



# Chapter 7

## Conservation Actions





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## Introduction

This chapter discusses conservation actions, which are the measures taken to conserve, protect, and manage Species of Greatest Conservation Need (SGCN) and their key wildlife habitats. The SWAP represents an opportunity to reverse declining population trends for numerous SGCN. These actions are intended to eliminate, minimize, and/or mitigate the threats addressed in Chapters 5 and 6 (**Element #3**). Over 1,000 conservation actions have been developed in Maryland’s State Wildlife Action Plan (SWAP) for key wildlife habitats and species. Maryland Department of Natural Resources (MD DNR), together with many of its partners (see Chapter 9), developed and prioritized these conservation actions through a series of workshops. Both priority and non-priority conservation actions can be found at the end of Chapter 7 and in Chapter 7 Appendices. These appendices are laid out in tabular format so that MD DNR and partners may efficiently find specific threats and conservation actions cross-referenced to SGCN or key wildlife habitats.

This chapter first discusses how conservation actions were prioritized based on seven criteria. Following the explanation of these criteria is an overview of regional conservation actions and the organization of Maryland conservation actions, including a discussion of how threats were addressed in the action development process. Overarching statewide conservation actions are listed in Table 7.3, followed by a narrative discussion of important and applicable conservation action categories used in the Maryland SWAP (Plan). These conservation action categories are as follows: 1) land and water acquisition and protection; 2) law and policy; 3) direct management of natural resources; 4) planning and administration; 5) data collection and analysis – inventory, monitoring, and research; 6) education, outreach, and technical assistance; and 7) climate change adaptation strategies.

Conservation actions are developed to allow flexibility to adapt to emerging issues and information, but with enough specificity to measure performance and engage partner work (AFWA 2012). The National Best Practices for State Wildlife Action Plans Report identified a “need for more specificity with regard to on-the-ground actions,” (AFWA 2012). Maryland’s conservation actions span a wide range of conservation effort categories as listed above. For instance, ‘data collection and analysis – inventory, monitoring, and research’ represents priority conservation actions for many SGCN. Although not traditionally portrayed as actions, these needs must be met when available information for habitats and species is insufficient to develop specific actions within more typical conservation actions categories. Data collection and analysis may also be needed for the development of monitoring plans and models of natural systems (conceptual diagrams) in order to practice adaptive management (discussed in Chapter 8). Use and dissemination of these prioritized conservation actions will allow for their incorporation into land use decisions and key conservation efforts across the state, as well as at regional and county levels. More information about coordination and implementation of Maryland’s SWAP is found in Chapter 9.

Maryland’s 2005 Wildlife Diversity Conservation Plan (WDCP) was used as the starting point for developing conservation actions in the 2015 revision. Actions from the 2005 WDCP were reviewed and evaluated for outdated information: this evaluation was also an opportunity for a first glance at what actions needed to be added for the revision. By incorporating existing population assessments and conservation plans into the development of the SWAP, MD DNR and its conservation partners have the opportunity to implement conservation actions that will have positive effects on population levels, as well as to coordinate at the regional level for far-ranging species. Numerous conservation plans and programs were researched and reviewed in developing revised and new actions for Maryland’s 2015



Plan. These plans and data sources can be found in Appendix 9a and in the Online Resources supplementary document.

All wildlife species and their habitats are impacted by land use decisions on public and private lands; therefore, protecting and managing these resources can only be successful when multiple organizations in addition to MD DNR are involved. Possible partners in carrying out conservation actions include other state and federal agencies, non-governmental organizations, academic institutions, tribes, municipalities, and private landowners. To ensure that conservation actions are realistic and comprehensive, many of these groups were invited to provide input throughout the SWAP revision process. Day-long taxa workshops were a key component in collaborating with partners and arranging avenues for them to provide input into the SWAP. Six workshop days were held for major SGCN taxa groups: mammals, birds, herpetofauna, fish, insects, and freshwater mussels. These workshops provided partners the opportunity to develop and prioritize conservation actions for the MD SWAP. More information on the process for working with partners to prioritize conservation actions for SWAP can be found in Chapter 9. Scientific names for SGCN are included in Appendices 1a and 1b. Scientific names for other species are included in the text of the chapter.

### **Prioritizing Conservation Actions**

A recommended best practice for SWAPs is to prioritize actions using a decision theory approach that considers species and habitat vulnerabilities as well as factors that support the likelihood of an action being implemented, such as cost, feasibility, and likelihood of success (AFWA 2012). Recognizing that implementation of conservation actions often depends on funding, resources, manpower, and partnerships are an important step in prioritization. Prioritizing is a must for this reason, and due to two additional realities, as follows: 1) Maryland is a state of high biodiversity, meaning there are hundreds of species and habitats to protect, and 2) funding for conservation actions is limited, and, in the case of State Wildlife Grants, has undergone a steady decrease over the last decade.

Each revised action (from 2005) and newly developed action (2015) was prioritized by considering seven criteria: urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support. These criteria were recommended by the Northeast Lexicon (Crisfield & NEFWDTC 2013) and minor revisions were made for Maryland's SWAP. The prioritization process focused on identifying priorities for implementation rather than for some other goal. Table 7.1 summarizes how each of these criteria was ranked for every conservation action to determine that action's overall prioritization status. Further explanation and details of this process and other factors to consider when analyzing these seven criteria can be found in Appendix 7a. MD DNR and its partners did not identify priority actions through a quantifiable method, but subjectively, by considering all of these criteria in the implementation of the action itself.



**Table 7.1 Prioritization criteria for Maryland’s conservation actions**

Conservation Action Prioritization Criteria	High	Medium	Low
<b>Urgency</b>	Initiate immediately, within 2 years	Initiate within 2-5 years (2017-2020)	Initiate within 5-10 years (2020-2025) or can wait 10 years to initiate
<b>Cost</b>	Relatively expensive (>\$500,000)	Moderately costly (\$50,000-\$500,000)	Relatively inexpensive (<\$50,000)
<b>Chance of Success</b>	Achievable/certain or very likely: 90-100% (demonstrated by other projects)	Somewhat likely or uncertain: 30-90% (e.g., Best Management Practice or sufficient information available)	Highly uncertain/unlikely/unknown: <30% (not tested/implemented anywhere)
<b>Benefit</b>	Highly beneficial	Moderately beneficial	Unclear benefits
<b>Collateral Benefit (to other species/habitat)</b>	Highly beneficial to other species/habitat	Moderately beneficial to other species/habitat	Unclear benefits to other species/habitat
<b>Feasibility/Likelihood of Implementation</b>	Feasible/Certain/Very Likely: 90-100%	Moderately difficult/Likely: 30-90%	Difficult/Unlikely/Unknown: <30%
<b>Public Support</b>	Very important/well supported	Moderately important/somewhat supported	Less important, much outreach

Conservation actions are listed in sufficient detail to guide the development and execution of specific projects and programs to implement those actions. The process for identifying performance measures for priority actions is explained in Chapter 8. If available information is insufficient to describe needed conservation actions, the Plan lists the identified inventory, monitoring, and research needed so that specific conservation actions can be developed.

### Regional Actions

The close proximity of many northeastern states has engendered a culture of cooperative and/or complementary management approaches amongst the region’s fish and wildlife agencies. The Northeast Association of Fish and Wildlife Agencies traditionally has supported a strong technical committee structure to further wildlife conservation. Technical committees are species- or habitat-focused groups that exchange ideas and develop common approaches to wildlife issues. Typically, these conservation actions are implemented by individual states using their own funds; in some cases, however, additional funding has been made available through the directors of state fish and wildlife agencies in the Northeast (Terwilliger Consulting, Inc. & Northeast Fish and Wildlife Diversity Technical Committee 2013).

These funds have been organized into the Regional Conservation Needs (RCN) program, which is the main conduit for funding projects of regional interest in the Northeast. The [RCN Program](#) formalizes a cooperative approach to address SGCN needs across multiple states. The purposes of the RCN program





are to develop, coordinate, and implement conservation actions that are regional/sub-regional in scope, and to build upon the many regional initiatives that already exist. The RCN program continues to provide information and support conservation actions and management that help to protect SGCN and their habitats. The RCN program utilizes a funding mechanism that is equitable to all Northeast states and the District of Columbia, creating a base of funding for regional projects. Since 2007, 37 different projects have been selected to receive RCN grants (Terwilliger Consulting, Inc. & Northeast Fish and Wildlife Diversity Technical Committee 2013).

Upon the completion of State Wildlife Action Plans for all of the northeastern states, the RCN program will be used to support the development and implementation of conservation actions for issues, threats, and opportunities that may be most effectively addressed at a regional/multi-state scale. This task will be accomplished with the input and involvement of multiple parties involved in the creation and implementation of the State Wildlife Action Plans. To measure the success of this effort, the number of conservation actions/research projects selected and completed and the number of articles, publications, and technical reports developed each year as a result of funded projects will be compiled. Maryland will support this regional conservation action by participating in the RCN program.

To address priority conservation actions related to broad-scale threats and for species that range widely, working with regional partners will be critical to the success of Maryland's SWAP. Additional opportunities to contribute to regional conservation actions result from Maryland's participation in formalized region-wide partnerships, such as Northeast Partners in Reptile and Amphibian Conservation, Atlantic Coast and Appalachian Mountains Joint Ventures, and North Atlantic and Appalachian Landscape Conservation Cooperatives. Working with local partners that are part of organizations that cross state boundaries, such as The Nature Conservancy and the National Audubon Society, also provides opportunities to carry out regional, national, and international conservation actions that address Maryland SWAP priorities at the appropriate scale.

## Organization of Conservation Actions

### Addressing Threats through Conservation Actions

To more efficiently enable conservation organizations across the state to identify and carry out conservation actions effectively, a major change was made for the 2015 SWAP revision as compared to the 2005 Plan. The conservation actions in the 2015 MD SWAP are organized by specific IUCN threat categories (see Chapter 5, Appendix 5a). This benefits conservation partners in that they will be able to strategically address specific threats by directing actions to them as outlined in the Plan, both for species taxa groups and key wildlife habitats. Tabular lists of conservation actions and threats can be found at the end of this chapter and in the Appendices for Chapter 7. For more information on processes for partner implementation of conservation actions, please see Chapter 9.

### The Organization of Conservation Actions at Different Scales

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 to maintain and/or improve species and habitat health and diversity in Maryland. Conservation actions are grouped into categories to facilitate use and implementation by partners. To facilitate implementation processes, potential key partners at the local, state, regional, and national levels were also identified for



conservation actions. MD DNR staff as well as various partners and stakeholders were asked to provide input to determine priority conservation actions, according to effectiveness of actions in addressing specific threats for the species and their habitats. Staff and stakeholders were given opportunities to provide input through meetings and workshops, and by review of draft materials published online.

In this chapter, information on conservation actions is organized as follows:

- 1) Overarching conservation actions are listed that apply to species and habitats across Maryland. Next, statewide actions, ranging from broad to narrow in scale, are discussed in further detail, including examples.
- 2) Priority and non-priority conservation actions specific to the 59 key wildlife habitats found in Chapter 4 are presented, and organized by the five main habitat categories: Upland, Wetland, Aquatic, Subterranean, and Other Habitats. Charts of key wildlife habitats are listed in this section to remind the reader which habitats are listed under which main categories.
- 3) Priority and non-priority conservation actions are listed by species taxa groups and individual species. These include categories for mammals, birds, reptiles and amphibians, fish, insects, crayfish, and freshwater mussels.

MD DNR and conservation partners identified over 1,000 conservation actions. Over 500 of these actions are directed towards key wildlife habitats and over 575 are directed at Species of Greatest Conservation Need. Although actions are organized into three categories as described above, they overlap in numerous cases and many may benefit conservation for multiple species and habitats. Both priority and non-priority conservation actions can be found at the end of Chapter 7 and in Chapter 7 Appendices.

### **Statewide or Overarching Conservation Actions**

During the process of identifying conservation actions for SGCN 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 (Table 7.2). This set of broad conservation actions best addresses the primary issues and threats previously identified in Chapter 5. For example, 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 of all SGCN across habitats. This new information will also provide data for the identified need of Geographic Information Systems (GIS) mapping and database management capacity that is so critical for monitoring and adaptive review of conservation strategies.

Historical approaches to natural resource protection and management have not yet provided a set of solutions that consistently stems resource losses and successfully reverses them. To succeed in improving conditions for SGCN and their habitats, government, businesses, conservation partners, and citizens all need to play a sustained role in their respective spheres of influence. With this SWAP, a new approach is being taken, with these guiding principles for overall actions:



- Using systems thinking to address problems. Threats will be considered not as individual issues but part of a connected whole. One benefit of this approach is that social, cultural and economic problems will be included and the solutions will have multiple and enduring benefits for each realm. As part of the systems approach, opportunities to fully tie biodiversity restoration and protection in with existing programs will be sought out.
- Addressing the sources of threats to biodiversity before fixing the symptoms, with an increased focus on prevention as an integral part of efficient stewardship.
- Adopting simple and less expensive solutions that can be implemented at a broad scale to maximize benefits, wherever possible.
- Focusing on connections between habitats in the face of a changing climate to increase the likelihood that species are able to move to new suitable habitat.
- Emphasizing work with private landowners and citizens using social marketing techniques to engage them to protect and help restore biodiversity.
- Developing a shared vision for success by including a broad set of stakeholders. This broader inclusion will increase the chances that a collective vision will be broadly embraced and meet the goals of a diverse public.

These actions can inform MD DNR and partners to better identify and address emerging threats over the next decade.

**Table 7.2 Overarching statewide conservation actions**

Conservation Action Category	IUCN Category	Conservation Action
Land and Water Acquisition and Protection	1 – 4 Land Conversion (Development, Agriculture, Energy, Roads & Service Corridors)	Develop a core network of protected wildlife diversity conservation lands to capture the full array of Maryland’s wildlife species and habitats.
	1 – 4 Land Conversion (Development, Agriculture, Energy, Roads & Service Corridors)	Develop mechanisms to ensure adequate connectivity of important wildlife diversity conservation sites.
	1 – 4 Land Conversion (Development, Agriculture, Energy, Roads & Service Corridors)	Utilize acquisition and easement programs to conserve high quality key wildlife habitat.
Law and Policy	15.3 Coordination / Admin Needs	Adequately apply and enforce existing laws, regulations, and ordinances to protect SGCN and key wildlife habitats.
	15.3 Coordination / Admin Needs	Establish effective laws, regulations, and ordinances at the local, state, and federal levels to conserve wildlife diversity.
Direct Management of Natural Resources	7 Natural Systems Modifications	Restore natural processes and hydrological function to key wildlife habitats in a landscape context.



Conservation Action Category	IUCN Category	Conservation Action
	8 Invasive and other Problematic Species, Genes, and Diseases	Develop and implement invasive species (including pathogens) management programs to reduce or prevent impacts to SGCN and key wildlife habitats.
	15.3 Coordination / Admin Needs	Fully implement existing recovery plans for threatened and endangered species and species of conservation concern.
Planning and Administration	12.2 Management Decision Needs	Update the BioNet GIS layer, which identifies the most important sites throughout the State for wildlife diversity conservation.
	12.2 Management Decision Needs	Incorporate wildlife diversity conservation at the local land use planning level.
	12.2 Management Decision Needs	Utilize existing environmental regulatory programs at the state, local, and federal levels to conserve key wildlife habitats and SGCN.
	12.2 Management Decision Needs	Work with private landowners and public land managers to assist with appropriate management for key wildlife habitats and SGCN.
	12.2 Management Decision Needs	Develop conservation implementation plans for priority targeted SGCN, key wildlife habitats, and/or sub-watersheds.
	12.2 Management Decision Needs	Continue development of Maryland’s Natural Areas system to ensure the best remaining SGCN populations and habitats are recognized and conserved.
	15.3 Coordination / Admin Needs	Secure adequate funding at the state, federal, local, and private levels to implement this State Wildlife Action Plan, including developing mechanisms for wildlife diversity users to help fund this Plan.
	15.3 Coordination / Admin Needs	Collaborate with Chesapeake Bay conservation initiatives to incorporate wildlife diversity conservation into efforts to “save the bay.”
	15.3 Coordination / Admin Needs	Collaborate with partners and appropriate industries to implement this State Wildlife Action Plan.
	15.3 Coordination / Admin Needs	Coordinate conservation actions at local, regional, and national levels.
Data Collection and Analysis – Inventory, Monitoring, and Research	12.1 Resource Information Collection Needs	Update Maryland’s natural community classification as needed to incorporate edits to regional and national standards, and map locations of priority natural communities using GIS technology.
	12.1 Resource Information Collection Needs	Continue to develop programs and implement strategies to monitor key wildlife habitats, priority SGCN, and the effectiveness of conservation actions in an adaptive management framework.
	15.1 Infrastructure Needs	Gather, maintain, and disseminate appropriate data, including GIS data layers, on species of concern and key wildlife habitats.



Conservation Action Category	IUCN Category	Conservation Action
Education, Outreach, and Technical Assistance	13.3 Utilization Needs	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.
	14.2 Education Needs	Train staff, partners, and land managers in state-of-the-art wildlife diversity conservation science, techniques, and philosophy.
	14.2 Education Needs	Conduct regular workshops with MD DNR partners and stakeholders to exchange information on SGCN and key wildlife habitat status and conservation efforts.
	14.2 Education Needs	Develop a knowledgeable citizenry that actively participates in wildlife and habitat conservation.
	14.3 Outreach Needs	Enlist the support of elected officials at the state, local, and federal levels.
	14.3 Outreach Needs	Utilize public outreach tools such as social media to increase awareness of the value of wildlife diversity conservation and to garner public support for such.
	15.3 Coordination / Admin Needs	Develop and utilize incentives for private landowners to conserve key wildlife habitats and SGCN on their lands.
Climate Change Adaptation	11 Climate Change and Severe Weather	Work with local governments, private citizens, and public land managers to develop and implement adaptation strategies that address climate change impacts in the context of other stressors.
	11 Climate Change and Severe Weather	Enhance integration and coordination of observation systems to improve the detection of biological responses to climate change and sea level rise.

**Conservation Actions Summarized by Category**

Many of these high priority overarching conservation actions are strategies and activities that are already being accomplished at various scales by MD DNR and its numerous partners. However, this SWAP 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. The following section provides a general discussion of the seven conservation action categories used in the Maryland SWAP (Table 7.3). Following this general narrative, as discussed previously, are all **priority** key wildlife habitat actions and **priority** species actions.



