program in Coastal Bays (physical and biological; MD DNR 1999)	Maryland Coastal Bays Program			X
Coastal Bays Comprehensive Monitoring Program (MD DNR 1999a)	Maryland Coastal Bays Program	X	X	X
Eutrophication Monitoring in Coastal Bays (MD DNR 1999a)	Maryland Coastal Bays Program	X	X	X
Pfiesteria Surveillance in Support of Maryland's Response to Toxic Outbreaks of *Pfiesteria* and Similar Dinoflagellates (8 Lower Eastern Shore rivers)	Maryland Coastal Bays Program	X	X	
Forest Pest Management program (Asian longhorned beetle, gypsy moth, et al.)	Maryland Dept. of Agriculture	X		
Plant Protection and Weed Management program (noxious weeds, plant pests, ginseng, sudden oak death)	Maryland Dept. of Agriculture	X		
Air Quality Monitoring (ozone, pollutants)	Maryland Dept. of the Environment			X
Septic System Monitoring program in Coastal Bays watershed (MD DNR 1999a)	Maryland Dept. of the Environment			X
Shellfish Harvest monitoring (water quality, disease, contaminants)	Maryland Dept. of the Environment	X	X	X
Wetland status and trends (LaBranche et al. 2003)	Maryland Dept. of the Environment			X
Wetland Mitigation Monitoring	Maryland Dept. of the Environment			X
Acid Mine Drainage Restoration monitoring (water quality)	Maryland Dept. of the Environment			X
American and Hickory Shad Restoration in Three MD Rivers	Maryland DNR	X		
Commercial Fishery Harvest Monitoring	Maryland DNR	X		
Recreational Fishery Harvest Monitoring	Maryland DNR	X		
Fall and Winter (Fish) Stock Assessment	Maryland DNR	X		
Finfish population monitoring in Coastal Bays	Maryland DNR	X	X	X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Maryland Biological Stream Survey (MBSS)	Maryland DNR	X	X	X
Stock Assessment of Selected Adult Resident and Migratory Finfish in Maryland's Chesapeake Bay	Maryland DNR	X		
Resident and Migratory Juvenile Finfish Recruitment Survey	Maryland DNR	X	X	
Assessment of Spring Recreational Finfish Harvest in the Choptank River	Maryland DNR	X	X	X
Investigation of Maryland's Atlantic Ocean and Coastal Bay Finfish Stocks	Maryland DNR	X	X	X
Investigation of Anadromous Alosids in Chesapeake Bay	Maryland DNR	X	X	
Fish Health/Disease Program (fishkills, bioassessments, immunological markers)	Maryland DNR	X		X
FISHMAP (Fishery Independent Sampling and Habitat Mapping)	Maryland DNR	X	X	X
Survey, Inventory, and Management of Maryland's Coldwater Fishery Resource (for 11 streams, 10 river basins)	Maryland DNR	X	X	X
Mattawomen Creek/Naval Ordnance Station Mercury Monitoring Study (bioaccumulation in bluegill, catfish, bass)	Maryland DNR	X		X
Maryland Anacostia River Basin Study (gamefish, stream barriers, benthos, water quality)	Maryland DNR	X	X	X
Fish Passage monitoring (fish)	Maryland DNR	X		X
Deer Management Program (population status and trends, white-tailed and sika deer)	Maryland DNR	X		
Mast survey (food supply for forest-dwelling fauna)	Maryland DNR			X
Maryland Bowhunter Survey (observations of 19 mammals, inc. Delmarva fox squirrel, in each county)	Maryland DNR	X		
Rare species monitoring (over 300 rare animals and many rare natural communities)	Maryland DNR	X	X	X
Nongame/Guild monitoring (e.g., colonial waterbirds, marshbirds, freshwater mussels)	Maryland DNR	X	X	X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Furbearer Management Program (furbearer species)	Maryland DNR	X		
Maryland Marsh Restoration and Nutria Control Project (nutria abundance and distribution)	Maryland DNR	X		
Chronic Wasting Disease Monitoring (deer)	Maryland DNR	X		
Marine Mammal and Sea Turtle Stranding Response program	Maryland DNR	X		
The Distribution and Status of the Hellbender in Maryland	Maryland DNR	X		
Eastern Tiger Salamander Study (distribution, population status)	Maryland DNR	X		
Midwinter Waterfowl Survey (Chesapeake Bay area)	Maryland DNR, USFWS	X	X	
Mute Swan Aerial Surveys (population status and trends in Chesapeake Bay)	Maryland DNR	X		
Status of the Bald Eagle in Maryland (mid-winter surveys, nesting productivity)	Maryland DNR, U.S. Army Aberdeen Proving Ground, USFWS	X		
Wild Turkey and Upland Game Bird Program (northern bobwhite populations)	Maryland DNR	X		
Maryland Breeding Bird Atlas Project 2002 – 2006	MD Ornithological Society, Maryland DNR, USGS BRD	X	X	
Spawning Horseshoe Crab Voluntary Monitoring program (MD DNR 1999b)	Maryland DNR, Maryland Coastal Bay Program	X		X
Fish and wildlife health and disease monitoring (finfish and mollusks in Ches. Bay)	Maryland DNR, National Ocean Service (Cooperative Oxford Laboratory)	X	X	X
Macroinvertebrate Study on Coldwater Tailrace Areas	Maryland DNR	X	X	X
Eyes on the Bay monitoring program (water quality in Chesapeake and Coastal Bays)	Maryland DNR			X
Chesapeake Bay Monitoring Program, Atmospheric Deposition Component	Maryland DNR			X
Maryland River Input and Mainbay Monitoring program (nutrients,	Maryland DNR			X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
sediments, freshwater flow on 4 rivers)				
Tidal Water and Habitat Quality Monitoring program (nutrients, DO, salinity, temperature, pH, algae abundance at 22 Ches. Bay and 55 tidal tributary stations)	Maryland DNR			X
Chesapeake Bay Monitoring Program, Zooplankton Component (12 Ches. Bay and tidal tributary stations)	Maryland DNR	X		X
Chesapeake Bay Monitoring Program, Nutrient Limitation Component (11 Ches. Bay and tidal tributary stations)	Maryland DNR			X
Chesapeake Bay Monitoring Program, Phytoplankton Component (12 Ches. Bay and tidal tributary stations)	Maryland DNR	X		X
Tidal Fish Community Indicators monitoring	Maryland DNR	X	X	X
Submerged Aquatic Vegetation Population Monitoring (Chesapeake and Coastal Bays)	Maryland DNR	X		X
Chesapeake Bay Monitoring Program, Ecosystem Processes Component (nutrient releases from sediments, water quality, chlorophyll, turbidity)	Maryland DNR			X
Chesapeake Bay Monitoring Program, Long-term Benthos Component (macroinvertebrate indicators at 27 fixed and 150 random Bay and tidal tributary stations)	Maryland DNR	X	X	X
Coastal Bays Water Quality Monitoring Program (physical and chemical properties, river inputs of sediments and nutrients, benthos, macroalgae)	Maryland DNR	X	X	X
Maryland Coastal Bays Volunteer Water Quality Monitoring Program	Maryland DNR	X		X
Continuous Monitoring (CONMON) Program (water quality at 34 estuarine stations)	Maryland DNR			X
National Coastal Assessment (aka Coastal 2000) (water quality, fish, benthos, sediment chemistry and toxicity)	Maryland DNR, EPA	X	X	X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Coastal LIDAR (high resolution elevation data)	Maryland DNR			X
Chesapeake Forest Project Monitoring (biodiversity, water quality, ecosystem health, Delmarva fox squirrel)	Maryland DNR	X		X
Invasive species monitoring (distribution and abundance of weeds, ballast water, non-native crabs, nutria, etc.)	Maryland DNR	X		
Special Rivers Project monitoring (riparian forest buffer success on 4 rivers)	Maryland DNR			X
Shoreline Change and Rate Monitoring	Maryland Geological Survey			X
Stream monitoring (Gunpowder, Gwynns Falls watersheds)	Maryland Save Our Streams	X	X	X
Great Herring Bay Stream and Shore Survey (sources of pollution)	Maryland Save Our Streams			X
Stream monitoring (aquatic invertebrates)	Maryland Stream Waders	X		X
Watershed water quality monitoring (14 citizen monitoring programs)	Maryland Water Monitoring Council			X
Stream Water Quality Monitoring (Montgomery and Prince Georges Counties)	Montgomery and Prince Georges County Stream Teams			X
Water quality monitoring (nutrients, chlorophyll, water clarity, fish, wildlife, habitat conditions; Nanticoke River)	Nanticoke Watershed Alliance	X		X
Bluebird Monitoring	Pickering Creek Audubon Center	X		X
Breton Bay Stream Sampling (macroinvertebrates, amphibians, crustaceans)	Potomac River Association	X		X
Maryland's Tributary Strategy Program (water quality for 10 watersheds in Ches. Bay watershed)	Tributary Teams (one for each of 10 watersheds)			X
LANDSAT Remote Sensing (land use/land cover)	NASA, U.S. Geological Survey			X
Chesapeake Bay Water Quality Monitoring	National Aquarium in Baltimore			X
Bird Source (national monitoring program)	National Audubon Society & Cornell		X	