**Table 7.3 Statewide conservation action categories**

Conservation Action Category	Examples
Land and Water Acquisition and Protection	<ul style="list-style-type: none"> <li>• Conservation area designation</li> <li>• Land acquisition and easements</li> <li>• Wildlife management areas</li> <li>• Private lands agreement</li> </ul>
Law and Policy	<ul style="list-style-type: none"> <li>• Law enforcement &amp; legal protection</li> <li>• Changes in government policy, legislation</li> </ul>
Direct Management of Natural Resources	<ul style="list-style-type: none"> <li>• Create new habitat</li> <li>• Restore natural ecological processes</li> <li>• Invasive species control</li> <li>• Population management</li> <li>• Working with landowners</li> <li>• Water and/or vegetation management</li> <li>• Dam and barrier removal</li> <li>• Fire management</li> <li>• Grazing/farm management</li> <li>• Native species reintroduction &amp; restoration</li> </ul>
Planning and Administration	<ul style="list-style-type: none"> <li>• Species and habitat planning, including integration with other plans</li> <li>• Environmental review</li> <li>• Agency administrative support</li> <li>• Program/project administration support</li> <li>• Coordination with partners</li> <li>• Regional and local land use planning and coordination</li> </ul>
Data Collection and Analysis – Inventory, Monitoring, and Research	<ul style="list-style-type: none"> <li>• Research, survey, inventory, and/or monitoring of wildlife populations/ habitats</li> <li>• Database development and management</li> <li>• Information systems operations and maintenance</li> </ul>
Education, Outreach, and Technical Assistance	<ul style="list-style-type: none"> <li>• Partner/stakeholder engagement</li> <li>• Student training</li> <li>• Technical assistance</li> <li>• Educator/instructor training</li> <li>• Support facilities and classrooms</li> <li>• Areas for public access</li> </ul>
Climate Change Adaptation	<ul style="list-style-type: none"> <li>• Develop and refine predictive models for climate change impacts to species/habitats</li> <li>• Identify and protect wetland migration corridors</li> </ul>



## Land and Water Acquisition and Protection

Protecting SGCN and their habitats through land and water acquisition is an important means of conserving these species over the long-term in Maryland. This action can be used to protect critical habitat threatened by development and other disturbances. Land protection is identified as a priority conservation action in every key wildlife habitat and species taxon list and was emphasized as such in the conservation partner workshops for the 2015 revision; this was also identified as a priority in the 2005 WDCP, where the continuation of land protection and acquisition was emphasized. Luckily, every municipality, agency, land trust, and citizen can contribute to conserving Maryland's wildlife through this action category as land protection comes in all spatial scales, from statewide landscapes to small backyard wildlife habitats.

A history of Maryland land conservation will briefly be discussed to provide background information for the programs, management, and tools used in land protection today. Following is an overview of current land conservation systems and programs in Maryland and a description of how future lands for conservation are identified.

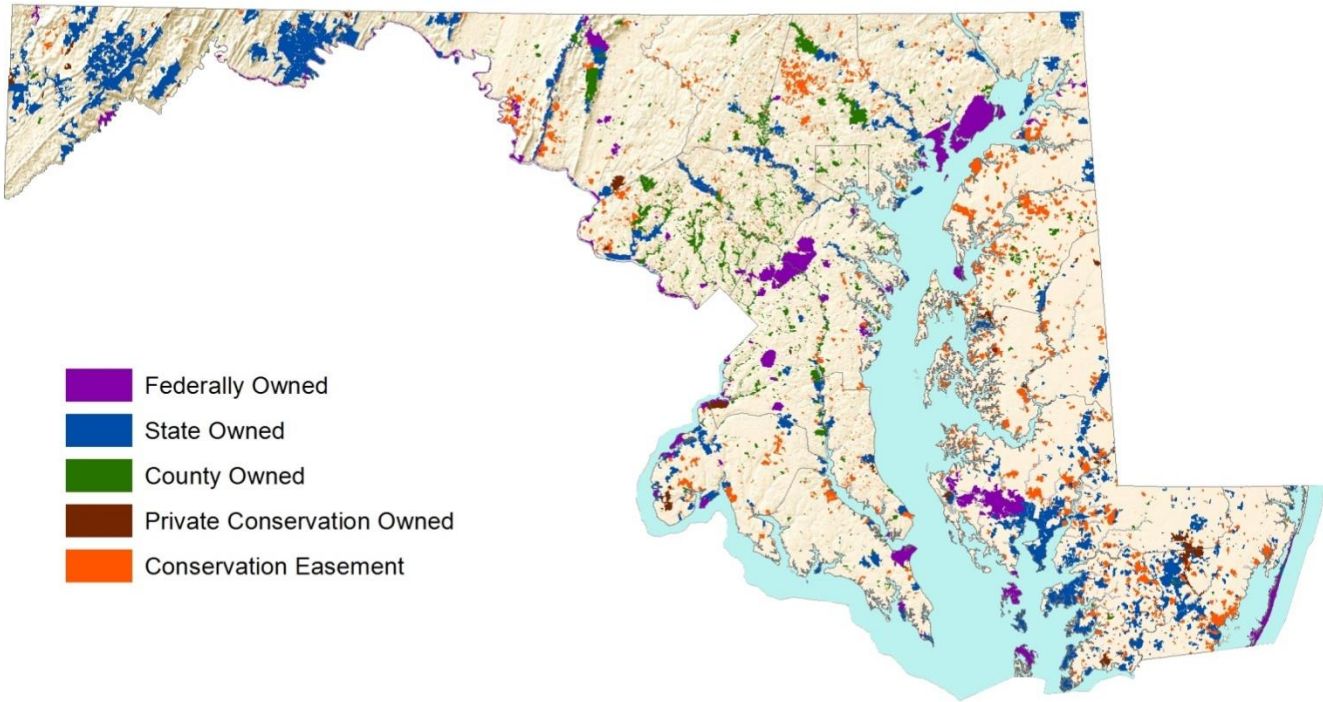
### History of Maryland Land Conservation

Maryland has one of the nation's oldest natural resources conservation programs, which began with the establishment of the State Oyster Police (which expanded later to become MD DNR's Natural Resources Police) in 1868. The concept of conserving natural resources for nature's sake became widespread in the United States in the 19<sup>th</sup> century, as popular media and culture spurred a nationwide conservation movement. The United States established the world's first national park with the creation of Yellowstone National Park in 1872, and Maryland followed as one of the first states to conserve public lands at the state level.

Maryland's public lands system began with the creation of the Potomac Reserve, known today as Garrett State Forest. In 1906, John and Robert Garrett donated nearly 2,000 acres of land in Garrett County on the condition that Maryland would establish a forestry program in the state. The state legislature responded by signing Maryland's first forestry law that year, making Maryland the third state in the Nation, after Pennsylvania and Wisconsin, to establish a statewide forestry program. The new law established a Board of Forestry to oversee the forest conservation program, which was initially based solely on land donations, and mandated the hiring of a state forester. Maryland's first state forester, Fred W. Besley, who served from 1906-1942, opened the forest reserves to the public to advertise the new forestry program, hired forest wardens and other staff to monitor the new state lands, and established additional state forests and parks. The first state purchase of parklands occurred in 1912, when Patapsco Valley State Park, the first 43 acres of which were donated as a forest reserve in 1907, was expanded with purchased tracts, and Fort Frederick State Park was added to the public lands system (MD DNR 2006).

Encouraged by public appreciation and use of conserved outdoor spaces, in 1969 MD DNR established Program Open Space, a state transfer tax fund that made possible the addition of tens of thousands of new acres to Maryland's public land system. Today MD DNR oversees over 480,000 acres of land throughout the state, with 224 sites managed for natural, historical, cultural, and recreational resources and for Maryland's citizens to enjoy (Figure 7.1) (MD DNR 2015).





**Figure 7.1 Protected land in Maryland.** Sources: MD DNR, MDP.

Other agencies and conservation organizations also purchase, protect, and manage Maryland’s lands. In 1927, the state legislature established the Maryland-National Capital Park and Planning Commission as a bi-county agency to oversee a regional park system within Montgomery and Prince George’s Counties. Currently, the Commission administers over 52,000 acres of regional parks, stream valley parks, and smaller neighborhood parks and recreation areas. Large federal properties include Blackwater National Wildlife Refuge, established in 1933, and the Chesapeake and Ohio Canal National Historical Park, established first as a National Monument in 1961 and converted to its current designation 10 years later. Federal military bases, such as Aberdeen Proving Ground in Harford County, Patuxent River Naval Air Station in St. Mary’s County, and Indian Head Naval Surface Warfare Center in Charles County provide excellent wildlife habitat on less-intensively used portions of their properties. Private conservation organizations, such as The Nature Conservancy, the Chesapeake Bay Foundation, and state and local chapters of the National Audubon Society also play an important, direct role in purchasing and managing remaining natural areas and properties critical to wildlife conservation.

In addition 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, Rural Legacy Program, and Forest Legacy Program, and through working directly with landowners to provide technical guidance on managing fish and wildlife habitats. Conservation easements, held by the Maryland Environmental Trust or one of the 20 local land trusts operating in Maryland, also protect private lands from development.





*Case Study: Maryland's Conservation Reserve Enhancement Program (CREP)*

The Chesapeake Bay watershed encompasses 64,000 square miles. This enormous land area drains into local rivers and streams which eventually flow into the Bay. Maryland contains more than 8,800 miles of freshwater streams (Boward et al. 1999), which flow through forests, agricultural lands, residential areas, and cities to reach their destination in the Chesapeake Bay. Runoff, or the water washed from land into waterways through rainfall, can present major problems for the Bay because these waters may carry high levels of pollutants from non-point sources into Maryland's aquatic resources. Agricultural lands can add substantial amounts of nutrients and sediments to local rivers and streams if not properly managed. Maryland's Conservation Reserve Enhancement Program (CREP), a component of the Conservation Reserve Program (CRP) and partnership between state agencies and the United States Department of Agriculture (USDA), aims to combat this issue by providing incentives for conservation actions to increase wildlife habitat, reduce erosion, and improve water quality on ecologically significant cropland and pastureland adjacent to water.

The USDA oversees a very important component of the U.S. economy through the USDA Farm Bill, a regularly reviewed, comprehensive, omnibus bill. This bill, the latest installment of which is the Agricultural Act of 2014, includes legislation addressing every facet of agriculture in the U.S., including food and nutrition programs, rural development, conservation, farming practices, farm credit, agricultural research, marketing, etc. Title II of the Farm Bill provides guidance and funding for conservation programs that directly affect terrestrial and aquatic habitats as well as Species of Greatest Conservation Need (SGCN) included in the 2015 Maryland SWAP.

Voluntary conservation-related programs are important tools for conservation success in Maryland, especially given the prevalence of privately owned agricultural lands in Maryland's landscape. These private landowners play a crucial role in keeping waterways clean and reducing negative impacts of agriculture through conservation programs. The USDA Farm Service Agency (FSA) oversees a number of voluntary private-lands conservation programs, the largest of which is the Conservation Reserve Program (CRP). Since it was signed into law in 1985, CRP offers yearly rental payments to farmers who agree to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as cultivated or native bunchgrasses and grasslands, wildlife and pollinators food and shelter plantings, windbreak and shade trees, filter and buffer strips, grassed waterways, and riparian buffers.

In 1997, Maryland became the first state to establish an agreement with FSA for implementing CREP. Maryland's CREP is overseen by a partnership of several state and federal agencies, including MD DNR, and provides monetary incentives for private land conservation of select lands highlighted by state agencies that have high conservation values. Private landowners who qualify contract with USDA to receive annual rental payments through the Commodity Credit Corporation (CCC) for taking land out of production for a period of 10 to 15 years and installing and maintaining specified conservation practices. Landowners can often receive partial reimbursement for installation costs, such as for riparian forest or vegetative buffer plantings, and can receive additional funds for agreeing to maintain the conservation practices permanently.

Maryland CREP's goal is to enroll 100,000 acres in the program: 77,000 acres of riparian buffers; 16,000 acres of highly erodible lands; 5,000 wetland acres; and 2,000 acres of rare and declining species habitat. Enrollment for rare and declining species habitat is currently far short of the desired result. Conservation efforts in the rare and declining habitat category [Conservation Practice 25 (CP25)] aim to



restore and maintain lands which are recognized as critically endangered or threatened ecosystems; namely, shallow emergent freshwater seepage wetlands, riverine systems supporting declining species, grassland-nesting bird habitat, Delmarva Bay habitat, streams supporting eastern brook trout, and forest interior dwelling species (FIDS) habitat. For CP25, lands not eligible for private conservation incentives under other practices, but eligible as a rare habitat, may receive funding in order to conserve rare, threatened, or endangered species living in the habitat.

A recent example of how CP25 is supporting SGCN birds can be found in Cecil County, where a private landowner enrolled 27.5 acres as habitat for grassland birds. This new habitat was adjacent to over 200 acres of cool season grasses that were planted under a different CREP program. Four years after the new planting of native warm season grasses and wildflowers, this property is supporting four SGCN grassland nesters, including at least five pairs of dickcissels. The success of the CP25 practice on this property has encouraged two nearby landowners to put similar practices into play on their farms, creating a much-improved landscape for grassland birds in this area.



*Dickcissel* (Sean McCandless)

In order to receive financial incentives for land conservation, landowners must contact the local FSA to determine eligibility of their land. The [Natural Resources Conservation Service](#) (NRCS) conducts site surveys, completes a conservation plan for the area, and obtains Conservation District approval of the plan. The landowner is responsible for implementing the plan, with planning assistance available from MD DNR. Additional reimbursement funds may be available through the Maryland Agricultural Water Quality Cost Share (MACS) Program. This extensive partnership has a current enrollment of approximately 65,000 acres in CREP, financially benefiting landowners and benefiting through conservation Maryland’s lands, waterways and SGCN.

Today approximately 23% of Maryland’s land is currently protected in conservation ownership through conservation organizations, municipalities, fee ownership by natural resource agencies, or permanent or long-term easements on private lands (Table 7.4). Maryland is recognized as a national leader in land preservation, parks, and recreation: over 862,000 acres are preserved by easement, which allows working landscapes like farms and forestry businesses to prosper; and another 726,000 acres are protected through public ownership, offering Marylanders an opportunity to enjoy nature, hike, fish, and hunt (Table 7.4). These 1.6 million acres also provide valuable “ecological services”: protecting the water supply, cleaning the air, filtering stormwater runoff, and providing habitat for wildlife in addition to having a significant economic impact for both the state and local jurisdictions (Maryland Department of Budget and Management et al. 2015).



*Case Study: Furnace Tract Land Acquisition Critical for Persistence of SGCN*

The Furnace Tract is a recent acquisition by MD DNR that previously had a conservation easement and was owned by a private forestry company. The state purchased the property to ensure the long-term viability of two rare species, a rare plant and a globally rare butterfly. Both of these rare species do not persist in areas overgrown by woody plant species. In order to allow these species to complete their life cycles, active management is needed. Deer herbivory is also a major issue at Furnace Tract and the construction of a temporary electric fence is undertaken annually by Natural Heritage Program (NHP) staff and volunteers. The fence is erected in the spring and taken down in the mid-summer. Woody plant management is conducted, as needed, by NHP staff and volunteers. These efforts have led to a dramatic increase in both of the target species on the Furnace Tract.

**Table 7.4 Protected lands in Maryland.** Source: Maryland Department of Budget and Management et al. 2015.

Protection Programs		
Program	Acres Protected	Date Last Updated
Conservation Reserve Enhancement Program (CREP) <sup>1</sup>	8,658	8/10/2015
MD DNR Lands	480,995	8/24/2015
Federal Lands – Non-military	86,797	11/13/2007
Forest Legacy	1,622	1/18/2012
GreenPrint	24,138	6/30/2010
Land Conservancy	47,604	11/19/2007
Local Park	147,137	2/2/2010
Maryland Agricultural Land Preservation Foundation	285,391	1/28/2013
Maryland Environmental Trust (MET)	131,637	3/5/2014
Maryland Historical Trust (MHT)	9,153	1/17/2012
Rural Legacy <sup>2</sup>	84,625	12/7/2015
Transfer of Development Rights/Purchase of Development Rights (TDR/PDR) Program	191,091	1/28/2013
<b>Grand Total (current amount of protected lands in the state)</b>	<b>1,498,848</b>	<b>12/7/2015</b>
Acquisition Programs		
Program	Acres Protected	Date Last Updated
CREP <sup>1</sup>	8,658	8/10/2015
GreenPrint	24,138	6/30/2010
Program Open Space (POS) Local	46,776	12/7/2015
POS Stateside	326,174	11/17/2015
Rural Legacy <sup>2</sup>	84,625	12/7/2015
<b>Grand Total</b>	<b>490,372</b>	<b>12/7/2015</b>

<sup>1</sup> This program is included in both tables since some easements may exist, though this is typically an acquisition program. In October of 2012, the state of Maryland fulfilled its obligation under the federal/state partnership Memorandum of Agreement for purchase of CREP permanent easements.

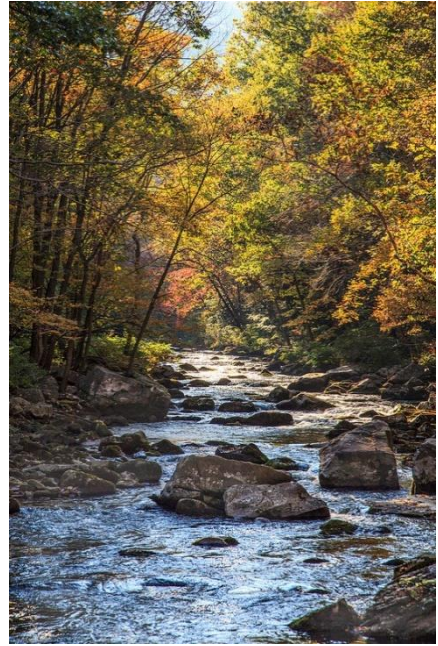
<sup>2</sup> These programs are included in both tables since some easements may exist, though these are typically acquisition programs.



## Maryland's Wildlands

When the Wilderness Act was signed into law in 1964, President Lyndon B. Johnson said, “If future generations are to remember us with gratitude rather than contempt, we must leave them more than the miracles of technology. We must leave them a glimpse of the world as it was in the beginning, not just after we got through with it,” (MD DNR 2015a). The Wilderness Act established a national system of congressionally designated areas sanctioned to be preserved in wilderness condition. Today, the Act protects 109.5 million acres of wilderness land in 44 states.

Maryland followed the federal government’s lead in 1971, when the Maryland Wildlands Act established a state system of legislatively authorized areas designated to be preserved for present and future generations. In order to be designated a wildlands area, land or water must be state-owned and possess features of interest worthy of preservation for the benefit of present and future Marylanders. Proposed wildlands must have preserved their wilderness character, meaning they are relatively untouched and unchanged by humans, and as a result often contain rare plant and animal species, including SGCN (COMAR 2015a).



*Savage River* (Steve Kling)

The aquatic counterpart to the Wilderness Act, the National Wild and Scenic Rivers Act, was passed in 1968 to preserve rivers with wild and natural scenic, geologic, historic, ecologic, recreational, and cultural resources. Although none of Maryland’s rivers are nationally designated as Wild and Scenic, the Maryland Wild and Scenic Rivers Act, once again following the federal government’s lead at the state level, designated nine Maryland rivers as Scenic and one river, the Youghiogheny, as Wild. A Wild River designation is granted only to undeveloped, primitive rivers with limited access, while Scenic Rivers may be less primitive and more accessible. All Wild and Scenic Rivers receive preservation and special management of river resources.

In 1973, Big Savage Mountain Wildland, encompassing dense forest, multiple rare animal species, and a reproducing brook trout population in Garrett County’s Savage River State Forest, became the state’s first designated wildlands area (Maryland Department of Natural Resources 2015b). By 2002, the Wildlands Preservation System had expanded to include over 40,000 acres of wildlands areas. With the next round of additions in April 2014, 50 years after the passage of the federal Wilderness Act, the Maryland General Assembly passed legislation to expand Maryland’s wildlands areas by 50% for a total of 38 designated wildlands areas containing 65,000 acres. This expansion added nine wildlands areas to the Wildlands Preservation System and expanded the boundaries of 14 previously designated wildlands areas (Chesapeake Conservancy 2014).

Designation as a wildlands area provides the highest level of protection possible to ecologically significant lands in Maryland’s state parks, state forests, and wildlife management areas. Permanent roads and installations, maintenance activities, and motorized and mechanized transport are prohibited (COMAR 2015b). Wildlands are not only for the benefit of hikers, hunters, anglers, canoers, and birdwatchers who enjoy these areas in their natural state, but they also provide optimal protection for



threatened and endangered species, other SGCN, and high quality key wildlife habitats. The preservation of primitive wildlands areas protects water quality, allows for wilderness research and simple recreation, and preserves unique ecological communities and rare habitats (National Park Service 2015). For generations to come, Maryland’s wildlands areas represent the “last great places” in Maryland, maintaining the richness and diversity of Maryland’s natural heritage.

### Targeting Areas for Acquisition and Protection

Maryland’s successful acquisition and easement programs are driven by multiple conservation targeting assessments and datasets, including Targeted Ecological Areas (TEAs), BioNet, Green Infrastructure and Blue Infrastructure analyses, and Stronghold Watersheds. Online interactive mapping tools like [GreenPrint](#) and [Water Resources Registry](#) deliver easy-to-use access to these various assessments, as well as additional analyses. For the purposes of regional State Wildlife Action Plan transparency, these tools can be used to identify Maryland’s Conservation Opportunity Areas. These data, detailed below, provide guidance to MD DNR, to other government agencies, and to various land and water conservation stakeholders in Maryland.



Canoeing (MD DNR)

### Targeted Ecological Areas

MD DNR receives a limited amount of funding for land protection and restoration projects, necessitating a careful selection process to target the most ecologically significant areas with the highest value for species, habitat, and ecosystem conservation, including the protection of important connecting corridors. Maryland’s leading state program for land preservation is Program Open Space (POS). Established in 1969, POS funds are used for the acquisition of parklands, forests, wildlife habitat, and other natural, scenic, and cultural resources for public use. These lands are selected for POS (Stateside) funding based on the Targeting Land Conservation System implemented in 2008, which set in place a science-driven system for targeting lands for conservation.

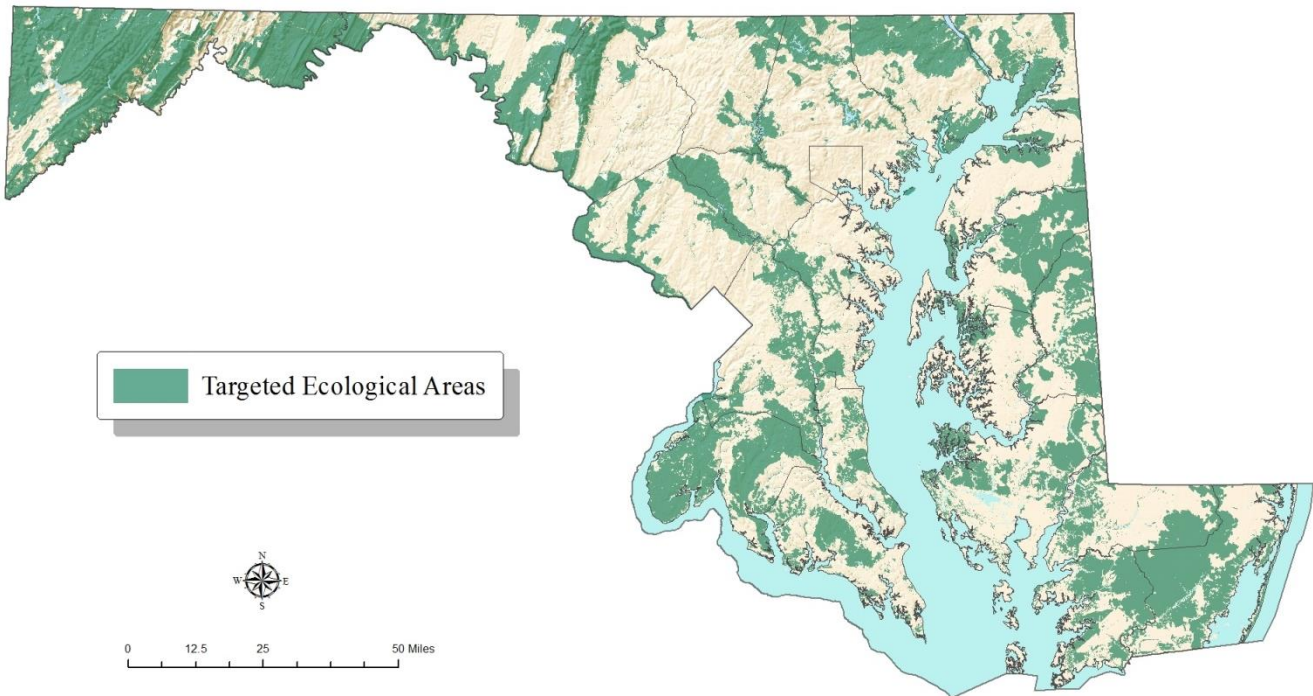
In deciding which Maryland lands represent the best investments in conservation, MD DNR developed an umbrella GIS dataset called Targeted Ecological Areas (TEAs), which is publicly available via an online interactive mapping tool called [GreenPrint](#). TEAs are considered the most ecologically valuable lands in the state, identified as such by a layered mapping system that takes into account five major ecological or thematic components:

1. Green Infrastructure and Forests Important for Protecting Water Quality – the most important large forests and wetlands, connecting corridors, and forested stream buffers;
2. BioNet – the most important areas for protecting habitats of rare species and Species of Greatest Conservation Need (SGCN), as well as significant natural communities;



3. Nontidal Streams and Fisheries – the most important areas for protecting Maryland’s freshwater aquatic biodiversity (i.e., Stronghold Watersheds, Tier II Watersheds, Coldwater Conservation Areas, and Sentinel Site Watersheds);
4. Tidal Fisheries, Bay and Coastal Ecosystems – high quality coastal habitat and critical natural resources in tidal waters and near-shore areas (i.e., Blue Infrastructure) and important spawning and nursery habitat for anadromous fish (i.e., Priority Anadromous Spawning Watersheds); and
5. Wetland Adaptation Areas – lands most likely to become important future wetland habitats based on sea-level rise prediction models.

With the exception of Wetland Adaptation Areas, each of these thematic datasets represents compilations of multiple GIS data layers. Thus, the Targeted Ecological Areas map represents a meta-synthesis of much of the biological and ecological data gathered and analyzed by numerous programs within MD DNR. Areas that scored the highest in each of these five datasets have been designated as Maryland’s TEAs (Figure 7.2). The first round of the analysis took place in 2008, identifying 1.5 million acres of unprotected TEA land. In 2011, new resource assessments and refreshed data were included in an updated TEA analysis, which identified 1.8 million acres of unprotected, ecologically important lands within the [GreenPrint map](#) (MD DNR 2014c).



**Figure 7.2 Maryland’s Targeted Ecological Areas (in green).** Source: MD DNR.



### **Maryland's Watershed Resources Registry**

Land conservation in Maryland occurs through many different governmental and non-governmental programs, and coordinating these efforts and finding the best remaining opportunities for land and resource conservation can be challenging. Numerous GIS data layers, as discussed previously, are available to provide information on the biological and ecological importance of the waterscape and landscape. However, putting them all together and providing analyses that address conservation needs has been difficult. Like GreenPrint, the [Watershed Resources Registry](#) (WRR) is also an online interactive mapping tool that was recently developed as a framework for integrated watershed management. Over a dozen federal, state, and local government agencies were involved with its development. WRR uses a watershed approach to characterize and identify potential opportunity areas for natural resource management and protection. The WRR contains the Targeted Ecological Areas data layer, many of the same data layers used to develop the TEAs, and some additional data layers. It also contains eight “opportunity assessments” or suitability analyses, each with its own set of criteria for locating and prioritizing potential areas suitable for restoration or preservation of several generalized habitats (i.e., upland, wetland, or riparian), as well as surface hydrology. It was developed primarily to help focus government funding and improve coordination of federal and state programs implementing the Clean Water Act, including such activities as non-point source pollution management, permit reviews, mitigation assessments, and Total Maximum Daily Load (TMDL) implementation. Because of the amount of biological and ecological data included in the WRR and its availability as a public website, it could also be used for numerous other applications, such as guiding master planning efforts, identifying mitigation opportunities for local DOTs, and assisting organizations to comply with TMDL regulations.

### **Biodiversity Conservation Network (BioNet)**

In 2005, the Wildlife Diversity Conservation Plan included a conservation action to ‘identify the most important sites throughout the state for wildlife diversity conservation.’ This action was completed in 2012, resulting in a new GIS assessment called the Biodiversity Conservation Network (BioNet). Through BioNet, MD DNR and its partners can prioritize conservation areas specifically for SGCN and their key wildlife habitats. The BioNet assessment was developed as an additional tool for proactive land conservation activities, such as targeting for acquisitions and easements, locating appropriate areas for project mitigation or habitat restoration, and planning for areas that require management to sustain dwindling species and habitats.

Since 1980, DNR's Natural Heritage Program (NHP) has been collecting, managing, analyzing, and distributing spatial data relating to the habitats of the state's rarest plants and animals, as well as high quality and rare natural communities and other living resources of conservation concern, including:

- 1,000 rare, Threatened or Endangered plants and animals
- 1,600 places where rare, Threatened or Endangered species live
- 200 additional Species of Greatest Conservation Need
- 200 Watch List plants
- 27 of 75 ecological communities considered to be rare in Maryland

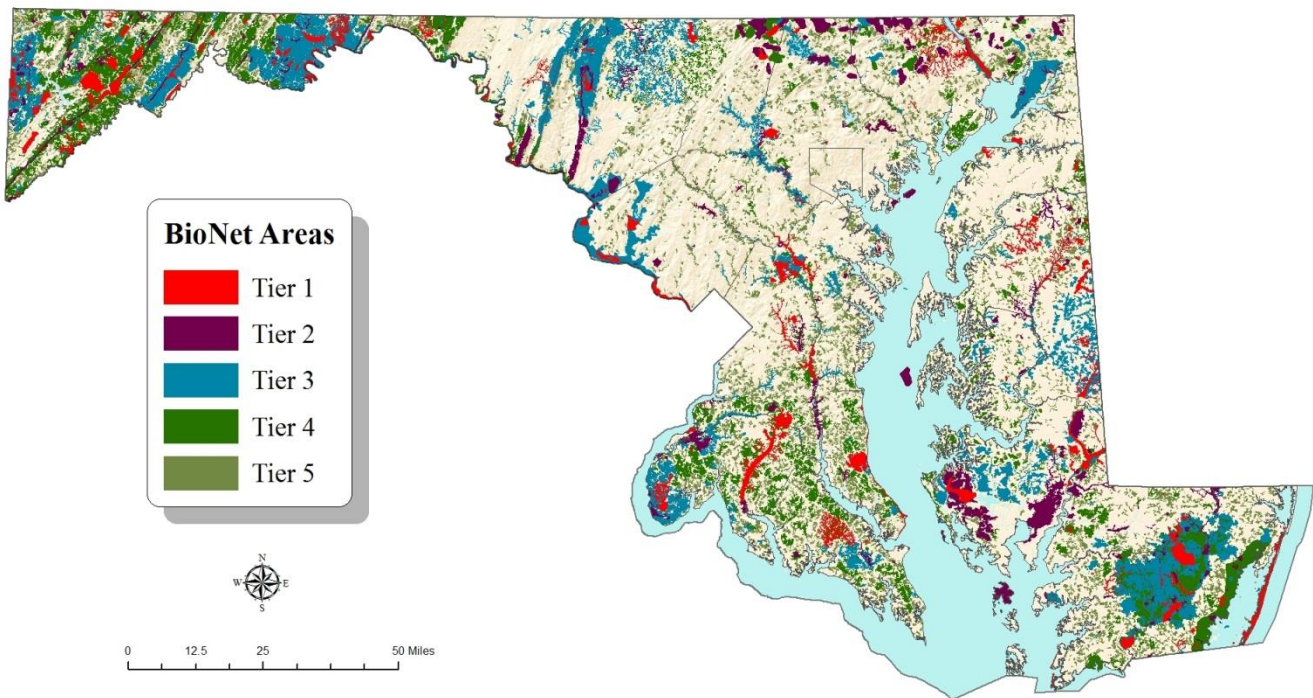
BioNet integrates information on all these resources and prioritizes Maryland's vanishing natural landscapes to highlight those areas that are most important to conserve the full complement of terrestrial and freshwater species and natural communities currently found within the state. The criteria used



within BioNet primarily focus on the most irreplaceable species and habitats, as well as the habitats where larger numbers of rare species are concentrated (Figure 7.3). In addition to focusing on vanishing species and habitats, and on high quality common habitats, the criteria were designed to incorporate the larger landscapes required for migratory animals, population dispersal, and habitat shifts resulting from climate change.

BioNet criteria evaluate and prioritize MD DNR’s information on the most fragile and critical “cogs and wheels” of our natural world:

- Only known occurrences of species and habitats in Maryland
- Globally rare species and habitats
- State rare species and habitats
- Species of Greatest Conservation Need
- Watch List plants and indicators of high quality habitats
- Animal assemblages (e.g., colonial nesting waterbirds, forest interior species)
- Hotspots where rare species and habitats are concentrated
- Intact watersheds
- Wildlife corridors and concentration areas



**Figure 7.3 Maryland’s BioNet priority tiers.** Source: MD DNR.

These areas are prioritized into a five-tiered system based on a continuum of rarity, diversity, and quality, with Tier 1 being the highest or most critically significant for biodiversity conservation. Examples of Tier 1 areas include habitats with the only known occurrence of a species in Maryland, with any occurrence of a globally critically imperiled species or vegetation community, with high quality occurrences of globally rare species or communities, or with hotspots where 10 or more state rare species or communities are concentrated.





This five-tiered system was designed to capture and support the full array of biological diversity within Maryland – not just those places that are one-of-a-kind, but also the places that are needed to maintain viable populations of more common species. Keeping common species common is a goal that will provide enormous benefits to Maryland’s quality of life and economy. Maryland’s citizens and Maryland’s wildlife cannot afford to wait until difficult and expensive efforts are necessary to save species from the brink of extinction. This means that even Tier 5 BioNet Areas can be significant conservation targets, both for the species these areas directly support, as well as for maintenance of the larger fabric of our natural landscape. The BioNet map includes 2.4 million acres of public and private lands in total for Tiers 1-5. The breakdown of acreages by tier, and the percentages conserved by various organizations and methods is shown in Figures 7.4 and 7.5.

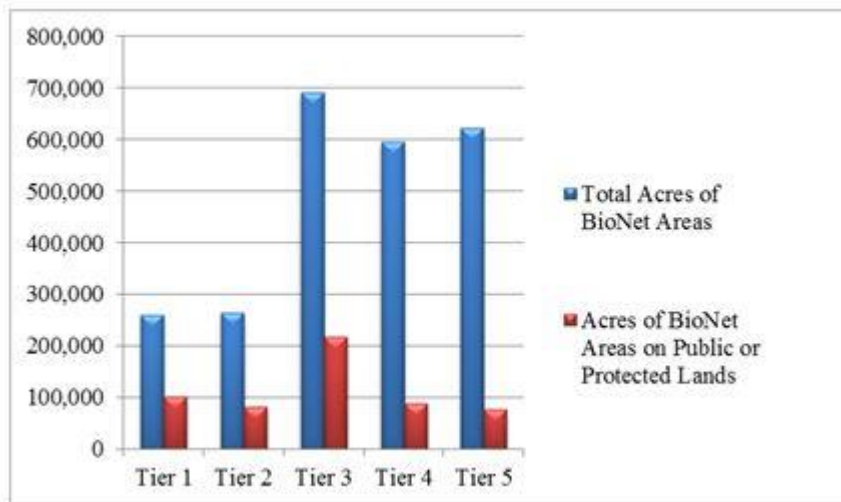


Figure 7.4 Acres of BioNet areas by tier. Source: MD DNR 2015.

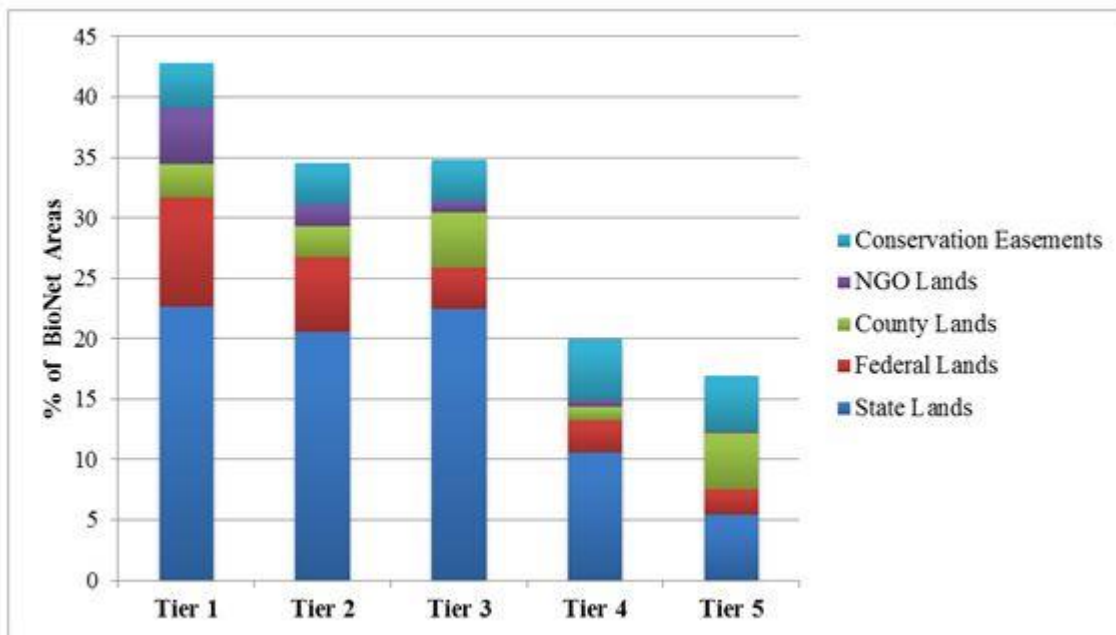


Figure 7.5 Percent of protected BioNet areas by tier and land ownership type. Source: MD DNR 2015.