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
	Lab of Ornithology			
Piping Plover Breeding Biology, Foraging Ecology and Behavior on Assateague Island NS	National Park Service	X		X
Marine species strandings at Assateague Island NS	National Park Service	X		
Tiger beetle distribution and abundance surveys, Assateague Island NS	National Park Service	X		
Feral horse population monitoring, Assateague Island NS	National Park Service	X		
Feral horse grazing effects monitoring, Assateague Island NS	National Park Service	X		X
Sika deer grazing effects monitoring, Assateague Island NS	National Park Service	X		X
Sika and white-tailed deer population and harvest monitoring, Assateague Island NS	National Park Service	X		
Mosquitoes and wildlife disease (EEE, WNV) monitoring, Assateague Island NS	National Park Service	X		
Vegetation change monitoring, North End of Assateague Island NS	National Park Service			X
Water quality monitoring in Coastal Bays	National Park Service			X
Bathing beach water quality, Assateague Island NS	National Park Service			X
Estuarine tides and water levels, Assateague Island NS	National Park Service			X
Bassett Creek streamflow monitoring (Assateague Island NS)	National Park Service			X
Meteorology monitoring at Assateague Island NS	National Park Service			X
Atmospheric deposition (rainfall and nitrogen) at Assateague Island NS	National Park Service			X
Assateague Island geomorphology (22 beach profiles, shoreline position)	National Park Service			X
Sea-level rise monitoring (Chesapeake Bay)	NOAA – National Geodetic Survey			X
NOAA Restoration Center Programs (oil spill and contaminant release response and restoration)	NOAA	X	X	X
Fisheries Statistics & Economics	NOAA-NMFS	X	X	

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
program (stock assessments, landings)				
National Estuarine Research Reserve System Wide Monitoring Program (water quality, weather, sediment, chlorophyll, SAV, land use)	NOAA – Chesapeake Bay National Estuarine Research Reserve			X
National Estuarine Research Reserve System Wide Monitoring Program (emergent vegetation)	NOAA – Chesapeake Bay National Estuarine Research Reserve	X		X
Fish Monitoring Program (Otter Point Creek)	Otter Point Creek – Anita C. Leight Estuary Center	X		X
Herpetology Monitoring Program (Otter Point Creek)	Otter Point Creek – Anita C. Leight Estuary Center	X		X
Water Quality Monitoring (Potomac River)	Potomac Riverkeeper			X
Operation Clearwater (microbial water quality monitoring, Severn River)	Severn River Association			X
South Riverkeeper (monitoring river condition)	South River Federation			X
State of the Beach monitoring program (8 indicators of coastal environmental health)	Surfrider Foundation			X
Volunteer Co-op Monitor Program (habitat condition)	The Nature Conservancy			X
Rare species monitoring (on TNC preserves)	The Nature Conservancy	X		X
Fish population surveys (Gunpowder, Potomac and Patuxent River watersheds)	Trout Unlimited	X		X
Stream water quality monitoring	Trout Unlimited			X
Poplar Island Restoration project monitoring (water quality, fish, wildlife, SAV, ichthyoplankton, etc.)	U.S. Army Corps of Engineers	X		X
Disposal Area Monitoring System (water quality, faunal surveys at offshore disposal sites)	U.S. Army Corps of Engineers			X
National Resources Inventory (NRI) (land use, wetlands distribution and abundance)	USDA Natural Resources Conservation Service			X
Forest Inventory Analysis (forest distribution and abundance)	USDA U.S. Forest Service			X
Nutria population monitoring at	USFWS –	X		

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Blackwater NWR	Blackwater NWR			
Waterfowl population monitoring	USFWS Blackwater NWR	X	X	X
Tundra swan migration monitoring (satellite tracking)	USFWS Eastern Neck NWR	X		
Wildlife monitoring at Eastern Neck NWR (waterfowl, songbirds, deer)	USFWS Eastern Neck NWR	X	X	X
Wildlife monitoring at Patuxent Research Refuge (deer, waterbirds, reptiles, amphibians, harvested species)	USFWS Patuxent Research Refuge	X	X	X
Bird nesting productivity monitoring	USFWS Patuxent Research Refuge	X		
National Wetlands Inventory Program (wetland abundance and distribution)	USFWS			X
Biomonitoring of Environmental Status and Trends (BEST) Program (measure and assess ecological impacts of contaminants)	USGS Patuxent Wildlife Research Center	X	X	X
Bird Banding Laboratory (banding and recovery monitoring, U.S. and Canada)	USGS Patuxent Wildlife Research Center	X	X	
Breeding Bird Survey (U.S. and Canada)	USGS Patuxent Wildlife Research Center	X	X	
North American Amphibian Monitoring Program (vocal amphibian populations)	USGS Patuxent Wildlife Research Center	X	X	
Northeast Amphibian Research and Monitoring Initiative (on DOI lands in Northeast)	USGS Patuxent Wildlife Research Center	X	X	X
Comprehensive Monitoring Program for Colonial Waterbirds	USGS Patuxent Wildlife Research Center	X	X	
Grassland Birds of North America, Distribution and Trends of Breeding and Wintering Populations	USGS Patuxent Wildlife Research Center	X	X	
Atlantic Seaduck Study: Movements, Habitat Use, and Feeding Ecology of Seaducks in Chesapeake Bay and Other Atlantic Coastal Areas (satellite tracking)	USGS Patuxent Wildlife Research Center	X	X	X
NPS Vital Signs Monitoring Program (water quality, nutrients, SAV at	USGS Patuxent Wildlife Research	X		X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
National Parks)	Center			
Impact Of (Tree) Harvest On Delmarva Fox Squirrels (monitor impacts of clearcut)	USGS Patuxent Wildlife Research Center	X		
Assessing The Relative Habitat Value Of Restored Versus Natural Coastal Marshes And Islands To Migratory Birds In Chesapeake Bay (nesting waterbirds)	USGS Patuxent Wildlife Research Center	X	X	X
Evaluation of Conservation Practices (Including Buffer Strips, Mowing, Fire Management, and Soil Amendments) in Agricultural Fields to Provide Optimum Habitat for Wildlife Diversity (wildlife use at 3 sites on Patuxent Research Refuge)	USGS Patuxent Wildlife Research Center	X		X
Assessing Nutria Impacts on Marsh Loss and the Impact of Control and Eradication Efforts on Marsh Conservation and Restoration (Blackwater NWR)	USGS Patuxent Wildlife Research Center	X		X
Canvasback population, mortality and life history in Chesapeake Bay	USGS Patuxent Wildlife Research Center	X		X
Predicting the Persistence of Coastal Wetlands to Global Change Effects (sea-level rise, wetland response at Blackwater NWR)	USGS Patuxent Wildlife Research Center			X
West Nile Virus Surveillance	USGS, MD Dept. of Health and Mental Hygiene	X		
Pesticides in Surface Water of the Mid-Atlantic Region (water quality in 463 streams regionally)	USGS			X
Chesapeake Bay River Input Monitoring Program	USGS			X
Chesapeake Bay Ecosystem Program (water quality, DO, nutrients, sediment loads)	USGS			X
National Water Quality Assessment (NAWQA) Program (fish, water quality in 21 MD basins)	USGS			X
Appalachian Clean Streams Initiative (acid mine drainage)	USGS			X