## Green Infrastructure

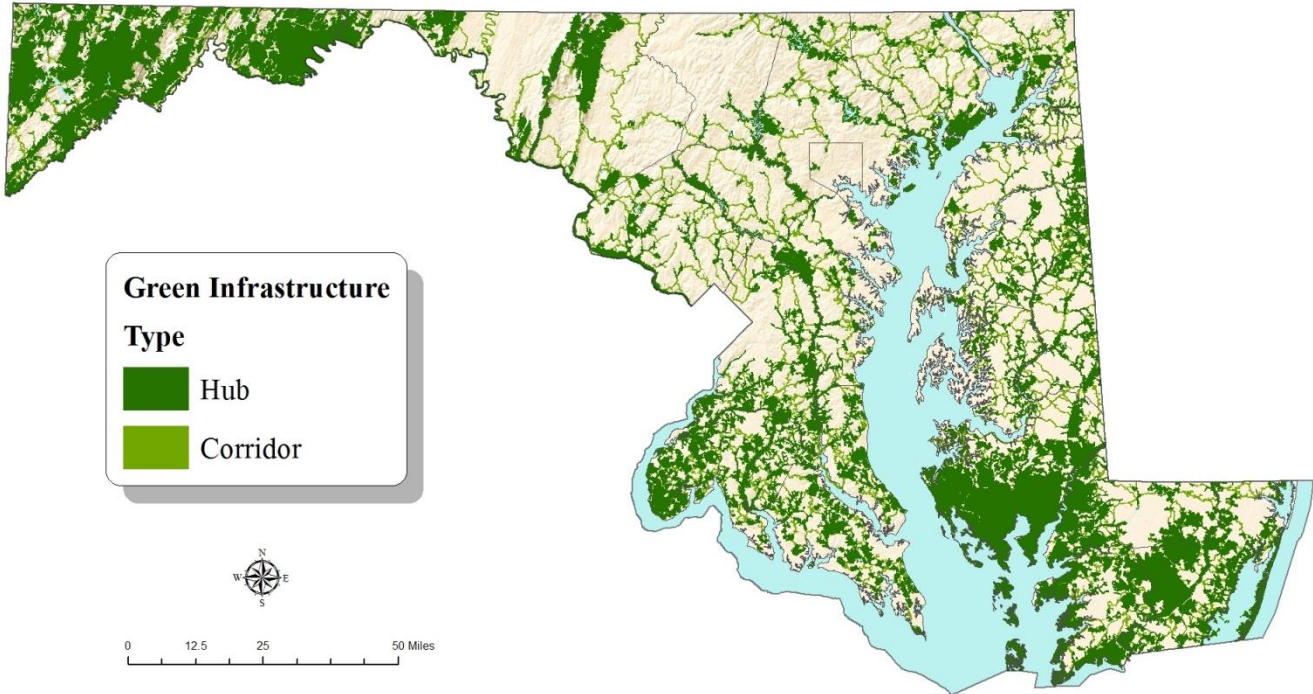
As Maryland's population grows and human development expands, natural areas in the state lose chunks of a valuable resource that can be thought of as "green infrastructure." Green infrastructure is made up of natural lands such as forests and wetlands that are crucial to the health of ecosystems and the natural environment, serving roles as habitats for organisms, air and water filtration systems, and nutrient and soil cycling systems. Humans value green infrastructure recreationally, aesthetically, and for economic reasons. However, as we carve great swaths from Maryland forests and wetlands to construct buildings, roads, and recreational facilities, we lose this irreplaceable natural resource. For these reasons, MD DNR formally analyzed the state's green infrastructure to identify and prioritize areas of greatest statewide ecological importance, as well as those at greatest risk of loss to development (Weber 2003).

Mapping of Maryland's green infrastructure began in 2000 with the use of Geographic Information Systems (GIS) analysis. MD DNR used land use cover maps, satellite and aerial imagery, and environmental and biological databases developed through the Natural Heritage Program, the Forest Service, and the Maryland Biological Stream Survey. The result was a network of hubs and corridors. Hubs are large, unbroken blocks of forest and wetland habitat, 250 acres or greater, that support significant or rare plant communities, unmodified wetlands, rare or sensitive species, biologically important rivers and streams, and existing conservation lands managed for natural values. Corridors are "habitat highways," such as riparian corridors and river valleys, which connect these hubs and allow the movement of animals, seeds, and water between the hubs. This hub and corridor system allows MD DNR to identify areas where more corridors are needed, or where rare communities are isolated. The final map captured 2.4 million acres of private and public land in Maryland, with less than 30% of the mapped green infrastructure already protected (Conn 2008).

Now that areas with green infrastructure have been identified (Figure 7.6), MD DNR works to conserve those hubs and corridors that have highest priority, including those providing habitat for rare species and those at greatest risk due to encroaching development. Human-disturbed areas, or gaps, within the green infrastructure system are also of priority for restoration efforts. Prioritized rankings of areas of green infrastructure allow land conservation efforts to combat the scattered effects of urban sprawl. The results of the assessment provide a direction for land conservation programs like Program Open Space. On a local level, conservation groups and local governments may use the [Green Infrastructure Assessment](#) to plan development in a manner that allows for conservation of key natural areas and for corridors linking larger patches of remaining habitats. The State of Maryland has termed this environmentally conscious development style "SmartGrowth" and has made a multitude of resources, including grants and further information about green infrastructure available to those interested in pursuing SmartGrowth for their own project.

The SmartGrowth program aims to combat trends of increasing development and urban sprawl by concentrating new development and redevelopment in areas that have existing or planned infrastructure. The Department of Planning oversees the Smart Growth program, and has succeeded in administering a number of policies and laws toward Smart Growth goals. SmartGrowth accomplishments implemented in municipalities around Maryland include construction of green spaces, multimodal boulevards, and improved pedestrian areas. SmartGrowth resources are available on the [Maryland Department of Planning website](#).





**Figure 7.6 Maryland's green infrastructure.** Sources: MD DNR 2015.

Smart Growth provides a wealth of resources to communities wishing to learn more about Smart Growth or plan new growth projects in accordance with Smart Growth goals. The [Reinvest Maryland Toolbox](#), available online at the Smart Growth website, points project-planners to federal and state programs that support infill, redevelopment and community revitalization. The Department of Planning website includes a page dedicated to interactive maps, many of which depict the changing Maryland landscape and urban sprawl. Important maps for the Smart Growth mission include maps depicting Maryland population growth, changes in land use, and urban sprawl.

### Blue Infrastructure

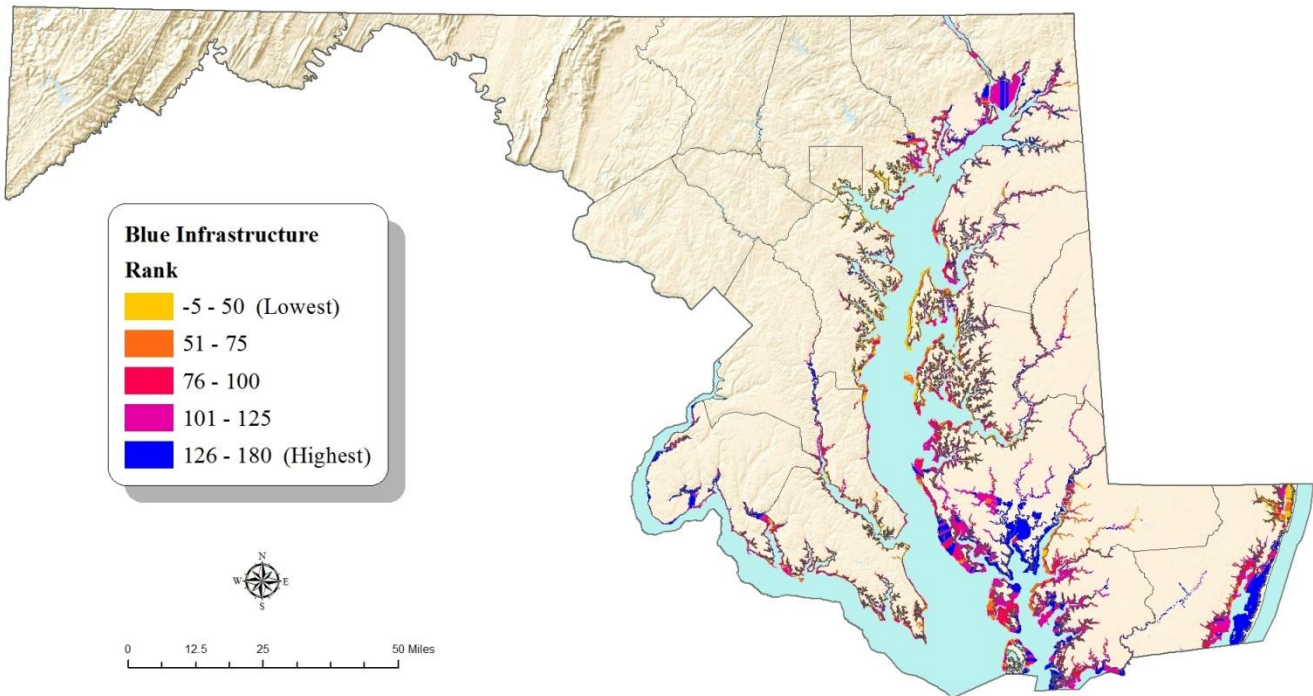
Maryland's coastal position bordering the Atlantic Ocean and containing the Coastal Bays and much of the Chesapeake Bay makes for a bounty of resources derived from the water. Maryland's aquatic resources and habitats, or "blue infrastructure," provide shelter for a variety of wildlife species, access to recreational activities, and benefit local economies based in the seafood and other water-dependent industries (Figure 7.7). Like human-made infrastructure, blue infrastructure requires care and investment from community members, especially as more demands are made on Maryland's aquatic resources with further development and population growth (McCall 2012).

Designed to complement the Green Infrastructure network, MD DNR's [Blue Infrastructure \(BI\) Near-shore Assessment](#) takes the concept of blue infrastructure to a practical level, providing a detailed spatial evaluation of coastal habitat, important natural resources, and associated human uses in Maryland's coastal zones. By analyzing numerous coastal and watershed features, this assessment aids in targeting and prioritizing conservation and management activities to maintain and improve coastal habitats (McCall 2012).



The BI Near-shore Assessment focuses on coastal shorelines as links between aquatic and terrestrial environments. As these links are important to humans as well as countless other organisms, the assessment identifies areas with diverse and high-quality resources, moving from land to water. In order to produce a BI rank for a source of blue infrastructure, the assessment takes into account the ecological integrity of resources in three major areas. First, land cover of the terrestrial near-shore zone is analyzed for buffering capacity, habitat provision, and maintenance of natural shore processes. The specific terrestrial near-shore factors include tidal wetland cores, sensitive species that depend on shoreline environments, sandy beaches, point-source pollution discharge, and shoreline stabilization areas. The next series in the assessment checks watershed characteristics, assessing undeveloped or protected lands, surface type, and watershed condition. Finally, the aquatic zone of the coastal area is assessed to a depth of two meters for resources such as oyster bars, SAV beds, other shellfish, access structures, sandy bottom, and fish spawning and nursery areas (McCall 2012).

The result of the BI Near-shore Assessment is [Maryland's Coastal Atlas](#), an online mapping tool that displays current uses, resources, and risks involved with Maryland's coastal blue infrastructure (MD DNR 2015c). While this tool is intended for state and local leaders to analyze data for coastal planning and management, it offers to every Marylander the ability to visualize the vast bounty provided to the State's inhabitants by blue infrastructure, providing a testament to the importance of conserving state coastal and aquatic regions.



**Figure 7.7 Maryland's blue infrastructure.** Sources: MD DNR.



### Stronghold Watersheds

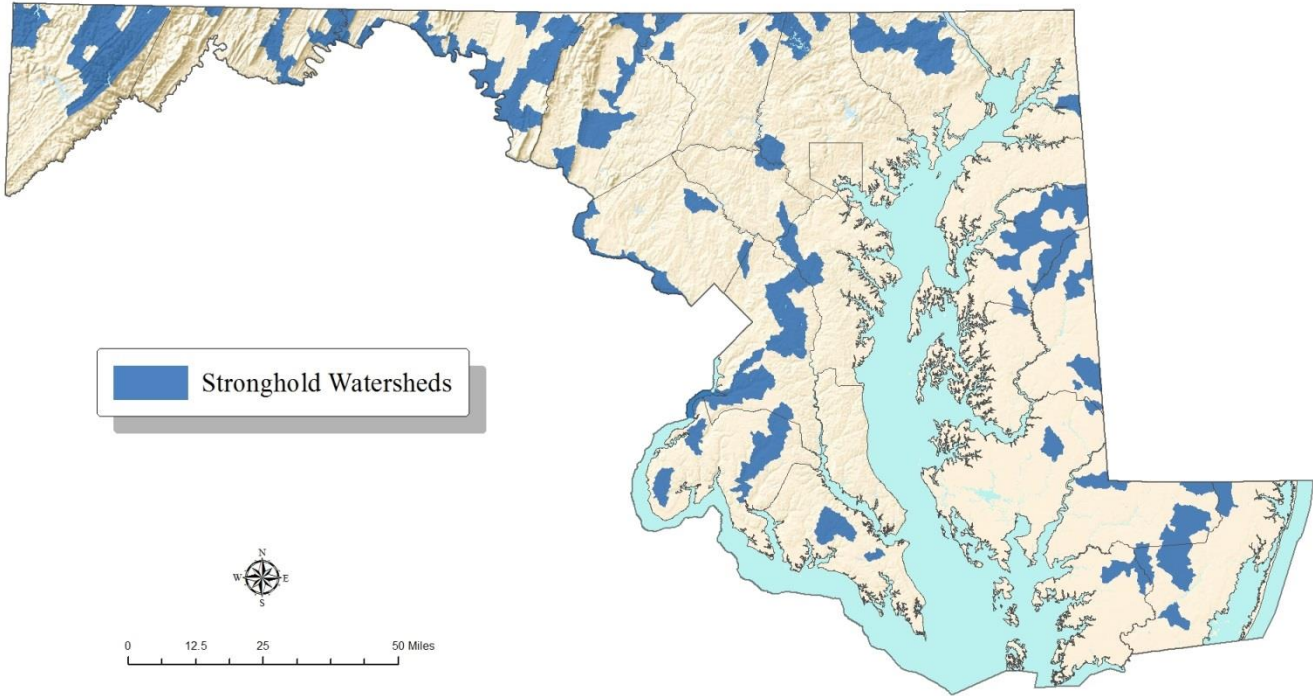
Plentiful species of fishes, amphibians, reptiles, and mussels formerly populated waterways throughout Maryland, but many of these species are now greatly reduced in abundance and geographic distribution from their former ranges. In 2005, after nearly 20 years of stream research, MD DNR Maryland Biological Stream Survey (MBSS) staff began analyzing watershed-scale data for freshwater fish and mussel diversity in Maryland. Initially, watersheds were identified that were strongholds for individual rare, threatened, or endangered freshwater aquatic species. In 2006, this analysis was augmented by Maryland Natural Heritage Program staff to include stronghold watersheds based on species richness of SGCN aquatic species and on rarity-weighted species richness. In 2007, strongholds for stream-associated amphibians and reptiles were included. Thus, MD DNR has identified those watersheds around Maryland that are most important for the protection of Maryland's freshwater aquatic biodiversity (MD DNR 2014d).



*Brook trout* (MD DNR)

Known as “stronghold watersheds,” these watersheds harbor the best remaining populations of rare, threatened, or endangered aquatic species, as well as diverse assemblages of these species, and are crucial to their survival. Managing the health of these watersheds is critically important to sustain the health of not only these species, but the ecosystem in which they play a role. In an important step towards protecting stronghold watersheds and the organisms they contain, MD DNR has used these data to map the locations of Maryland's stronghold watersheds (Figure 7.8). In addition to their key role as high quality water systems, stronghold watersheds provide important opportunities for ecological and biological research and offer an educational glimpse at some of Maryland's rarest animals.





**Figure 7.8** Maryland’s stronghold watersheds (in blue). Source: MD DNR 2007.

### Law and Policy

Maintaining laws and policies to ensure the protection of healthy wildlife populations and habitats is a critical conservation action recommended by Maryland’s State Wildlife Action Plan (SWAP). Laws and policies can prevent damaging impacts through processes such as permitting and environmental review. They can also lead to necessary conservation programs and practices through financial incentives and fund generation. Native wildlife populations and habitats should be adequately protected by state laws, regulations, and policies so that Maryland residents can continue to enjoy the natural world and the recreational, economic, and quality of life opportunities that these resources provide. The overall policy of the Maryland Department of Natural Resources (MD DNR) is reflected in its vision and mission statements:

**Vision Statement:** In a sustainable Maryland, we recognize that the health of our society and our economy are dependent on the health of our environment. Therefore, we choose to act both collectively and individually to preserve, protect, restore, and enhance our environment for this and future generations.



**Mission Statement:** The Department of Natural Resources leads Maryland in securing a sustainable future for our environment, society, and economy by preserving, protecting, restoring, and enhancing the State’s natural resources.

Laws, regulations, and policies should be clearly understood by all partners and stakeholders. MD DNR oversees the protection, restoration, and conservation of wildlife in the State, and MD DNR’s Wildlife and Heritage Service uses legal tools to effectively manage wildlife-related activities, such as its take, sale, and possession. Specific regulations and the list of protected species can be found in the Code of Maryland Regulations (COMAR) in section 08.03.08, while other regulations under Title 08.03 (Wildlife) guide protection of various wildlife species groups and their habitats in Maryland. MD Natural Resources Police (MD NRP) are trained, equipped, and funded to enforce wildlife laws, including those relating to nongame and endangered species. Throughout Maryland, the NRP has statewide authority to enforce conservation, boating, and criminal laws. Within state parks, state forests, wildlife management areas, and all public lands owned and operated by MD DNR, MD NRP is responsible for all law enforcement activities.



*Maryland Natural Resources Police inspect oyster boats on the first day of dredging season (Candy Thomson, MD DNR)*

Under the Law and Policy action category, conservation actions identified in the SWAP include activities such as enhancing and enforcing laws against illegal access to protected areas. Examples of these actions include minimizing human activity impacts to sandy beaches used as nesting areas by piping plovers and terns, and curtailing habitat destruction caused by recreational activities, such as use of off-road vehicles outside of designated areas.

This action category also includes actions pertaining to the illegal collection or harvest of SGCN. Examples of intentional collection include illegal collecting of butterflies or other insects, and reptiles and amphibians, which has increasingly detrimental impacts. There are unintentional examples of harvest by which the collector can *legally* take species, such as blue crab, but *illegally* harvest (bycatch) other species, such as the northern diamond-backed terrapin. Other actions under the Law and Policy category include revising Maryland’s list of Threatened and Endangered species, improving protocols for limited activity in rare habitats, and managing public water access areas.



## Direct Management of Natural Resources

The direct management of natural resources involves many types of conservation actions and may be the most diverse of the seven action categories. This is because there are endless conservation actions to manage natural resources, provide stewardship to aquatic and terrestrial SGCN, and restore wildlife populations and their habitats. Some of these actions include, but are not limited to:

- Creating new habitat
- Restoring natural ecological processes
- Controlling invasive species
- Managing populations
- Working with landowners
- Managing water and/or vegetation
- Removing dams and barriers
- Managing fire
- Stabilizing shorelines
- Reintroducing and restoring native species

MD DNR with its conservation partners must work to create new habitat and restore disturbed habitat to its natural state so that SGCN can reach healthy population numbers. This conservation action can be applied to native habitats that have been degraded, fragmented, or destroyed as a result of the many threats identified in Chapter 5. Creating and restoring habitat provides SGCN with the opportunities and space these species require for survival (e.g., breeding and foraging areas). The long-term goal for habitat creation and restoration is the re-establishment of functioning ecosystems that support a full array of species maintained through natural processes. Smaller scale and shorter-term vegetation management, including planting/seeding, can create and improve native habitat for SGCN while moving towards a goal of functioning natural systems. For example, planting and seeding for native grasses and wildflowers, which many times are destroyed or lost due to development or inappropriate management, can benefit many SGCN insects, including pollinators.