Monitoring Plans/ Programs	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
LIDAR Topographic Surveys, Assateague Island	USGS, National Park Service			X
USGS-NPS Vegetation Mapping Program (at Assateague Island National Seashore)	USGS, National Park Service			X
Chesapeake Bay Remote Sensing Program (chlorophyll)	University of Maryland Center for Environmental Science, Maryland SeaGrant		X	X
Tundra Swan Trax Study (migration tracking, habitat use, survival rates)	Virginia Dept. of Game and Inland Fisheries, Maryland DNR	X		X
Submerged Aquatic Vegetation (SAV) Surveys (distribution and abundance in Ches. Bay)	Virginia Institute of Marine Sciences			X
Beach Water Quality Sampling Program	Worcester County			X
Golf Course Voluntary Water Quality Monitoring in Worcester County (groundwater, surface water; MD DNR 1999a)	Worcester County			X

Appendix 6a. WDCP Development Plan and Process Schedule

This appendix depicts the WDCP process and the project flow chart of major steps identified in this two-year effort. It outlines the tasks and stages of Maryland's WDCP process and lists the timeframe for completion and the key parties leading and/ or involved with each stage (**Elements #5, #6, and #7**). Timeframes are presented in quarterly intervals of the calendar year, and represent actual completion schedule of tasks. The ten-year, anticipated implementation and revision schedule is presented annually.

TIMELINE	2004 Quarters				2005 Quarters			Implementation
TASKS	**1st**	**2nd**	**3rd**	**4th**	**1**	**2nd**	**3rd**	**2006-2015**
Planning (Project development and research)	X							
Project planning and scoping	X							
Planning Meetings- Agency and stakeholders	X							
Develop communication/outreach materials/ plan	X							
Research/ inventory programs, plans, data, maps	X	X	X					X
Contact staff, stakeholders, public	X	X	X	X	X	X	X	X
Plan Development (8 key elements)								
ID species / habitats of Greatest Conservation Need								X
Research and Compile data (kt compile existing) GCN list- GT sent categories, get staff input- LD draft list, send to staff for additions- Feb draft/send habitat/sp assoc to staff-Feb Staff assign habitat associations- March Staff Refine April- prepare workshop-kt	X	X						Assess and update
Engage DNR staff, other public agencies and stakeholders, experts, TWW- workshop	X	GCN Habitat	X		X	Threats Actions	X	Review assessment
Review and refine lists (staff)		X	X	X	X			X Update
Engage broader public as appropriate		X	X	X	X			X Update
ID Conservation Actions for each species/habitat								
Research and Compile existing data (kt and staff)	X	X	X					X Update
Engage agency staff and stakeholders- workshops		begin	X	X	X			X Update
Review and refine lists (staff)		begin	X	X	X			X Update

TIMELINE	**2004 Quarters**				**2005 Quarters**			**Implementation**
Engage broader public as appropriate		begin	X	X	X			X Update
Develop monitoring/evaluation strategy		X	X	X	X			X Update
Develop maps and supporting materials				X	X	X		X Update
Write Plan								
Outline and Format (kt draft for staff approval)		X	X					
Draft Plan kt with staff assistance				X	X	X	X	2013-2015
Review					X	X	X	2014-2015
Final Plan Submitted							X	2015

Appendix 6b. List of Contacted Partner and Stakeholder Groups

This appendix lists Maryland's partner and stakeholder groups that were contacted in the development of this WDCP and that will continue to be contacted with updates during its implementation and revision. These groups received email, mail, phone or meeting requests for information and input on the development and implementation of Maryland's WDCP (**Elements #7 and #8**). They were invited to attend the workshops held to incorporate their input on GCN species, key wildlife habitats, and threat and conservation action development. They were also notified of web page updates.

- 1000 Friends of Maryland
- Aberdeen Proving Ground Superfund Citizens Coalition, Inc.
- Aberdeen Proving Ground Volunteers for Improvement of Natural and Cultural Resources
- Accokeek Foundation
- Adkins Arboretum
- Adopt-a-Watershed
- Alice Ferguson Foundation
- Allegany College of Maryland
- Alliance for Community Education
- Alliance for Sustainable Communities
- Alliance for the Chesapeake Bay
- American Bat Conservation Society
- American Chestnut Land Trust
- American Fisheries Society
- American Forests
- American Rivers
- American Water Resources Association
- American Whitewater
- Anacostia Community Boathouse Association
- Anacostia Congress Heights Partnership
- Anacostia Floodplain Restoration Alliance
- Anacostia River Business Coalition
- Anacostia Riverkeeper
- Anacostia Watershed Restoration Committee (AWRC)
- Anacostia Watershed Society
- Annapolis Conservancy Board
- Anne Arundel County Volunteer Water Quality Monitoring Program
- Anne Arundel Waterway Restoration Alliance
- Appalachian Trail Conference Land Trust
- Assateague Coastal Trust
- Atkins Arboretum
- Audubon Naturalist Society
- Back River Neck Peninsula Community Association
- Baltimore Environmental Center
- Baltimore Walks - The Gwynns Falls Trail

- Beaver Creek Watershed Association
- Being in Place - Alliance for Sustainable Communities
- BioTrek Naturalist, Inc.
- Brandywine North Keys Citizens Association
- Broad Creek Conservancy
- C & O Canal Association
- Calvert Marine Museum Society
- Cambridge South Dorchester Middle School
- Canoe Cruisers Association
- Cape St. John Civic Association
- Carroll County Land Trust
- Carrollton Manor Land Trust
- Catoctin Land Trust
- Center for A New American Dream
- Center for Chesapeake Communities
- Center for Low Impact Development
- Center for the Environment, Commerce and Energy
- Center for Urban Ecology
- Center for Watershed Protection
- Central Maryland Heritage League
- Charles County Community College
- Chesapeake Appreciation, Inc.
- Chesapeake Association of Environmental Professionals
- Chesapeake Audubon Society
- Chesapeake Bay Acid Rain Foundation
- Chesapeake Bay Commission
- Chesapeake Bay Critical Area Commission
- Chesapeake Bay Environmental Center
- Chesapeake Bay Foundation
- Chesapeake Bay Foundation, Inc.
- Chesapeake Bay Program
- Chesapeake Bay String of Pearls Project
- Chesapeake Bay Trust
- Chesapeake Coastal Creeks Association
- Chesapeake Wetland Center at Horsehead
- Chesapeake Wildlife Heritage
- Chester River Association
- Chester Riverkeeper
- Chestertown Wildlife Exhibition and Sale
- Citizens Concerned for a Cleaner Prince George's County
- Citizens for the Preservation of Queenstown Creek
- Citizens for the Protection of Washington County
- Citizens to Conserve and Restore Indian Creek
- Citizens to Save South Valley Park and Whetstone Run
- Clean Water Action
- Clean Water Fund

- Coastal States Organization
- College Park Committee for a Better Environment (CBE)
- Committee on the Environment
- Community and Environmental Defense Services
- Community Commons
- Community Forestry Network
- CONCERN, Inc.
- Conservancy for Charles County
- Conservation Federation of Maryland
- Croom Citizens Association
- Deer Creek Scenic River Advisory Council
- Deer Creek Watershed Association
- Defenders of Wildlife
- Delta Waterfowl
- Dorchester County Resource Preservation & Development Corp.
- Dorchester County Soil Conservation District
- Dorchester MD Cooperative Extension
- Ducks Unlimited
- Eastern Neck Wildlife Refuge
- Eastern Shore Land Conservancy
- Echo Hill Outdoor School
- Environmental Advisory Committee (EAC)
- Environmental Concern
- Environmental Defense
- Evitts Creek Environmental Learning Center
- Eyes of Paint Branch
- Fair Hill Nature Center
- Fallston High School
- Farmers and Hunters Feeding the Hungry
- Fishing Creek Watershed Association (MD)
- Frederick County Trails
- Friends of Annapolis Creeks
- Friends of Blackwater National Wildlife Refuge
- Friends of Carroll County Streams
- Friends of Gwynns Falls/Leakin Park
- Friends of Jug Bay
- Friends of Kensington Hills Branch
- Friends of Mattawoman Creek
- Friends of Maydale
- Friends of Mount Aventine, Inc.
- Friends of Northwest Branch
- Friends of Saint Leonard Creek
- Friends of Sligo Creek
- Friends of the Annapolis' Creeks
- Friends of the Indian Creek Watershed
- Friends of the Lake

- Friends of the Nanticoke River
- Friends of the Potomac
- Friends of the Upper Choptank River
- Future Harvest - CASA, University of Maryland
- George's Creek Watershed Association
- Greater Baltimore Canoe Club
- Greater Bear Creek Watershed Association
- Greater Patapsco Community Association
- Gunpowder Valley Conservancy
- Gunpowder Watershed Coalition
- Gwynns Falls Watershed Association
- Harford Land Trust
- Herring Bay
- Herring Run Watershed Association
- Hood College
- Horn Point Environmental Lab Water Monitoring
- Horsehead Wetlands Center
- Howard County Conservancy
- Hunting Creek Watershed Management Task Force
- Hyattsville Organization for a Positive Environment
- Institute for Conservation Leadership
- Interstate Commission on the Potomac River Basin
- Interstate Commission on the Potomac River Basin (ICPRB)
- Irvine Natural Science Center
- Irvine Nature Center
- Isaac Walton League
- Jones Falls Watershed Association
- Jug Bay Wetlands Sanctuary
- Kensington Land Trust
- Kent Conservation
- Lake Linganore Association
- Lake Linganore Conservation Society
- Land Trust International
- Little Elk Creek Agricultural Preserve
- Living Classrooms Foundation
- Long Green Valley Conservancy
- Low Impact Development Center
- Lower Eastern Shore Heritage Committee
- Lower Shore Land Trust
- Lower Susquehanna Heritage Greenway
- Magothy River Association
- Magothy River Land Trust
- Marine Fish Conservation Network
- Marshy Hope Creek Greenway
- Maryland Bowhunters Association
- Maryland Conservation Council

- Maryland Deer Hunters Association
- Maryland Division Isaac Walton League
- Maryland Environmental Trust
- Maryland Farm Bureau
- Maryland Fly Anglers, Inc.
- Maryland Forests Association
- Maryland Herpetological Society
- Maryland League of Conservation Voters
- Maryland Legislative Sportsmen Caucus
- Maryland Mountain Trust
- Maryland Native Plant Society
- Maryland Natural History Society
- Maryland Ornithological Society
- Maryland Public Broadcasting Foundation, Inc.
- Maryland Save Our Streams
- Maryland Sportsman's Association
- Maryland Wetlands Restoration Steering Committee
- Mason-Dixon Canoe Cruisers, Inc.
- Mattaponi Basin Citizen's Association
- Mid-Maryland Land Trust Association
- Mid-Maryland Rural Legacy Association
- Monocacy Basin Stream Monitoring Project
- Monocacy Canoe Club
- Monocacy Scenic River Advisory Board
- Monocacy Watershed Conservancy
- Montgomery County Agricultural Center
- Montgomery County Stream Teams
- Montgomery Sycamore Island Club
- Mount Washington Preservation Trust
- Nanjemoy Creek Environmental Education Center
- Nanjemoy-Potomac Environmental Coalition, Inc.
- Nanticoke Watershed Alliance
- Nassawango Creek Preserve Stewardship Committee
- National Aquarium in Baltimore-Conservation Education
- National Audubon Society – MD/DC Office
- National Audubon Society - Chesapeake Chapter
- National Fish and Wildlife Foundation
- National Parks and Conservation Association
- National Wild Turkey Federation
- National Wildlife Federation
- Natural Resources Defense Council
- New Columbia Audubon Society
- New Forest Society
- Northeast Midwest Institute
- Otter Point Creek Alliance
- Owings Mills Green Action