*NHP biologists managing growth of invasive aquatic species *Phragmites australis* with herbicidal spray (Kerry Wixted, MD DNR)*





### *Case Study: Restoring the northern goshawk's nesting sites in Maryland*

After being extirpated from Maryland in the 1900s due to habitat loss and forest overharvest, the northern goshawk, a powerful forest raptor that is listed as endangered in Maryland, has returned in small numbers to breed in the state. The goshawk's breeding range in Maryland is concentrated in Garrett County, where four core goshawk nesting territories have been found. However, goshawk breeding activity has been minimal at these locations recently due to changes in forest conditions. Goshawks are shy birds that are sensitive to human disturbance and prefer mature forest stands for nesting. An ongoing MD DNR project aims to restore the forest near one of these nesting locations in an effort to bring the recovering goshawk back to Maryland.



*Northern goshawk*  
(Dave Brinker, MD DNR)

The area targeted for restoration is a 26-acre hardwood stand in the Potomac-Garrett State Forest. This area never fully recovered after sustaining wind damage during "Superstorm" Sandy in 2012, resulting in a change from old forest to a younger forest with excessive plant undergrowth. Plant competition reduced the regeneration of white pine trees which were typical of the area, and the forest grew too dense to be a good nesting habitat for the northern goshawk. Plans to thin the understory are currently in progress, including herbicidal regimens for plants and selective harvesting of understory trees. MD DNR's Wildlife and Heritage Service (WHS) has partnered with the MD Forest Service for this project, with WHS assisting the Forest Service with the layout and marking of this harvest to ensure the result is an improved nesting area for the goshawk. With less competition, white pine seedlings and saplings will be able to grow, accelerating the recovery of the ideal mixed hardwood/conifer forest type. This treatment aims to increase available goshawk nesting habitat and improve the potential for reoccupation by these magnificent birds of prey.

Invasive species are a serious threat to Maryland's natural resources (see Chapter 5) and removal of these species is a common action recommended to bring back native habitat conditions. Problematic native species, such as white-tailed deer, can cause wide-spread detrimental impacts to SGCN through impacts on their habitats, and the Maryland SWAP recommends conservation actions to better manage and even reduce these populations in many areas of the state. Prescribed burning is a conservation action that is critical for the health and restoration of fire-dependent habitats, such as Shale and Serpentine Barrens, Pitch Pine Forests, and Delmarva Bays, which support many rare plants and Species of Greatest Conservation Need.

Dams, culverts, and other human-made barriers contribute to habitat fragmentation for SGCN, particularly aquatic organisms. Dams considered for removal have been identified and prioritized according to the ecological benefit generated by the project. In instances where complete or partial removal of the dam is unmanageable, alternative activities such as retrofitting culverts or removing partial blockages to allow for fish passage should be funded and implemented. Reducing stream channelization, ditches, and impoundments are other conservation actions that improve stream habitat connectivity.



To directly improve SGCN populations, artificial structures can be used to replace or supplement habitat that has been impacted through human intrusion or other threats. Tunnels can provide a safe passageway for a variety of wildlife when traditional habitat routes used for animal movements are fragmented by roads. Another recommended conservation action is the placement of bat boxes in appropriate habitats that can provide shelter, particularly during the breeding season.

With the majority of Maryland's lands in private ownership, it is critical to work with landowners to create, improve, or maintain these habitats for healthy wildlife populations. The SWAP identifies numerous actions for state agencies and organizations that provide assistance to landowners, as well as actions individual landowners can take to access assistance available to them. MD DNR and partners should work together to publicize and promote existing Best Management Practices (BMPs) to reduce negative impacts to wildlife habitats, and develop BMPs where they are needed. This includes large-scale conservation projects like working with licensed foresters and biologists on large land parcels, to smaller parcel interests of providing wildlife habitat, such as native plantings to enhance pollinator habitat.

Financial incentives and assistance are extremely important when working with private landowners. The Conservation Reserve Enhancement Program (CREP) is one such program that provides financial assistance to encourage long-term conservation efforts on private agricultural land. CREP aims to incentivize conservation actions to provide wildlife habitat, reduce erosion, and improve water quality on ecologically significant cropland and pastureland adjacent to water. See CREP case study under Land and Water Acquisition and Protection.

## Planning and Administration

Conservation actions relating to planning and administration may not seem as important as other action categories, such as direct management of natural resources, but this is hardly the case. A certain level of planning and administration are necessary to allow for any of the other conservation action categories to exist, due to the need for funding, policies, and careful, thought-out planning and prioritization.

Conservation planning can be conducted at all geographic scales: nationally, regionally, statewide, and locally. It is important to realize that collaborative efforts of partners among these scales will bring about successful wildlife conservation. This can be as simple as integrating and implementing partner plans and recommended conservation actions into one's organization and collaborating on these conservation projects, with both funding and on-the-ground efforts. In other words, there is no need to 'reinvent the wheel' when it comes to wildlife conservation planning, but it is important to keep up-to-date with current policy, culture, and most importantly, scientific information. With inventory, monitoring, and research action outcomes, wildlife and habitat plans (from all scales) should be regularly reviewed and updated, including species management plans, public land management plans, private lands management plans, and prioritization or targeting plans. Prioritization planning is particularly important due to limited funding for nongame and endangered species conservation. BioNet is a great example of MD DNR prioritizing habitat for SGCN and actively sharing these data with internal and external partners to use in their wildlife planning and land protection activities.

Local planning and zoning by counties and cities can be a great benefit to SGCN and their habitats through a variety of actions. These can include identifying conservation goals in their comprehensive plans and working with developers on regulations and guidelines that improve the environment, and



therefore, SGCN. Environmental reviews can avoid, minimize, and mitigate negative impacts by providing recommendations relevant to various types of private and public development projects. These reviews range from database searches to site visits.

Appendix 9a lists over 60 wildlife and habitat plans and programs that support conservation efforts in Maryland. The SWAP supports conservation action recommendations from these plans, as well as regional and federal plans such as U.S. Fish and Wildlife Species Recovery Plans and regional Bird Conservation Area plans (Partners in Flight). MD DNR will continue to work with partners to integrate conservation actions from this 2015 SWAP into their planning efforts and vice versa. This focused, collaborative planning effort will allow for more resources (i.e., money, time) to be used in actual implementation of these actions on the ground.

Administrative support and continued partnerships are both essential for the implementation of Maryland's SWAP. Conservation actions are recommended relating to increased interagency support and coordination for effective program and project management. Over the past several years, the primary source of funding for nongame species management and conservation, namely federal State Wildlife Grants, has declined. Continued efforts to increase funds and capacity are needed in order to fully implement Maryland's SWAP. Efforts to improve budgets and staffing are necessary, even to meet prioritized conservation actions. Additional support from partners to increase available resources would benefit many collaborative conservation projects.



*MD DNR hosting SWAP planning meeting  
(David Curson, MD-DC Audubon)*

Participation on advisory committees is necessary to continue SWAP collaborative efforts. MD DNR works with other state agencies, federal agencies, NGOs (non-governmental organizations), regional partnerships, local governments, universities, museums, tribes, and citizens to implement projects in support of SGCN and their key wildlife habitats. Sustainable, working relationships with these diverse partners are critical to conduct successful wildlife conservation and meet the goals of the SWAP. Chapter 9 includes more information about partner work on the SWAP and conservation in Maryland. As discussed throughout the State Wildlife Action Plan, regional conservation efforts are critical as the majority of wildlife species at risk in Maryland are not restricted to the state, and key wildlife habitats know no state boundaries. Many threats identified in Maryland's SWAP occur throughout the region and cannot be tackled solely on a state level (e.g., climate change, invasive species, and excess nutrients). MD DNR and its partners should continue to support regional conservation efforts, such as regional species and habitat conservation plans and the Northeast Regional Conservation Needs (RCN) Program.



## Data Collection and Analysis – Inventory, Monitoring, and Research

Before effective conservation actions can be determined for some SGCN, specific information or research is needed. Data collection (inventory, monitoring, and research) actions are recommended for many SGCN and key wildlife habitats to fill data and knowledge gaps and improve conservation efforts. Certain groups of species are in severe need of data collection and analysis, such as small mammals and invertebrates. Filling these data gaps will provide a more comprehensive knowledge of wildlife status, distribution, and health of species' populations. Data are also collected to address the need to gather inventory data for the purpose of meeting the legal mandate to officially list and codify species.



*MD DNR biologist in the field*  
(Wes Knapp, MD DNR)

Databases with up-to-date and complete information sets can better inform conservation planners, who will as a result be more efficient and effective in their planning for natural resources. For example, with an improved distributional database, GIS mappers can better support statewide, regional, and localized strategies for wildlife and key habitats. This information can be given to partners, private landowners, municipalities, and other stakeholder organizations to help reduce threats and improve populations of SGCN and their key wildlife habitats. In order to compile the best databases and information systems, the SWAP recommends support for the development, management, and maintenance of these technologies and operations for MD DNR and all partner organizations, including those at regional and national levels.

Data analysis and monitoring of SGCN and key wildlife habitats is needed to address threats at all scales, from locating detrimental invasive species to understanding sites that are resilient to climate change. As new threats emerge, new data collection actions need to take place to allow conservation planners to best understand how to abate these threats. The MD SWAP strongly recommends collaborating with partners for conservation work, an action which includes sharing data and managing databases in a manner that distributes information quickly and efficiently.

## Education, Outreach, and Technical Assistance

Conservation actions related to education, technical assistance, and outreach can be found throughout the SWAP, as these actions are essential for successful conservation. MD DNR and its partners need to advocate to each other, citizens, and outside organizations about conservation. Important outreach topics include what conservation is, why conservation is important, and how to be involved in conservation activities. This Plan is about taking action, and MD DNR cannot take action alone. Maryland's SGCN and habitats need aware, knowledgeable, motivated citizens to assist in abating threats to SGCN and their key wildlife habitats.

Existing education-based conservation actions are aimed at a diverse range of audiences. Educational programs for youth, such as [Project Wild](#), teach children about wildlife and their habitats through hands-



on learning activities. Nature education courses such as [Master Naturalist](#) provide knowledge and training that enable citizen naturalists to participate in citizen science efforts, teach classes, and lead outdoor field trips. Technical assistance actions such as consultations with county Critical Area programs and [Wild Acres](#) provide landowners with the knowledge, resources, and tools to manage their land in support of SGCN and natural habitats. In order for MD DNR and partners to provide these actions through programming, financial support for educator/teacher training and the maintenance of education facilities and areas is imperative. Funding and outreach needs often intersect in such conservation actions. While public access areas must be maintained and kept available for public usage, education and outreach by MD DNR and partners about safety in recreational areas is a key component for ensuring the health of Maryland’s citizens as well as its rare and endangered natural communities and species.



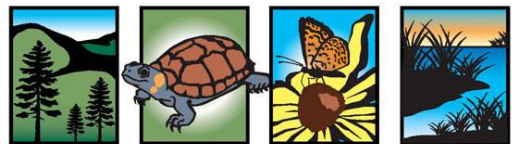
WHS staff hosting MD DNR educational display (MD DNR)

The end goals of education, outreach, and technical assistance actions are to provide citizens with the knowledge, awareness, and skills to help identify and assist with addressing ecological threats and challenges. Behavioral changes in human recreation and other activities are an important step towards leading citizens to think positively about and take positive actions toward the natural environment.

Part of this action category includes partner and stakeholder engagement. This outreach can be through communication-oriented actions including social media outlets, newsletters, press releases, and presentations. Continuing collaborative on-the-ground actions related to the direct management of natural resources is critical to maintain working, positive relationships with partners and stakeholders. Many public and private conservation groups have programs designed to promote opportunities for private landowners to manage for wildlife habitat (e.g., Natural Resources Conservation Service, MD Department of Agriculture, USFWS, MD DNR). MD DNR can also provide technical assistance to municipal, local, and other state agencies to inform management decisions through science and conservation data.

*Case Study: Maryland Natural Areas Guide*

Often dubbed “America in Miniature” Maryland is home to hundreds of awe-inspiring natural sites reflecting the diversity of land formations and ecosystems within the state. With the online release of the [DNR’s Maryland Natural Areas Guide](#), Marylanders have access to a wealth of information about some of the best natural areas in the state. Ancient boreal bogs, expansive savannah grasslands, and mighty fossil-infused cliffs await exploration, and the Maryland Natural Areas Guide is the one-stop resource to learn about and discover 31 carefully selected sites. The selected Natural Areas are a small subset of all Maryland’s natural sites, chosen to best illustrate Maryland’s bounty. To be nominated as a recognized Natural Area, sites had to qualify under at least



MARYLAND Natural Areas



one of four categories: sites that contain rare natural communities, sites home to rare plant and animal species, sites that represent in exemplary fashion Maryland’s signature natural communities, or sites containing outstanding geological features. The next levels of the selection process evaluated landscape characteristics, natural community value, and species viability of each proposed natural area. Chosen sites embodied exceptional quality as a natural site in terms of size, maturity, naturalness, and uniqueness. Final decisions were based on negative impacts to the site by human or natural disturbances and the site’s long-term prospects for continued existence (MD DNR 2012a).

Natural Areas are truly special places in Maryland. Voluntary recognition as a Natural Area carries a commitment to sustainable management of a given area to conserve the natural features that the area was established to recognize and protect. Natural Area recognition is meant to encourage interest from Maryland citizens, and the Natural Areas Guide website showcases the natural biodiversity found throughout Maryland. The online guide profiles each Natural Area with photographs and maps depicting rare species, directions to the site, and details about possible recreation activities in the area. Because of the diversity of selected sites, there are natural areas to fit any outdoor interest.

The natural areas profiled in the online guide are spread across Maryland. Six sites can be found in the Central Region, nine in the Eastern Region, eight in the Southern Region, and eight in the Western Region (Figure 7.9). Recreation activities vary amongst sites, but include opportunities for hiking, canoeing and kayaking, nature photography, and birdwatching. Educational opportunities abound for visitors to learn about local history, rare and endangered species living in the area, and the intricate webs of plant and animal communities that drive the continued success of beautiful natural areas (MD DNR 2012b).

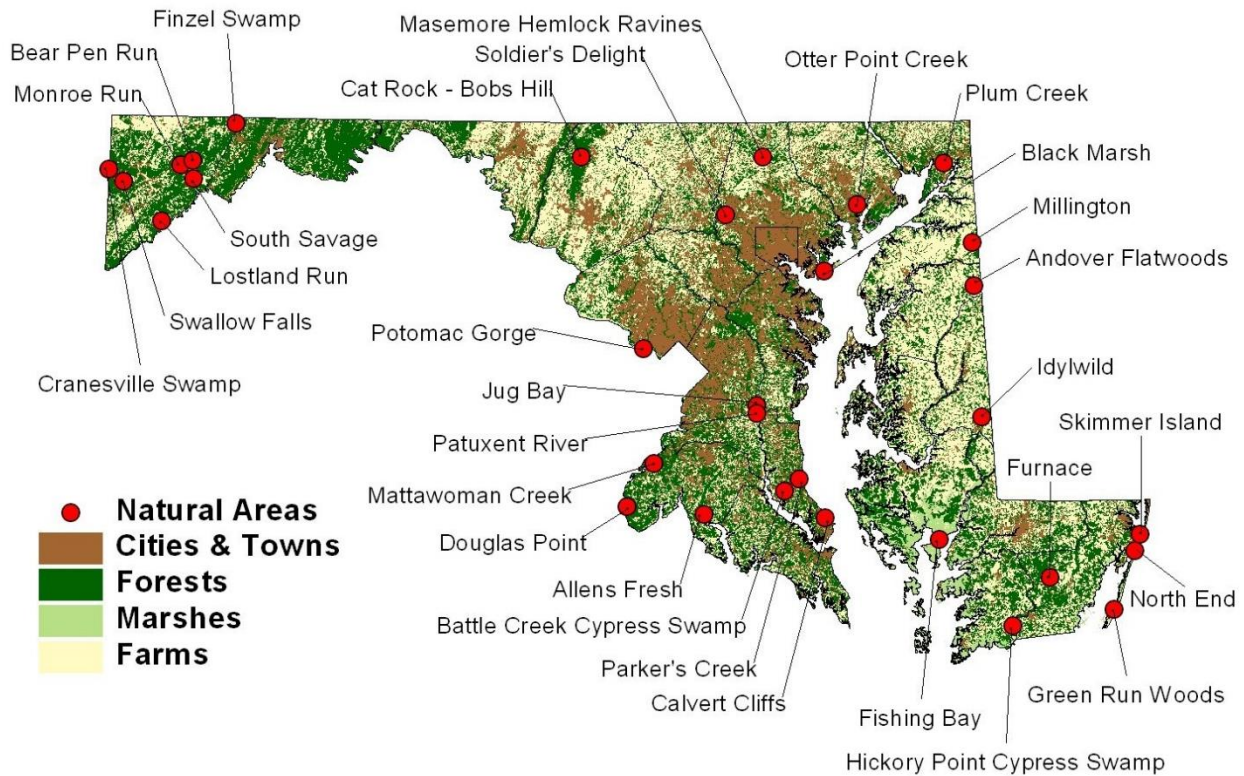


Figure 7.9 Maryland's Natural Areas. Source: MD DNR 2012b.

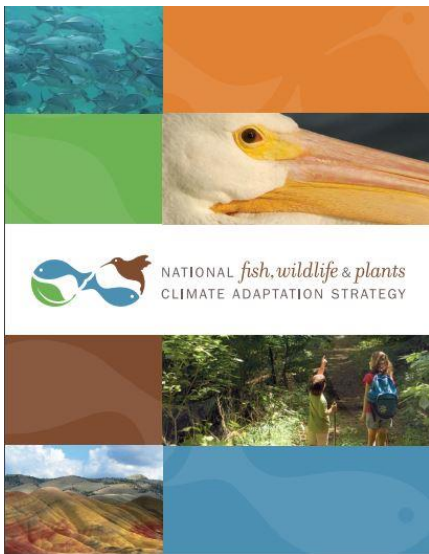


## Conservation Actions to Address Climate Change: Adaptation Strategies

As discussed in Chapter 6, climate change has the potential to alter species' distributions and ecological relationships across the Northeast (Manomet Center for Conservation Sciences & National Wildlife Federation 2012). Shifts in the distribution of species have already been documented across the Northeast as the regional climate has warmed significantly over the past century. In general, species' distributions are moving up in latitude and elevation, as species respond to warmer climatic conditions. Habitat boundaries and ecological communities have also shifted, and sea-level rise threatens coastal habitats (Terwilliger Consulting, Inc. & the Northeast Fish and Wildlife Diversity Technical Committee 2013). This action category section discusses climate change adaptation strategies, approaches, and processes for varying scales, considering the Northeast region and Maryland. This section does not prescribe one specific approach to taking action; rather, it outlines a range of adaptation tactics, which will require thoughtful consideration of the needs of the species, habitat, and location, the stakeholders and partners involved, the scale at which a decision or policy is being implemented, and the financial and personnel resources available to managers.