- Oyster Recovery Partnership
- Parks and People Foundation
- Pasadena Sportfishing
- Patapsco River Conservation Association
- Patapsco Riverkeeper
- Patapsco/Back River Tributary Strategy Team
- Patuxent River Commission
- Patuxent Sierra Club
- Patuxent Tidewater Land Trust
- Pheasants Forever
- Pickering Creek Environmental Center
- Pocomoke River Alliance
- Port Tobacco River Conservancy
- Potomac Conservancy
- Potomac River Association
- Potomac River Greenways Coalition, Inc.
- Potomac River Paddlers
- Potomac River Waterfowlers Association
- Potomac Riverkeeper
- Potomac Trail Council
- Potomac Watershed Partnership
- Potomac-Patuxent Chapter Trout Unlimited
- Prince Georges Audubon Society
- Prince George's County Stream Teams
- Quail Unlimited
- Queen Anne's Conservation Association
- River Federation
- Ruffed Grouse Society
- Salisbury Zoological Park
- Save Our Streams
- Sawmill Creek Recovery Team
- Scenic Rivers Land Trust
- Severn River Association
- Severn River Land Trust, Inc.
- Severn Riverkeeper
- Sierra Club
- Sierra Club Montgomery County Group
- Sierra Club, Potomac Chapter
- Smallwood Village Association
- Smithsonian Environmental Research Center
- Society of Natural History of Delaware
- Somerset County MD Cooperative Extension Service
- Somerset County Soil Conservation District
- Somerset County Tourism
- South Cecil County Committee and Watershed Association
- South County Conservation Trust/Exchange

- South County Exchange
- South River Federation
- Southeast Watershed Forum
- Spa Creek Conservancy
- St. Mary's Friends of the Chesapeake
- St. Mary's River Watershed Project
- St. Mary's Scenic River Advisory Board
- Stream Watch
- Takoma Park Green Team
- Talbot River Protection Association
- Teaming with Wildlife Coalition
- The Conservation Fund
- The Nature Conservancy – MD/DC Field Office
- The Wilderness Society
- The Wildlife Society
- Thorpewood Foundation
- Town Creek Watershed Landowners' Association
- Trout Unlimited
- University of Maryland, Center for Environmental Science
- Upper Chesapeake Watershed Association
- USNPS National Chapter Region Conservation Data Center
- Washington Rowing Association
- Watershed Protection Coalition, Inc
- Weems Creek Conservancy
- Whitehall Bay Institute
- Wicomico County Department of Recreation, Parks and Tourism
- Wicomico County MD Cooperative Extension Service
- Wicomico Scenic River Commission
- Wildfowl Trust of North America
- Wildlife Conservation Society
- Wildlife Habitat Enhancement Council
- Women and Environmental Solution
- Worcester County Citizen's Coalition
- Worcester County MD Cooperative Extension Service
- Worcester County Soil Conservation District
- Worcester County Tourism
- Worcester Environmental Trust
- World Wildlife Fund

Appendix 6c. Coordination with Federal, State and Local Agencies and Indian Tribes during WDCP development

This Appendix summarizes the coordination process used throughout the WDCP development process to inform and involve its partners (**Element #7**). The Department of Natural Resources, Natural Heritage Program (NHP), took the lead in coordinating Maryland's WDCP, beginning its planning process in the summer of 2003 as information on the SWG and WCRP requirements and guidelines became available. Due to severe budget and personnel restrictions, NHP secured the services of a contractor, Terwilliger Consulting Inc. (TCI), involved in and familiar with the process at the state, regional and federal level.

Natural Heritage Program staff and TCI attended the IAFWA/USFWS Federal Aid Training Workshop at the National Conservation Training Center (NCTC) in West Virginia, and additional workshops for Region 5 states in Delaware in August 2003, for Region 4 states in GA in July 2004, the 50-state Coordination meeting in TX in January 2004 and the "One Year Out" meeting in Nebraska in August 2004. These meetings not only allowed states to share their progress and plan status, but also allowed for additional input and guidance from the National Advisory Acceptance Team and others. The consultant gave presentations about Maryland's process and plan status at each of these meetings.

A **WDCP Development Team** was formed with key DNR Natural Heritage Program and Maryland Biological Stream Survey staff. This committee met with TCI to compile existing resources and develop the initial timeline and framework for the development of the plan. A series of organizational and input solicitation meetings were held to involve first senior staff and then all division staff. The effort to obtain input was then expanded to the other divisions and units within the Department of Natural Resources through a series of emails, personal contacts, and meetings. Additional meetings with each division upon request were held to identify species of GCN, key habitats, threats and conservation actions.

A general scope of work was developed to guide the effort, identifying key tasks to be accomplished. The IAFWA and its committees, throughout the planning process, provided specific guidance. With this guidance in mind, and with the input of a broadening circle of stakeholders and conservation community, Maryland designed its WDCP development approach, providing for general and technical input throughout the process (Appendix 6a).

In addition, the effort quickly expanded with outreach to major research and conservation entities within the state. Stakeholders (See Appendix 6b), and more specifically the MD TWW Coalition was actively engaged in the WDCP process.

This WDCP process attempted to utilize and integrate existing Federal, State and local agency and Tribal programs that significantly affect wildlife conservation in Maryland. Representatives from each tribe and agency were identified and contacted for their input. These stakeholders and collaborators were invited to actively participate in the process. Federal partners include, but are not limited to, the U.S. Fish and Wildlife Service (Chesapeake Bay Field Office, National Wildlife Refuge Offices, Fishery Resources Office, and Federal Aid); U.S. Geological Survey; National Park Service; Natural Resources

Conservation Service; U.S. Environmental Protection Agency; U.S. Department of Agriculture; National Oceanic and Atmospheric Administration; and the Department of Defense. MD DNR's partner agencies at the state level include, but are not limited to, Department of the Environment, Department of Agriculture, Department of Planning, Department of Transportation (SHA), University of MD, and major state universities. Partners at the local government level include the planning and zoning agencies within each of Maryland's 23 counties, as well as Baltimore City.

There are no federally recognized Indian tribes in Maryland today. Non-recognized Indian tribes and communities include the Piscataway-Conoy Confederacy in La Plata, Maryland, and the American Indian Cultural Center of Cedarville Band in Waldorf, Maryland. They were contacted and invited to participate in the WDCP process.

Contact early in the process focused on informing and engaging these collaborators in the WDCP process, as well as inventorying their existing programs (See Appendices 4b & 5). An assortment of outreach techniques were used to maximize coordinated input, including surveys, personal contact and correspondence, meetings and presentations. Relevant target species, habitats and conservation actions from their existing programs were captured, compiled and integrated into the WDCP process. Follow-up correspondence kept them informed of WDCP progress and solicited their additional input and feedback at each major phase of the process. Further contact/ presentations solicited input as GCN species, key habitats, threats and potential conservation actions were identified during the process. Information on existing programs was discussed during the process to identify opportunities for collaboration/partnership in the implementation, evaluative review, and adaptive modification of the WDCP.

The DNR WHS will continue to take the lead in monitoring the progress as the WDCP is implemented (see Chapter 5) and in sharing this information with all the Agency and Tribal representatives involved in the development of the plan.

Appendix 6d. Public Participation Process

During the development phase of the WDCP, the WDCP Committee and contractor (TCI) worked to actively involve the public at different levels and during different stages of the process (**Elements #7 and #8**). Information on each major public and private (NGO) program was researched. This resulted in an inventory of all significant existing local, state, and regional/national programs, data sources, tools and information compiled from meetings, correspondence, and research from literature and the internet. This pool of knowledge was then used as the foundation for public outreach strategies. For the purposes of this WDCP effort, the "public" was categorized into 3 external tiers:

Tier 1- partners/collaborators with significant role/ program

?? Key private (NGO) conservation groups, such as TNC, Audubon, PIF, etc.
?? Leaders/staff/programs can contribute significant data/scientific knowledge base to be incorporated directly into WDCP
?? Leaders/staff/programs can collaborate on implementation, monitoring and assessment/re-evaluation of Plan

Tier 2- interested groups and individuals with limited role/program

?? Many smaller or localized NGO's, such as small private preserves, watershed groups, or local advocacy groups
?? Staff/members have limited/no data/scientific knowledge base that is directly applicable to the WDCP but have a potential role in advocacy/outreach/general input into the development and future implementation of Plan

Tier 3- General Public

?? Citizens not directly involved in a Tier 2 group project
?? Able to benefit from the development and implementation of the plan as related to economic, recreational and quality of life benefits from effective state-wide Wildlife Conservation

Tier 1 and many Tier 2 individuals and groups were contacted for input throughout the WDCP process. Regular correspondence and sharing of technical information was critical to assist in the development of the WDCP. Workshops and individual feedback provided “peer review” and refinement during the processes of identifying GCN species and key habitats with their associated vegetative communities, of evaluating the most critical problems and threats to species and their habitats, and of selecting and prioritizing conservation actions that will be effective. Use of various programs’ existing target species/habitats and recommended conservation strategies was significant in providing input into WDCP development. Tier 3 individuals and groups were informed about the WDCP process and goals. They were kept informed of on-going progress through information posted on the web, articles, and press releases.

Further input was solicited from individuals and groups after DNR staff had sufficiently developed the document to a “Draft” product stage, ready for external review by those interested. Drafts were posted on the web with comment response forms. For example, Maryland's draft GCN species and key wildlife habitats were posted in November, 2004 and its draft threats and conservation actions in May 2005 for pubic and stakeholder comment. Input was also solicited from over 300 Tier 1 and Tier 2 groups (Appendix 6b) at 2 workshops: June 26, 2004 at the national Wildlife Visitor Center in Laurel, Maryland focused on selection of GCN species and key habitats, and July 23, 2005 at Howard Community College in Columbia, Maryland focused on habitat threats and conservation actions. This outreach process included presentations to these groups and surveys to request feedback and review of the draft product. Participants completed survey/score sheets during the workshops and additional input was received via web responses. The results from these workshops were summarized and shared on the web, providing participants and general public with documentation about how their comments and input were incorporated into the document. This WDCP process was designed to include the continued input from public stakeholders at all 3 Tiers and will keep the public informed of SWG projects and results through annual reports, articles, and web site progress reports.