### Overview of Climate Change Adaptation *(includes text excerpted from Staudinger et al. 2015)*

Climate change adaptation is a growing field within conservation and natural resource management focused on preparing for and responding to current and future impacts of climate change, and reducing related vulnerabilities (IPCC 2007; Parry et al. 2007; Heller & Zaveleta 2009; Glick et al. 2011). Ecological systems are subject to natural variability over short and long time scales, but climate change is increasingly pushing species and systems to surpass historical ranges of fluctuations. Therefore, managers are being encouraged to embrace a new paradigm of managing for change rather than persistence (Milly et al. 2008). This requires goals and actions that consider not only how a system or population has already changed, but also what conditions it is expected to experience as climate change continues (Stein et al. 2013). In addition, conservation and management initiatives that are enacted broadly across the landscape to increase connectivity among refugia and protected habitats, and sustain ecological functioning and processes, are increasingly necessary (Stein et al. 2013).



*The National Fish, Wildlife, and Plants Climate Change Adaptation Strategy*

Climate change adaptation requires thinking over multiple temporal and spatial scales to sustain fish and wildlife populations and their habitats. Over the short-term and at a small scale, regardless of whether further assessment and information is needed, there are things that can be done now to minimize the effects of climate change on both ecosystems and humans. Over the long-term and at a large scale, responses to climate change can take advantage of existing and emerging knowledge to identify areas that are more resilient, more likely to adapt, or conversely, that are at highest risk. Many broad recommendations for adapting ecosystems to climate change have already been suggested and synthesized (e.g., Millar et al. 2007; Heinz Center 2008; Ogden & Innes 2008; Heller & Zaveleta 2009). A national perspective on climate change adaptation for natural resources is provided in the [National Fish, Wildlife and Plants Climate Adaptation Strategy](#) (NFWPCAS 2012). Information is organized under seven broad goals for adaptation, which as a whole address resistance, resilience, and transition with options at finer scales:



- Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate;
- Manage species and habitats to protect ecosystem functions and provide sustainable cultural, subsistence, recreational, and commercial use in a changing climate;
- Enhance capacity for effective management in a changing climate;
- Support adaptive management in a changing climate through integrated observation and monitoring and use of decision support tools;
- Increase knowledge and information on impacts and responses of fish, wildlife, and plants to a changing climate;
- Increase awareness and motivate action to safeguard fish, wildlife, and plants in a changing climate and;
- Reduce non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate.

To address the challenge of incorporating a climate change adaptation perspective into an existing management framework, seven major principles can serve as a starting point (Millar et al. 2007; Joyce et al. 2008; Wisconsin Initiative on Climate Change Impacts 2011; Swanston & Janowiak 2012). These principles are listed in Table 7.5.

**Table 7.5 Climate-adaptation principles for management frameworks.** Source: Staudinger et al. 2015.

Climate Adaptation Principle	Description
Prioritization and triage	It will be increasingly important to prioritize actions for adaptation based both on the vulnerability of natural resources and on the anticipated effectiveness of actions that attempt to reduce vulnerability.
Flexible and adaptive management	Adaptive management provides a decision-making framework that maintains flexibility and incorporates new knowledge and experience over time.
“No regrets” decisions	Actions that result in a wide variety of benefits under multiple scenarios and have little or no risk may be initial places to consider re-prioritization and look for near-term implementation.
Precautionary actions	Where vulnerability is high, precautionary actions to reduce risk in the near term may be extremely important, even when long-term uncertainty is high.
Variability and uncertainty	The effects of climate change go far beyond increasing temperatures; increasing climate variability will lead to equal or greater impacts that will need to be addressed as well.
Integrating mitigation	Many adaptation approaches complement actions to mitigate climate change; for example, adapting forests to future conditions can help maintain and increase their ability to sequester carbon.
Monitoring systems	Improved, better-integrated, and increasingly coordinated monitoring systems are needed to detect, track, and attribute species and habitat shifts to climate change over spatiotemporal scales.





Several tools are available to support planning and decision-making in resource conservation to address the complex challenge of climate change. These tools offer frameworks and structured steps aimed at enhancing transparency and participation in planning and decision making, and directly address sources of uncertainty from climate change (e.g., possible future conditions, model projections), human response behaviors, and other sources (e.g., land use change). Those discussed by Staudinger et al. (2015) include: The Adaptation Workbook (Swanston & Janowiak 2012); Climate-Change Vulnerability Assessments; Structured Decision-Making (Hammond et al. 1999); Adaptive Resource Management (Williams & Brown 2012); and Scenario Planning. The Northeast Climate Science Center Report (Staudinger et al. 2015) and Chapter 8 of this Maryland SWAP present a more detailed discussion and application of these adaptation tools.

### Regional Case Studies

Staudinger et al. (2015) provide a synthesis of numerous species and habitat-specific adaptation strategies and actions from existing assessment reports and management plans, which is intended to showcase a range of possibilities for natural resource management under future global change. These adaptation strategies and actions range from large scale to local scale, and even for specific species or habitat actions. Staudinger et al. (2015) describe regional case studies more fully than others, as the report is intended to provide regional recommendations for the Northeast and Midwest. Those discussed by Staudinger et al. (2015) include: Landscape Conservation Cooperatives and Landscape Conservation Design; USDA Northern Forests Sub Hub; Northern Institute of Applied Climate Science; Climate Change Resource Center (CCRC); Climate Change Response Framework (CCRF); and the Southeast Conservation Adaptation Strategy

### Maryland's Climate Action Plan *(Excerpted from Maryland Commission on Climate Change 2013)*

Maryland's Climate Action Plan includes two climate change adaptation strategy documents that are currently being used to guide state-level adaptation planning efforts. The first strategy document (Phase I), released in 2008, addressed the impacts associated with sea level rise and coastal storms. The second strategy (Phase II), released in 2011 as a compendium to the Climate Action Plan, addresses changes in precipitation patterns and increased temperature and the likely impacts to human health, agriculture, forest and terrestrial ecosystems, bay and aquatic environments, water resources, and population growth and infrastructure.

Together, the strategies are the product of the work of more than 100 experts from the governmental, nonprofit, and private sectors that held a series of meetings for the purpose of interpreting the most recent climate change literature, evaluating adaptation options, and recommending strategies to reduce Maryland's overall climate change vulnerability. The strategies provide the basis for guiding and prioritizing state-level activities with respect to both climate science and adaptation policy over the near and longer terms. A variety of projects designed to apply components of the strategies are well underway and additional efforts have been identified as high-priorities for early action. Summaries of Maryland's Phase I and II adaptation strategies related to wildlife species and habitats are outlined below in Figures 7.10 and 7.11.

MD DNR has the lead role among state agencies in advancing the scientific understanding of Maryland's vulnerability to climate change, and advocating for sound planning to avoid or minimize the anticipated impacts. In October 2010, MD DNR issued a new policy to direct its investments in and management of land, resources, and assets so as to better understand, mitigate and adapt to climate



change. The policy establishes practices and procedures related to new land investments, facility siting and design, habitat restoration, government operations, research and monitoring, and resource planning. The goal of the policy is to lead by example and, along the way, encourage and educate others in the methods for managing natural resources and designing facilities with an understanding of the effects of climate change.

**Forests and Terrestrial Ecosystems Adaptation Strategies** (Excerpted from Maryland Commission on Climate Change 2013)

Forests and terrestrial ecosystems contribute an estimated \$2.2 billion to Maryland’s economy and \$24 billion in ecological services. The condition of these ecosystems and the services they provide is likely to be altered by climate change. Climate change will alter distributions of species and habitats and exacerbate existing stressors at an uncertain rate and degree. Native species populations may decline, increase, or migrate from the state while new species may migrate in due to habitat shifts. Likewise, the services provided by forests such as temperature regulation, water filtration, aesthetic value, and habitat may correspondingly be altered. Existing stressors on species and habitats may be exacerbated by climate change. Statewide adaptation strategies for forests and terrestrial ecosystems are shown in Figure 7.10.


FORESTS AND TERRESTRIAL ECOSYSTEMS					
	Priority Recommendations	Lead Agency	Key Partners	Priority	Timeframe
Expand land protection and restoration and revise targeting priorities.	Integrate climate data and models into existing resource assessments and spatial planning frameworks.	DNR	EPA, CBP, USDOJ, USFWS, NGOs, NASA, NOAA	high	medium-term
	Incorporate climate change adaptation strategies into State resource management plans.	DNR	MDP, EPA, CBP, USDOJ, USFWS, NOAA, USFS, NGOs	high	medium-term
	Collaborate with federal partners to support regional and national adaptation planning.	DNR	EPA, CBP, USDOJ, USFWS, NOAA, USFS, NGOs	medium	medium-term
	Update existing land protection targeting programs and project evaluation protocols.	DNR	EPA, CBP, USDOJ, USFWS, NOAA, USFS, NGOs	high	ongoing
	Develop climate change adaptation guidance and technical tools suitable for local government planning.	DNR	MDP, UMD-Extension	high	ongoing
Adjust management practices and reduce existing stressors.	Strengthen State and local programs to slow the loss and fragmentation of forest and terrestrial ecosystems to new development.	DNR	MDP, MDE, MDOT, USFWS, USFS, EPA, CBP, NGOs	high	ongoing
	Review and revise forestry best management practices.	DNR	UMD-Extension	medium	medium-term
	Continue to support incorporation of the policies and strategies of Maryland’s Sustainable Forestry Act of 2009 into State and local planning decisions.	DNR	State Forest Conservancy District Boards	high	ongoing
	Evaluate sustainable forestry certification programs for opportunities to enhance climate resilience.	DNR	Sustainable Forestry Initiative, Forestry Boards, Forest Stewardship Councils	medium	medium-term
	Improve capacity to manage and respond to stressors exacerbated by climate change.	DNR	MDA, MD Invasive Species Council, Forest Health Emergency Contingency Program	medium	short-term
Foster stewardship on private lands.	Develop new tools to guide adaptation stewardship activities on private lands.	DNR	Forest Stewardship Councils, UMD Extension	high	short-term
	Incorporate adaptation concerns into existing programs.	DNR	USFS, Forest Stewardship Councils, UMD Extension	high	short-term
	Develop new conservation easement mechanisms to promote adaptation stewardship activities on private lands.	DNR	USFS, Forest Stewardship Councils, UMD-Extension, MDA	high	ongoing

**Figure 7.10 Statewide climate change adaptation strategies for forests and terrestrial ecosystems.**  
Source: Maryland Commission on Climate Change 2013.



**Bay and Aquatic Ecosystems Adaptation Strategies** (Excerpted from Maryland Commission on Climate Change 2013)

Within the Chesapeake Bay watershed and oceanfront, Maryland’s extensive aquatic ecosystems range from freshwater swamps and bogs, tidal and non-tidal freshwater rivers and marshes, tidal brackish and saline rivers and marshes, and coastal bays. These ecosystems are primarily influenced by precipitation, temperature, tropical storms, and human activity. Currently, the services provided by the Bay are estimated to be approximately \$1 trillion, annually. However, human development and pollution have degraded their natural resilience, leaving them more vulnerable to extreme events. Climate change will likely exacerbate this problem, creating a threat to these ecosystems. The Bay has already warmed by 3°F since the 1930s, and additional temperature increases could change the composition of commercial fisheries and increase anoxia in the Bay. To protect its marine, estuarine and aquatic ecosystems against future damage, action is needed to alleviate existing stressors and to strategically conserve and restore critical bay and aquatic habitats. Figure 7.11 depicts the statewide adaptation strategies for bay and aquatic ecosystems.



BAY AND AQUATIC ECOSYSTEMS					
	Priority Recommendations	Lead Agency	Key Partners	Priority	Timeframe
Advance protection of at-risk species and habitats.	Revise state-level protection targeting programs to reflect climate change adaptation priorities.	DNR	UMD, USACE, USGS, USFWS, NOAA, NGOs	high	ongoing
	Develop new protection and conservation mechanisms to promote adaptation stewardship activities on private lands.	DNR	UMD, USACE, USGS, USDOJ, USFWS, NOAA, NGOs	medium	medium-term
	Amend legal mechanisms to designate and protect temperature-sensitive streams.	DNR	MDE, EPA	high	ongoing
	Implement an adaptive management approach.	DNR	MDE, MDOT, MDA, MDP, federal partners, NGOs	high	medium-term
Restore critical bay and aquatic habitats to enhance resilience.	Proactively pursue, design, and construct habitat restoration projects to enhance the resilience of bay and aquatic ecosystems.	DNR	USACE, USGS, USFWS, NOAA, EPA, CBP, NGOs	high	long-term
	Conduct an audit of state-owned lands to identify habitat restoration potential for enhancing ecosystem resilience and increasing on-site carbon sequestration.	DNR		medium	short-term
	Increase on-the-ground implementation of existing stream restoration practices.	DNR	USGS, EPA, CBP, USFWS	high	short-term
Reduce existing stressors.	Remove barriers to habitat connectivity.	DNR	MDE, USFWS, NOAA	high	ongoing
	Reduce impervious surface cover.	DNR, MDE	MDP	high	ongoing
	Prepare for new or expanding ranges of invasive species.	DNR	MDA, MD Invasive Species Council, USFWS	high	ongoing
Foster a collective response to climate change.	Adjust bay and watershed restoration priorities in light of a changing climate.	DNR	MDE, UMD, NOAA, USGS, EPA, Penn State, USFWS	medium	ongoing in Coastal Plain
	Integrate both adaptation and mitigation reduction strategies into natural resource management plans and programs.	DNR	USFWS, NOAA, NGOs	high	short-term
	Revise fishery and wildlife management to build climate resilient safeguards.	DNR	USFWS, NOAA, NGOs	high	long-term
	Increase collaboration among federal, state, regional, and local climate change adaptation partners.	DNR	UMD, NOAA, USGS, EPA, NGOs	high	short-term

**Figure 7.11 Maryland statewide adaptation strategies for bay and aquatic ecosystems.**

Source: Maryland Commission on Climate Change 2013.



## Additional State Adaptation Responses

### *Statewide Coastal Resiliency Assessment*

The Statewide Coastal Resiliency Assessment is a cooperative project of MD DNR's Chesapeake & Coastal Service and The Nature Conservancy that seeks to decrease vulnerability of coastal human and natural communities using natural features. This will be accomplished by identifying and prioritizing restoration opportunities along shoreline segments near vulnerable human communities that lack robust natural infrastructure. MD DNR is invested in understanding Maryland's vulnerability to coastal hazards and acting to mitigate impacts to the State's people, natural resources, public lands, and investments (Maryland Commission on Climate Change 2013).

The Assessment will establish priorities for natural infrastructure solutions within tidal regions of the coastal zone. Priorities will be determined based on community vulnerability to coastal hazards such as sea level rise, flooding, and erosion. Natural features with wave attenuation, infiltration, sediment stabilization, and other risk reduction benefits will be ranked based on their ability to buffer coastal communities from the impacts of coastal hazards. This project will produce spatial data to help MD DNR and partners identify, plan for, and invest public funds in the most beneficial coastal resilience restoration and conservation projects. Assessment goals are to: 1) identify existing natural infrastructure with risk reduction value for vulnerable human communities and prioritize protection opportunities for these areas; and 2) develop a Marsh Protection Index to identify key marsh areas that enhance community resiliency (Maryland Commission on Climate Change 2013).

### *Ecological Niche Climate Models*

MD DNR biologists used ecological niche climate models to inform the Baltimore Checkerspot Recovery Team where areas in Maryland were most suited for conservation and recovery work in the state. Climate models indicated that only the mountainous regions of the state and the most northern stretches of the Maryland Piedmont will continue to provide suitable climatic conditions in the coming decades. While habitat maintenance and population monitoring will include all Maryland populations, wetland restoration, captive rearing, and introduction efforts will initially be limited to the Piedmont Region. This is the region where Baltimore checkerspots (*Euphydryas phaeton*) have experienced the greatest declines, and where populations are separated by considerable distances and significant dispersal barriers (e.g., large cities and towns, major highways). Further, actions will focus on increasing connectivity amongst the remaining Baltimore checkerspot colonies in the Piedmont by creating a network of suitable wetlands that would assist species dispersal into the northern stretches of the Piedmont Region and, eventually, into more northern states.



*Baltimore checkerspot butterfly*  
(Jennifer Selfridge, MD DNR)

### *Incorporation of Climate Change Parameters into Existing Plans and Processes*

As discussed earlier in this Chapter, Maryland's GreenPrint initiative identifies the most ecologically valuable areas in the state and designates these lands and waters as "Targeted Ecological Areas" (TEAs).



In 2011, MD DNR updated the TEAs designations to include coastal ecosystems and habitats for climate change adaptation and marsh migration.

MD DNR's Forest Service has included climate change and adaptation information as a required element in forest management plans since 2011. These plans are required by any forest landowner who participates in state property tax abatement programs or USDA forestry programs and thus will reach a wide audience. Climate change is also being addressed as an additional stressor in Forest Resource Assessments and the five-year strategy plan by working with other local, state, and federal agencies to incorporate adaptation into existing forestry programs (Maryland Commission on Climate Change 2013). Climate change impacts are also considered in the development of 15-year plans for wildlife management areas. A partnership between MD DNR and Maryland Department of the Environment is addressing the mapping of vulnerable habitats, including ephemeral, intermittent, and headwater stream systems and vernal pools, as well as the development of field protocols for their identification and model ordinances for their protection by local governments and organizations. Future collaboration may address models for those streams that will be most sensitive to climate change and those that will remain coldwater systems (Maryland Commission on Climate Change 2013).

## Conservation Actions

This chapter lists the **priority and non-priority conservation actions for implementation** that were developed by MD DNR and partners for key wildlife habitats and Species of Greatest Conservation Need (SGCN) in Maryland's SWAP. A listing of conservation actions for key wildlife habitats begins on page 42 and a listing of conservation actions for SGCN begins on page 103. These appendices are laid out in tabular format so that MD DNR and partners may efficiently find specific threats and conservation actions cross-referenced to taxa groups, SGCN, or key wildlife habitats. These tables of conservation actions can also be found in Chapter 7 Appendices.

### Conservation Actions for Key Wildlife Habitats

Conservation actions for implementation specific to the 59 key wildlife habitats (as described in Chapter 4) are organized below by the five main habitat categories: Upland, Wetland, Aquatic, Subterranean, and Other Habitats. The actions listings move from broad to narrow in scope, with actions for the overall habitat categories listed before actions specific to individual key wildlife habitats. Following is a list of Maryland's key wildlife habitats sorted by major habitat categories; the priority conservation actions listings follow this system.



**Upland Habitats**

**A. Forests**

- High Elevation Ridge Forest
- Hemlock-Northern Hardwood Forest
- Cove Forest
- Montane - Piedmont Oak-Pine Forest
- Oak-Hickory Forest
- Basic Mesic Forest
- Mesic Mixed Hardwood Forest
- Coastal Plain Oak-Pine Forest
- Coastal Plain Pitch Pine Forest
- Maritime Forest and Shrubland

**B. Glades, Barrens, and Rock Outcrops**

- Serpentine Barren
- Shale Barren
- Acidic Glade and Barren
- Basic Glade and Barren
- Cliff and Rock Outcrop
- Coastal Bluff

**C. Coastal Beaches and Dunes**

- Coastal Beach
- Maritime Dune and Grassland

**Wetland Habitats**

**A. Floodplain Wetlands**

- Montane - Piedmont Floodplain
- Coastal Plain Floodplain

**B. Groundwater Wetlands**

- Montane Bog and Fen
- Montane – Piedmont Acidic Seepage Wetland
- Montane – Piedmont Basic Seepage Wetland
- Piedmont Seepage Wetland
- Piedmont Upland Depression Swamp
- Coastal Plain Flatwood and Depression Swamp
- Coastal Plain Seepage Swamp
- Coastal Plain Seepage Bog and Fen
- Delmarva Bay
- Maritime Swamp
- Vernal Pool
- Spring

**C. Tidal Wetlands**

- Tidal Forest
- Tidal Freshwater Marsh and Shrubland
- Tidal Brackish Marsh and Shrubland
- Tidal Salt Marsh and Shrubland
- Intertidal Mudflat and Sand Flat

**Aquatic Habitats**

**A. Streams and Rivers**

- Coldwater Stream
- Limestone Stream
- Highland Stream
- Piedmont Stream
- Coastal Plain Stream
- Blackwater Stream
- Highland River
- Piedmont River
- Coastal Plain River

**B. Bay and Ocean**

- Shellfish Bed
- Hard bottom (Living and Non-living)
- Submerged Aquatic Vegetation
- Macroalgae
- Pelagic-Open Water

**Subterranean Habitats**

- Cave and Karst

**Other Habitats**

- Managed Montane Conifer Forest
- Managed Successional Forest
- Managed Grassland
- Roadside and Utility Right-of-way
- Artificial Impoundment and Wetland
- Artificial Structure – Buildings and Other Structures
- Artificial Structure – Mine and Tunnel



## Conservation Actions for Upland Habitats

### Conservation Actions for Forests

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Hardwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
<b>IUCN 1-4: Urbanization/Development</b>												
1-4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	P	P	P	P	X
1-4	Habitat loss (from various causes)	Encourage implementation of BMPs that minimize and reduce habitat fragmentation in land use plans, especially for large, contiguous forest blocks and old growth conditions.	P	P	P	P	P	P	P	P	P	P
1-4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P	P	P	P	P	P	P	P	P
1-4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., Ecologically Significant Areas, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.		P	P	P	P	P	P	P		
<b>IUCN 1: Residential and Commercial Development</b>												
1	Residential and Commercial Development	Conserve and restore seepage, floodplain, and tidal wetlands associated with streams and rivers.	P	P	P	P	P					
1	Residential and Commercial Development	Work with local jurisdictions to effect adequate zoning considerations in order to protect SGCN habitat.					P	P	P	P	P	



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Hardwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
1.3.1	Tourism and recreation	Limit infrastructure development for recreation (such as trails, parking lots, etc.) in key areas for SGCN that are sensitive to disturbance (e.g., wood turtle, timber rattlesnake, salamanders).	P	X	X	P	P					
<b>IUCN 2: Agriculture and Aquaculture</b>												
2	Agriculture and Aquaculture	Encourage beneficial agricultural practices (e.g., late mowing, grass forb buffers in agricultural settings, farm bill programs, other landowner incentives), involvement in Conservation Reserve programs, and the development of incentives to conserve and restore habitats of SGCN.				X	X	X	X	X		
<b>IUCN 3: Energy Production and Mining</b>												
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site and configure hydraulic fracturing development in a manner that avoids or minimizes impacts to SGCN and habitats.	X	X	X	X	P	P	P			
3.2.1	Mining and quarrying: surface mining - Coal strip mining	Site and configure industrial surface mines in a manner that avoids and minimizes impacts to SGCN and habitats.			X	X	X	X	X			
3.3.1	Wind power	Site industrial wind development (including roads) in a manner that avoids or minimizes impacts to SGCN and habitats.	P	X		X		X	X	X		
3.3.1	Wind power	Work to develop and implement operational BMPs to reduce impacts of wind farms on key habitats and associated SGCN.	P	X	X	X	X	X	X	X		
<b>IUCN 4: Transportation and Service Corridors</b>												
4.1.1	Roads and railroads: land conversion to roads and railroads	Work with Maryland Department of Transportation to improve transportation planning for new roads to minimize fragmentation of habitat and negative impacts to SGCN.	X	X	X	X	X	X	X	X	X	





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
4.1.2	Roads and railroads: movement of cars and other vehicles on roads and railroads	Work with Maryland Department of Transportation to encourage and facilitate additional opportunities for public mass-transportation.					X	X	X	X	X	
<b>IUCN 5: Biological Resource Use</b>												
5.3	Logging and wood harvesting	Establish and maintain adequate forest buffers along streams and rivers using strategies such as working with watershed groups to encourage forest conservation.		P	P	P	P	P	P	P	X	
5.3.2	Logging and wood harvesting; intentional use – large scale	Utilize appropriate silvicultural treatments to ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls, downed wood, dense thickets, snags).	P	P	P	P	P	P	P	P	P	P
5.3.2	Logging and wood harvesting; intentional use – large scale	Conserve and encourage conifer dominated forests in western Maryland.	X	P	X	P						
5.3.2	Logging and wood harvesting; intentional use – large scale	Protect, and where possible, restore old growth forest (including adequate no-cut buffers) on public and private lands, and where possible, expand these areas and promote the establishment of additional extensive tracts of old growth forest.	P	P	P	P	P	P	P	P	P	P
<b>IUCN 6: Human Intrusions and Disturbance</b>												
6.1	Recreational activities	Limit access when or where necessary to protect SGCN and their sensitive habitats.	X	X	X	X	X	X	X	X	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Educate the public about the value of wildlife habitats and their conservation to address and minimize human disturbance issues from off-road vehicle use.	X	X	X	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Work closely with all stakeholders to; 1) avoid potential impacts to natural resources by eliminating ORV use in sensitive habitats where appropriate and, 2) educate user groups on the value and importance of conserving SGCN habitat.	X	X	X	X	X	X	X	X	X	X
<b>IUCN 7: Natural Systems Modifications</b>												
7.1.2	Fire: suppression of fire frequency/ intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation. NGOs, USFWS	P			P	P			P	P	X
7.1.2	Fire: suppression of fire frequency/ intensity	Utilize appropriate prescribed burning in or light disking of selected portions of individual fields to maintain early-successional seral stages and increase coverage of tall forbs, where appropriate.				P	P	P	P	P		
7.3.4	Lack of ecosystem functions due to species loss	Manage habitat by mimicking natural disturbance patterns for the benefit of SGCN.					P			P	P	
7.3.4	Lack of ecosystem functions due to species loss	Reintroduce blight resistant American chestnut to appropriate habitats, where feasible.	X		X	X	X	X	X			
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>												
8.1	Invasive and Other Problematic Species, Genes, and Diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P	P	P	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
8.1.4	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland animals	Implement appropriate Integrated Pest Management practices to minimize the effects of serious animal and plant pest species while protecting SGCN and other non-target species.	X	X	X	X	X	X	X	X	X	X
8.1.4	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland animals	Manage the feral horse population on Assateague Island to reduce adverse habitat impacts.										P
8.1.5	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland plants	Develop and implement effective programs and methods to control invasive animals and plants and to prevent their establishment in a manner compatible with SGCN.	P	P	P	P	P	P	P	P	P	P
8.1.5	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland plants	Increase training and awareness of operational BMPs for public land managers (federal, state, local) to control and reduce the spread of invasive species.	P	P	P	P	P	P	P	P	P	
8.2.2	Problematic native species: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity; control populations to reduce negative browsing impacts in SGCN habitats; consider a more liberal doe season in specific areas.	X	X	X	X	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
<b>IUCN 9: Pollution</b>												
9.5.5	Air-borne pollutants: herbicides and pesticides	Develop a statewide inter-agency (MDA, MDE, MD DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.										P
9.5.5	Air-borne pollutants: herbicides and pesticides	Limit the use of pesticides such that SGCN and key wildlife habitats are not adversely affected.	X	X	X	X	X	X	X	X	X	X
<b>IUCN 11: Climate Change and Severe Weather</b>												
11.1.1	Habitat shifting or alteration: sea-level rise	Work with partners to develop climate change adaptation strategies, such as assisted migration for select species and habitats of conservation concern.	P	P	P	P	P	P	P	P	P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Use dredge spoil to protect and restore habitat from alterations due to sea-level rise.										P
<b>IUCN 12: Resource Management Needs</b>												
12.1.1	Lack of initial baseline inventory	Conduct surveys to document the location and quality of key wildlife habitats.	X	X	X	X	X	X	X	X	X	X
12.1.3	Need to answer research questions	Determine historical range of this key wildlife habitat and target priority sites for monitoring and research.	X	X						X	P	
12.2.1	Need to provide technical assistance	Develop and assist with implementation of habitat management guidelines for use by foresters and land managers including forest stewardship plans.	P	P	P	P	P	P	P	P	P	X
12.2.1	Need to provide technical assistance	Include habitat protection and conservation needs in land management plans.	P	P	P	P	P	P	P	P	P	P
12.2.2	Need to conduct environmental reviews	Conduct reviews of land use change plans and encourage local, state, and federal agencies to incorporate habitat conservation actions and BMPs into land use change decisions.	P	P	P	P	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Hardwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
12.2.3	Need for fish, wildlife and/or habitat planning	Work with local, state, and federal agencies to Include habitat conservation BMPs and protection needs and actions into land use planning efforts and land management plans.	P	P	P	P	P	P	P	P	P	P
<b>IUCN 14: Education/ Outreach Needs</b>												
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding the conservation of key wildlife habitats, their value, and SGCN through social media, Master Naturalist training, and other efforts.	X	X	X	X	X	X	X	X	X	X
<b>IUCN 15: Administrative Needs</b>												
15.1.2	Need to maintain or improve information management systems	As new forest land cover data are developed, update GIS layer that identifies forest interior habitat for use in planning/zoning.	X	X	X	X	X	X	X	X	X	
15.3.2	Need for coordination for effective program/project management	Work with conservation partners to implement forest conservation on private lands adjacent to public land.	X	X	X	X	X	X	X	X	X	X
15.3.3	Need for updates to existing laws/regulations and enacting new laws/regulations	Clarify the Maryland Seed Tree law through regulations to more easily allow for mixed hardwood-pine stands.					X	X	X	X	X	
15.3.5	Need for changes in government policies	Develop policies that better regulate broadcast spray programs to avoid impacts to SGCN.	X	X	X	X	P	X	X			
15.3.5	Need for changes in government policies	Work with other resources professionals, partners, and elected officials to evaluate and address potential legal barriers to prescribed burning activities.	P			P	P					



Conservation Actions for Glades, Barrens, and Rock Outcrops

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
<b>IUCN 1-4: Urbanization / Development</b>								
1 - 4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	X
1 - 4	Habitat loss (from various causes)	Encourage implementation of BMPs that minimize and reduce habitat fragmentation in land use plans, especially for large, contiguous forest blocks and old growth conditions.	P	P	P	P	P	P
1 - 4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P	P	P	P	P
<b>IUCN 2: Agriculture and Aquaculture</b>								
2	Agriculture and Aquaculture	Encourage beneficial agricultural practices (e.g., late mowing, grass forb buffers in agricultural settings, farm bill programs, other landowner incentives), involvement in Conservation Reserve programs, and the development of incentives to conserve and restore habitats of SGCN.	P	P	X	X	X	X
<b>IUCN 3: Energy Production and Mining</b>								
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site and configure hydraulic fracturing development in a manner that avoids or minimizes impacts to SGCN and habitats.		X	X	X	X	
3.3.1	Wind power	Work to develop and implement operational BMPs to reduce impacts of wind farms on key habitats and associated SGCN.					P	
<b>IUCN 6: Human Intrusions and Disturbance</b>								
6.1	Recreational activities	Limit access when or where necessary to protect SGCN and their sensitive habitats.	X	X	X	X	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Educate the public about the value of wildlife habitats and their conservation to address and minimize human disturbance issues.	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Work closely with all stakeholders to; 1) avoid potential impacts to natural resources by eliminating off-road vehicle use in sensitive habitats where appropriate and, 2) educate user groups on the value and importance of conserving SGCN habitat.	P	P	P	P	P	P
6.1.5	Recreational activities: rock climbing	Work with climbing clubs to minimize habitat degradation and disturbance.					P	
<b>IUCN 7: Natural Systems Modification</b>								
7.1.2	Fire: suppression of fire frequency / intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation.	P	P	P	P	X	
7.3.1	Shoreline Stabilization	Develop and implement shore erosion control practices (including living shoreline designs) that are compatible with cliff maintenance and the needs of SGCN.						P
7.3.1	Shoreline stabilization	Repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines.						X
7.3.4	Lack of ecosystem functions due to species loss	Reintroduce blight resistant American chestnut to appropriate habitats, where feasible.					X	
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>								
8	Invasive and Other Problematic Species, Genes, and Diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P	P	P	P	P
8.1.4	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland animals	Implement appropriate Integrated Pest Management practices to minimize the effects of serious animal and plant pest species while protecting SGCN and other non-target species.	P	P	P	P	P	X
8.1.5	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland plants	Develop and implement effective programs and methods to control invasive animals and plants and to prevent their establishment in a manner compatible with SGCN.	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
8.1.5	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland plants	Work with partners to control or eradicate populations of invasive, non-native terrestrial / wetland plants, such as phragmites and purple loosestrife, using appropriate BMPs and effective education campaigns.						P
8.2.2	Problematic native species / diseases: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity; control populations to reduce negative browsing impacts in SGCN habitats; consider a more liberal doe season in specific areas.	P	P	P	P		
<b>IUCN 9: Pollution</b>								
9.4.1	Garbage and solid waste	Develop and implement improved, effective trash pick-up systems in natural areas and other priority habitats.	P					
9.5.5	Air-borne pollutants: herbicides and pesticides	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.	P	P	P	P	P	X
<b>IUCN 11: Climate Change</b>								
11.1.1	Habitat shifting or alteration: sea-level rise	Work with partners to develop climate change adaptation strategies, such as assisted migration for select species and habitats of conservation concern.	P	P	P	P	P	P
<b>IUCN 12: Resource Management Needs</b>								
12.1.1	Lack of initial baseline inventory	Conduct surveys to document the location and quality of key wildlife habitats.	X	X	X	X	X	X
12.1.2	Lack of up-to-date information	Establish and maintain long-term habitat monitoring programs in targeted areas.						X
12.1.3	Need to answer research questions	Conduct habitat research to determine BMPs, effects of fire, and natural fire regimes.	P	P	P	P		
12.1.3	Need to answer research questions	Determine forest matrix requirements to sustain functionality of smaller patch habitats found within forested systems.		P	P	P	P	
12.1.3	Need to answer research questions	Determine historical range of this key wildlife habitat and target priority sites for monitoring and research.	P	P	P	P	P	
12.2.1	Need to provide technical assistance	Develop and assist with implementation of habitat management guidelines for use by foresters and land managers including forest stewardship plans.	P	P	P	P	P	





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
12.2.1	Need to provide technical assistance	Maintain functioning subsurface habitats.					X	
12.2.1	Need to provide technical assistance	Include habitat protection and conservation needs in land management plans.	P	P	P	P	P	P
12.2.2	Need to conduct environmental reviews	Conduct reviews of land use change plans and encourage local, state, and federal agencies to incorporate habitat conservation actions and BMPs into land use change decisions.	P	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Work with local, state, and federal agencies to include habitat conservation BMPs and protection needs and actions into land use planning efforts and land management plans.	P	P	P	P	P	P
<b>IUCN 14: Education / Outreach Needs</b>								
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding the conservation of key wildlife habitats, their value, and their SGCN through social media, Master Naturalist training, and other efforts.	P	P	P	P	P	P
<b>IUCN 15: Administrative Needs</b>								
15.3.2	Need for coordination for effective program/project management	Utilize USACE, MDE, and CAC regulatory processes to protect habitat.						P
15.3.2	Need for coordination for effective program/project management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts.						X
15.3.2	Need for coordination for effective program/project management	Continue partnership with MDA to maintain a viable CREP agreement with FSA that achieves enrollment goals. Modify 2009 amendment and make changes as necessary.						X
15.3.2	Need for coordination for effective program/project management	Develop Conservation Innovation Grants (CIG) with NRCS to stimulate development and adoption of innovative conservation approaches and technologies in conjunction with agricultural and forestry practices.						X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
15.3.2	Need for coordination for effective program/project management	Develop Regional Conservation Partnership Program to leverage federal Farm Bill dollars with State and private funding to maximize effectiveness of conservation efforts.						X
15.3.2	Need for coordination for effective program/project management	Work closely with USDA and Congressional representatives to develop and implement subsequent Farm Bills.						X
15.3.2	Need for coordination for effective program/project management	Partner with National Association of Conservation Districts, National Association of State Conservation Agencies, National Association of Resource Conservation and Development Councils, National Conservation District Employees Association, and NRCS in developing the National Conservation Planning Partnership, a multi-year commitment to conservation planning.						X

**Conservation Actions for Coastal Beaches and Dunes**

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Coastal Beaches and Dunes Key Wildlife Habitats	Coastal Beach	Maritime Dune & Grassland
<b>IUCN 1 – 4: Urbanization / Development</b>				
1 - 4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	X	X
1 - 4	Habitat loss (from various causes)	Encourage implementation of BMPs that minimize and reduce habitat fragmentation in land use plans, especially for large, contiguous forest blocks and old growth conditions.	P	P
1 - 4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Coastal Beaches and Dunes Key Wildlife Habitats	Coastal Beach	Maritime Dune & Grassland
1 - 4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	
<b>IUCN 2: Agriculture and Aquaculture</b>				
2.4.2	Marine and freshwater aquaculture	Design and site aquaculture facilities in a manner that positively impacts estuarine and marine ecosystems.	P	
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1	Human Intrusions and Disturbance	Limit access when or where necessary to protect SGCN and their sensitive habitats.	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Work closely with all stakeholders to; 1) avoid potential impacts to natural resources by eliminating ORV use in sensitive habitats where appropriate and, 2) educate user groups on the value and importance of conserving SGCN habitat.	P	P
<b>IUCN 7: Natural System Modifications</b>				
7.3.1	Shoreline stabilization	Develop and implement shore erosion control practices (including living shoreline designs) that are compatible with cliff maintenance and the needs of SGCN.	P	
7.3.1	Shoreline stabilization	Repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines.	X	
7.3.4	Lack of ecosystem functions due to species loss	Restore functional dunes and native vegetation.	X	X
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1	Invasive non-native/alien species/diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P
8.1.4	Invasive non-native/alien species/diseases: invasive native terrestrial/ wetland animals	Manage the feral horse population on Assateague Island to reduce adverse habitat impacts.		P
8.1.5	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland plants	Develop and implement effective programs and methods to control invasive animals and plants and to prevent their establishment in a manner compatible with SGCN.	P	P
<b>IUCN 9: Pollution</b>				
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Coastal Beaches and Dunes Key Wildlife Habitats	Coastal Beach	Maritime Dune & Grassland
9.4.1	Garbage and solid waste	Develop and implement improved, effective trash pick-up systems in natural areas and other priority habitats.	P	
9.5.5	Air-borne pollutants: pesticides and herbicides	Develop a statewide inter-agency (MDA, MDE, MD DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.		P
9.5.5	Air-borne pollutants: pesticides and herbicides	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.		P
<b>IUCN 11: Climate Change</b>				
11.1.1	Habitat shifting or alteration: sea-level rise	Work with partners to develop climate change adaptation strategies, such as assisted migration for select species and habitats of conservation concern.	P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Use dredge spoil to protect and restore habitat from alterations due to sea-level rise.	P	P
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct surveys to document the location and quality of key wildlife habitats.	X	X
12.2.1	Need to provide technical assistance	Include habitat protection and conservation needs in land management plans.	P	P
12.2.2	Need to conduct environmental reviews	Conduct reviews of land use change plans and encourage local, state, and federal agencies to incorporate habitat conservation actions and BMPs into land use change decisions.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Work with local, state, and federal agencies to include habitat conservation BMPs and protection needs and actions into land use planning efforts and land management plans.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Work with the CAC and coastal counties to identify important Habitat Protection Areas for terrapins so those sites can be incorporated into local plans.	P	
<b>IUCN 14: Education/Outreach Needs</b>				
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding the conservation of key wildlife habitats, their value, and their SGCN through social media, Master Naturalist training, and other efforts.	P	P