Citizen Participation by Objective (CPO) Worksheet Results identified the following specific actions/messages and techniques as most effective for SWG WDCP. Potentially Affected Interests (PAIs)

	CPO TECHNIQUES:
OBJECTIVE	**1B** = Open Meetings; **1C** = Forum
Bleiker #	**2B** = Content-type Advice-Giving Advisory Committee
	16A = Use Existing Clubs, Groups Organizations; **16B** Use their newsletters
	16C = Use Existing School Systems and Institutions
	38B = Create and Maintain Electronic Bulletin Board; **38C** = website
#1	**1** Create detailed Null Alternative that is simple and concise and convince *PAIs of its importance/seriousness
	8 Get PAIs consent that you and our organization are the right entity for the job
	9 Convince PAIs that it will increase quality of life for some/many PAIs
	12 Inform PAIs of history, mandate, legitimacy of agency/program
	21 Get PAIs to agree on legitimacy of your office
#3	**1** Clearly document/diagram PS/DM process
	17 Do this on a regular basis – keep them updated
	5 Get internal (agency) # of PAIs to buy into/agree to implement project
	6 Design process to include PS/DM to develop informed consent
	9 Get PAIs to feel that the process is fair and proper
#4	**3 C** Insure Plan gets implemented
	5 Address problems/issues of funding – who makes decisions, potential land-use impacts/protection up front (before they do)

	8 Make process more specific to deal with and counter and problems identified
#6	**1 B** Review, expand and update PAIs list, identify secondary and tertiary PAIs
	7 Convince PAIs you are listening, care and understand ; and are addressing their concerns
#9	**7** Create and maintain simple catalog of issues/problems and solutions
	4 Develop and communicate a grabbing, clear null alternative
#13	**1** Identify other PAIs with whom we need contact
	2 Keep PAIs informed and informed of other PAI's comments
	3 Develop plan to contact PAIs on regular basis
	5 Communicate other PAI's comments
	6 Seek out and follow up on PAIs who are silent when they have input you want
	6 Maintain contact list of PAIs who have dropped communication
	11 Create website that will address these concerns

*PAI= Potentially Affected Interest

Appendix 6e. Public Input Plan

This appendix summarizes the input plan that was designed for use in Maryland's WDCP process to contact Maryland's stakeholders and public (**Elements #7 and #8**). The input plan identified three different tiers of stakeholders and developed appropriate messages, methods, and objectives for each group. The Bleiker Citizen Participation by Objective (CPO) and Systematic Development of Informed Consent (SDIC) techniques and programs were used to develop this plan and they were consulted for follow up during this process in order to develop the most effective methods for outreach to the many "publics" or PAIs (Bleiker and Bleiker 2000, http://www.consentbuilding.com/).

MD's Public Input Plan **Bleiker CPO/SDIC worksheet results:** **Contact Method / Type of Promotion**	**Tier 1 Stakeholders –** TWW, DNR, Fed/State Partners, Collaborators **Goal: Consult and Collaborate**	**Tier 2 Stakeholders –** Interested but limited investment **Goal: Inform and Involve**	**Tier 3 - General Public** **Goal: Inform**	**Target Date – Regular Updates** **Development through Revision and Implementation**
Direct mail / email (use Bleiker LP and messages for CPO) Fact sheets / program materials	Email, mail 4/04 Intro 12/04 - BLP and species / habitat list	Email, mail 4/04 Intro 12/04 – BLP and species / habitat list	X	Minimum every two months but each concrete step (Same as website – see below)
Follow up informal meeting	Follow up meetings (TWW, TNC, EPA 6) 10/04			
Direct mail / email Brochures / flyers	Email, mail 4/04	Email, mail 4/04	X	Initial mailing, then distribute at meetings and presentations throughout 04-05

MD's Public Input Plan **Bleiker CPO/SDIC worksheet results:** **Contact Method / Type of Promotion**	**Tier 1 Stakeholders –** TWW, DNR, Fed/State Partners, Collaborators **Goal: Consult and Collaborate**	**Tier 2 Stakeholders –** Interested but limited investment **Goal: Inform and Involve**	**Tier 3 - General Public** **Goal: Inform**	**Target Date – Regular Updates** **Development through Revision and Implementation**
Website – Updated quarterly Phase 1 – Introductory material Phase 2 – GCN species and habitat info Phase 3 – Conservation Actions and Threats Phase 4 – Conservation Actions Draft Phase 5 – Draft Plan update Phase 6 – final plan announcement Annual Updates from Reviews and Assessments during Implementation 2006-2013 WDCP development process repeats 2013-2015	Intro Draft species / habitats – 12/04	X	X	April – Intro materials July – GCN info and solicit – 7/04 draft Update 12/04 January – Conservation actions – solicit input Jan 05 – Conservation actions draft April – June 05 – Draft plan September 05 – Final Plan Updates and assessments yearly through implementation Revision- begin entire process over with annual input/modifications
Planning meetings DNR agency internal memos Inreach TWW meetings / correspondence	X			Meeting – every month Monthly updates Monthly emails & as needed
Newsletters – put in organization's newsletters	X 10/04 MOS 12/04 – 1/05	X	X	Quarterly to every 6 months
Attend NGO / partner meetings and provide updates / get input			X	As requested

MD's Public Input Plan **Bleiker CPO/SDIC worksheet results:** **Contact Method / Type of Promotion**	**Tier 1 Stakeholders –** TWW, DNR, Fed/State Partners, Collaborators **Goal: Consult and Collaborate**	**Tier 2 Stakeholders –** Interested but limited investment **Goal: Inform and Involve**	**Tier 3 - General Public** **Goal: Inform**	**Target Date – Regular Updates** **Development through Revision and Implementation**
Magazine articles – DNR or state conservation organizations	X	X	X	Quarterly to every 6 months
Public relations: press releases – as appropriate – and reader-friendly articles	Quarterly X	X	X	Quarterly with website updates
Workshop / open space	June – GCN; July - Conservation Actions	X	X	2 for Tier 1, possible invited to Tier 2
DNR staff and TWW staff briefing / report at all meetings possible	Distribute brochures and updates	Distribute brochures and updates	Distribute brochures and updates	All meetings possible Develop schedule and list Minimum monthly
Presentations to Tier 2 and Tier 3 groups – go to their meetings / events				As requested