**Conservation Actions for Wetland Habitats**

**Conservation Actions for Floodplain Wetlands**

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
<b>IUCN 1-4: Urbanization/Development</b>				
1-4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P
1-4	Habitat loss (from various causes)	Establish and maintain landscape-scale network of protected floodplain habitat as species dispersal and movement corridors.	P	P
1-4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P
1-4	Habitat loss (from various causes)	Establish and maintain appropriate buffers to wetlands through landowner incentive programs, acquisition, easements, regulatory means and implementation of BMPs. Expand buffers provided by regulation to afford adequate protection.	P	P
1-4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P
1-4	Habitat loss (from various causes)	Maintain wetland breeding habitat and adjacent upland non-breeding habitats (life zones) of SGCN.	P	P
1-4	Habitat loss (from various causes)	Protect rare natural communities associated with floodplain wetland systems (e.g., riverside prairies, Atlantic white cedar swamps, bald cypress swamps).	P	P
1-4	Habitat loss (from various causes)	Restore floodplain forests including reestablishment of old growth, natural hydrology, and improved water quality.	P	P
<b>IUCN 2: Agriculture and Aquaculture</b>				
2	Agriculture and aquaculture	Work with landowners, farming community, and MD Department of Agriculture (MDA) to develop and encourage the implementation of BMPs for agricultural practices and to conserve, restore, and protect wetlands through Farm Bill programs (e.g. Conservation Reserve Program) and other landowner incentives for the maintenance of habitats of SGCN.	P	P
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing	Ensure that sufficient regulatory protection is in place to prevent or minimize hydraulic fracturing impacts on wetlands and the surrounding forest matrix and watershed.	P	



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
3.2.2	Surface mining - rock quarry	Prevent/minimize rock and sand quarrying impacts to wetland areas and surrounding watersheds, including appropriate buffers.	X	X
<b>IUCN 4: Transportation and Service Corridors</b>				
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MDOT to improve transportation planning for new roads to minimize loss and fragmentation of habitat and negative impacts to SGCN; explore options for off-site mitigation.	P	P
4.1.1	Roads and railroads; land conversion from natural habitat to roads and railroads	Work with MDOT to construct roads in such a way that minimizes effects on movement patterns of SGCN, especially for amphibians and reptiles that use these wetlands year-round or seasonally as breeding habitat.	P	P
4.2.1	Utility and service lines	Coordinate with utility companies to improve habitat management in wetlands and wetland buffers.	X	X
<b>IUCN 5: Biological Resource Use</b>				
5.3	Logging and wood harvesting	Establish and maintain adequate forest buffers along streams and rivers using strategies such as working with watershed groups to encourage forest conservation.	P	P
5.3	Logging and wood harvesting	Restore forest cover to deforested watersheds/catchment basins/buffers by developing wetland habitat protection, restoration and management guidelines for public land managers and foresters.	P	P
5.3	Logging and wood harvesting	Work with forestry community to improve and enforce timber harvest BMPs for private landowners that protect wetlands and, where appropriate, the surrounding forest matrix with adequate connectivity between wetlands.	P	P
5.3.2	Logging and wood harvesting; intentional use - large scale	Utilize appropriate silvicultural treatments to ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls, downed wood, dense thickets, snags).	X	X
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1	Recreational activities	Coordinate with public land managers to protect wetlands from impacts of active recreational use.	P	P
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Reduce and, wherever possible, eliminate ORV use in wetlands and other fragile habitats; work with ORV industry to better inform riders of ecological impacts and responsibility; limit access when necessary.	P	P
<b>IUCN 7: Natural Systems Modifications</b>				
7	Natural systems modifications	Restore prior converted and other degraded wetlands to naturally functioning systems.	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
7.2	Dams and water management/use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology (includes beaver dams in wetland areas, which can be beneficial in small quantities, harmful when there are too many).	P	P
7.2	Dams and water management/use	Restore hydrology through ditch plugging, water control structures, and other appropriate practices.	P	P
7.3.3	Removal of coarse woody debris	Establish and maintain effective natural buffers adjacent to wetlands by restoring natural communities.	P	P
7.2.5 - 7.2.7	Dams and water management/use: groundwater withdrawal	Ensure that groundwater and surface water withdrawal for development and agriculture is adequately monitored and regulated such that these activities do not negatively impact SGCN and their habitats.	P	P
7.2.9	Dams and water management/use: small dams	Work with landowners to encourage retention of emergent wetlands (e.g. DO NOT impound).	X	X
7.2.14	Dams and water management/use: impervious surfaces	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to wetland areas.	P	P
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Allow natural reestablishment of beaver and manage populations to approximate natural conditions.	X	X
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore the Atlantic white-cedar component in Coastal Plain wetland systems.		X
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8	Invasive and other problematic species, genes, and diseases	Develop and implement protocols to control invasive species and prevent their establishment that is compatible with SGCN.	P	P
8.1.2	Invasive and other problematic species, genes, and diseases	Limit or prohibit the use of non-native fish as BMPs for mosquito control and vegetation management in wetlands.	X	X
8.1.2	Aquatic animals	Determine the ranges/current distribution of <i>Gambusia</i> .	X	X
8.1.4	Terrestrial/ wetland animals	Work with partners to control or eradicate populations of invasive, non-native terrestrial / wetland animals, such as nutria and emerald ash borer, using appropriate BMPs and effective education campaigns.	P	P
8.2.2	Problematic native species / diseases: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity to control populations and reduce browsing levels.	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
8.5.2	Viral/prion-induced diseases: <i>Ranavirus</i>	Promote disinfection protocols to minimize spread of <i>Ranavirus</i> .	P	P
<b>IUCN 9: Pollution</b>				
9.1.1	Domestic and urban waste water: sewage	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff to improve water quality within wetlands.	X	X
9.1.2	Domestic and urban waste water: run-off	Protect wetlands from contamination, siltation, and eutrophication by improving stormwater management practices and erosion control measures.	P	P
9.1.2	Domestic and urban waste water: run-off	Work with MDOT and local and county governments to reduce impacts from road salt, silt, pesticides and other runoff contaminants on wetlands.	X	X
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil and gas spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X
9.2.2	Industrial and military effluents: seepage from Mining	Restore wetlands affected by coal mining and acid mine drainage.	X	X
9.2.2	Industrial and military effluents: seepage from Mining	Work with mining industry and regulators to improve regulations and implementation in order to eliminate detrimental impacts to hydrology and water quality of wetlands.	P	P
9.2.3	Agricultural and forestry effluents: hydraulic fracturing	Establish baseline and follow-up monitoring of streams and wetlands that may be impacted by hydraulic fracturing.	X	
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian and wetland buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P
9.3.1	Agriculture and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.	P	P
9.5.5	Air-borne pollutants: pesticides and herbicides	Promote use of only highly selective pesticides to control pest insect species.	X	X
9.5.5	Air-borne pollutants: pesticides and herbicides	Prevent/minimize mosquito control impacts on wetlands; develop a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.	X	X
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Improve understanding (via surveys, remote sensing data, etc.) of the historical and current distribution, characteristics and condition of wetland habitats.	X	X





IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
12.2.2	Need to conduct environmental reviews	Incorporate habitat conservation actions and BMPs into project reviews and land use change decisions by local, state, and federal agencies.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat conservation needs and actions into local, state, and federal land use planning efforts and land management plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore wetlands on public lands and incorporate these measures in public land management plans, including forest stewardship plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P
<b>IUCN 14: Education/Outreach Needs</b>				
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Update information on rare wetland types by working with certified wetland delineators and agency regulators to more easily recognize these significant wetlands.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding necessary conservation of wildlife habitats and their SGCN.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Encourage landowners to reduce the use of fertilizers, such as through the Bay Wise Program.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Increase public awareness of sensitivity of wetlands to encroachment of introduced plants, including native species.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Promote guidelines for restoration of wetlands that incorporate natural processes and native natural communities.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, UME service professionals, and other resource professionals to help educated private landowners on the value of wetlands and buffers and provide management guidance (BMPs) on how to best conserve important habitats.	P	P
<b>IUCN 15: Administrative Needs</b>				
15.1.2	Need to maintain or improve information management systems	Regularly update GIS layers that identify forest interior habitats, Wetlands of Special State Concern, and other significant resources for use in local, state, and federal land planning and management.	P	P
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts.	X	X
15.3.3	Need for updates to existing laws/regulations and enacting new laws/regulations	Modify the loblolly pine seed tree law to so that forestry practices can more easily encourage the establishment of mixed deciduous-pine stands and more natural forest communities.		X



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
15.3.3	Need for increased legal protection	Modify, as needed, nontidal wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern, to better protect wetlands and surrounding wetlands.	P	P
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.	P	P
15.3.5	Need for changes in government policies	Work with public and private entities to improve SGCN habitat in areas that are managed for waterfowl.	X	X

**Conservation Actions for Groundwater Wetlands**

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
<b>IUCN 1-4: Urbanization/Development</b>														
1-4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	P	P	P	P	P	P	P
1-4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P	P	P	P	P	P	P	P	P	P	P
1-4	Habitat loss (from various causes)	Establish and maintain appropriate buffers to wetlands through landowner incentive programs, acquisition, easements, regulatory means and implementation of BMPs. Expand buffers provided by regulation to afford adequate protection.	P	P	P	P	P	P	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
1-4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P	P	P	P	P	P	P	P	P	P	P
1-4	Habitat loss (from various causes)	Maintain wetland breeding habitat and adjacent upland non-breeding habitats (life zones) of SGCN.	P	P	P	P	P	P	P	P	P		P	P
<b>IUCN 2: Agriculture and Aquaculture</b>														
2	Agriculture and aquaculture	Work with landowners, farming community, and MD Department of Agriculture (MDA) to develop and encourage the implementation of BMPs for agricultural practices and to conserve, restore, and protect wetlands through Farm Bill programs (e.g. Conservation Reserve Program) and other landowner incentives for the maintenance of habitats of SGCN.	P	P	P	P	P	P	P	P	P	P	P	P
<b>IUCN 3: Energy Production and Mining</b>														
3.1.1	Oil and gas drilling/pipelines: drilling and distribution of petroleum and other liquid hydrocarbons	Avoid or minimize gas and petroleum pipelines within sensitive wetland areas and their buffers.	P	P	P	P	P	P	P	P	P		P	P
3.1.2	Hydraulic fracturing	Ensure that sufficient regulatory protection is in place to prevent or minimize hydraulic fracturing impacts on wetlands and the surrounding forest matrix and watershed.	P	P	P								P	



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
3.2.2	Surface mining - rock quarry	Prevent/minimize rock and sand quarrying impacts to wetland areas and surrounding watersheds, including appropriate buffers.	X	X	X	X	X	X	X	X	X		X	X
3.3.1	Wind power	Site industrial wind development (including roads) in a manner that avoids or minimizes impacts to SGCN and habitat.						X						
<b>IUCN 4: Transportation and Service Corridors</b>														
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MDOT to improve transportation planning for new roads to minimize loss and fragmentation of habitat and negative impacts to SGCN; explore options for off-site mitigation.	P	P	P	P	P	P	P	P	P	X	P	P
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MDOT to construct roads in such a way that minimizes effects on movement patterns of SGCN, especially for amphibians and reptiles that use these wetlands year-round or seasonally as breeding habitat.	P	P	P	P	P	P	P	P	P	X	P	P
4.2.1	Utility service lines	Coordinate with utility companies to improve habitat management in wetlands and wetland buffers.	X	X	X	X	X	X	X	X	X	X	X	X
<b>IUCN 5: Biological Resource Use</b>														
5.3	Logging and wood harvesting	Restore forest cover to deforested watersheds/catchment basins/buffers by developing wetland habitat protection, restoration, and management guidelines for public land managers and foresters.	P	P	P	P	X	X	P	P	X	X	X	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
5.3	Logging and wood harvesting	Work with forestry community to improve and enforce timber harvest BMPs for private landowners that protect wetlands and, where appropriate, the surrounding forest matrix with adequate connectivity between wetlands.	P	P	P	P	P	P	P	P	P	P	P	P
5.3.2	Logging and wood harvesting; intentional use – large scale	Utilize appropriate silvicultural treatments to ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls, downed wood, dense thickets, snags).		X	X		X	X	X			X		
5.3.2	Logging and wood harvesting; intentional use – large scale	Protect, and where possible, restore old growth forest (including adequate no-cut buffers) on public and private lands, and where possible, expand these areas and promote the establishment of additional extensive tracts of old growth forest.		P	P		P	P	P			P		
<b>IUCN 6: Human Intrusions and Disturbance</b>														
6.1	Recreational activities	Limit public access to the most sensitive wetlands to avoid trampling and compaction.	X							X				
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Reduce and, wherever possible, eliminate ORV use in wetlands and other fragile habitats; work with ORV industry to better inform riders of ecological impacts and responsibility; limit access when necessary.	P	P	P	P	X	X	P	P	X	X	X	P
6.1	Recreational activities	Coordinate with public land managers to protect wetlands from impacts of active recreational use.	P	P	P	P	P	P	P	P	P	P	P	P
<b>IUCN 7: Natural Systems Modifications</b>														
7	Natural systems modifications	Restore prior converted and other degraded wetlands to naturally functioning systems.	P	P	P	P			P	P				P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
7.1.2	Fire and fire suppression: suppression of fire frequency / intensity	Implement prescribed burn programs, where appropriate as a restoration measure, to help control woody vegetation in wetlands and their buffers.								X	X			
7.1.2	Fire and fire suppression: suppression of fire frequency / intensity	Re-establish natural fire regimes to restore and maintain habitats.										X		
7.2	Dams and water management/ use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology (includes beaver dams in wetland areas, which can be beneficial in small quantities, harmful when there are too many).	P	P	P	P	P	P	P	P	P	P	P	P
7.2	Dams and water management/ use	Restore hydrology through ditch plugging, water control structures, and other appropriate practices.	P	P	P	P	P	P	P	P	P	P	P	P
7.2.5-7.2.7	Dams and water management/ use: groundwater withdrawal	Ensure that groundwater and surface water withdrawal for development and agriculture is adequately monitored and regulated such that these activities do not negatively impact SGCN and their habitats.	P	P	P	P	P	P	P	P	P	P	P	P
7.2.5-7.2.7	Dams and water management/ use: groundwater withdrawal	Protect the immediate catchment basin and groundwater supply feeding springs that support SGCN.												P
7.2.14	Dams and water management/ use: impervious Surfaces	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to wetland areas.				X	X	X			X		X	



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
7.3.3	Removal of coarse woody debris (streams, forests)	Establish and maintain effective natural buffers adjacent to wetlands by restoring natural communities.	P	P	P	P	P	P	P	P	P	P	P	P
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Allow natural reestablishment of beaver and manage populations to approximate natural conditions.		X	X				X					
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Promote the establishment and growth of floating-leaved and submerged vegetation.									X			
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore the Atlantic white-cedar component in Coastal Plain wetland systems.						X	X					
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore the northern conifer component (e.g., red spruce, eastern white pine, eastern hemlock) of bog-fen wetland complexes on the Allegheny Plateau.	X	X	X								X	
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	To the extent possible, manage habitats by mimicking natural disturbance patterns.									X			



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>														
8	Invasive and other problematic species, genes, and diseases	Develop and implement protocols to control invasive species and prevent their establishment that is compatible with SGCN.	P	P	P	P	P	P	P	P	P	P	P	P
8.1.2	Invasive non-native aquatic animals	Limit or prohibit the use of non-native fish as BMPs for mosquito control and vegetation management in wetlands.									X		X	
8.2.2	Problematic native species: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity to control populations and reduce browsing levels.	P	P	P	P	P	P	P	P	P	P	P	P
8.5.2	Viral/prion-induced diseases: <i>Ranavirus</i>	Promote disinfection protocols to minimize spread of <i>Ranavirus</i> .	P	P	P	P	P	P	P	P	P	P	P	P
<b>IUCN 9: Pollution</b>														
9	Pollution	Initiate measures to prevent and minimize pollution by surrounding the habitat with adequate buffers of native plant communities.					X	X			X		X	
9.1.1	Domestic and urban wastewater: sewage	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff to improve water quality within wetlands.	X	X	X	X	X	X	X	X	X	X	X	X
9.1.2	Domestic and urban wastewater: Run-off	Protect wetlands from contamination, siltation, and eutrophication by improving stormwater management practices and erosion control measures.	P	P	P	P	P	P	P	P	P	X	P	P
9.1.2	Domestic and urban wastewater: Run-off	Work with MDOT and local and county governments to reduce impacts from road salt, silt, pesticides and other runoff contaminants on wetlands.	X	X	X	X	X	X	X	X	X		X	X





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil and gas spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X	X	X	X	X	X	X	X	X	X	X
9.2.2	Industrial and military effluents: seepage from mining	Restore wetlands affected by coal mining and acid mine drainage.	X	X	X								X	
9.2.2	Industrial and military effluents: seepage from mining	Work with mining industry and regulators to improve regulations and implementation in order to eliminate detrimental impacts to hydrology and water quality of wetlands.	P	P	P	P			P	P				P
9.2.3	Hydraulic fracturing	Establish baseline and follow-up monitoring of streams and wetlands that may be impacted by hydraulic fracturing.	X	X	X								X	X
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian and wetland buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P	P	P	P	P	P	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.	X	X	X	X	P	P	X	X	P	X	P	X
9.4.1	Garbage and solid waste	Reduce wetland degradation from filling and garbage dumping by educating the public.		P										P
9.5.5	Air-Bourne Pollutants	Promote use of only highly selective pesticides to control pest insect species.	X	X	X	X	X	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
9.5.5	Air-borne pollutants: herbicides and pesticides	Prevent/minimize mosquito control impacts on wetlands; develop a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.	X	X	X	X	X	X	X	X	X	P	X	X
<b>IUCN 11: Climate Change and Severe Weather</b>														
11.1.1	Habitat shifting or alteration: sea-level rise	Plan for landward "migration" or shifting of habitats in coastal areas, such as increasing emphasis on conserving buffers and migration corridors.										P		
<b>IUCN 12: Resource Management Needs</b>														
12.1.1	Lack of initial baseline inventory	Complete a statewide inventory and ecological assessment of targeted wetlands, such as vernal pools, Delmarva bays, and intertidal flats.									P		P	X
12.1.1	Lack of initial baseline inventory	Improve understanding (via surveys, remote sensing data, etc.) of the historical and current distribution, characteristics and condition of wetland habitats.	X	X	X	X			X	X				X
12.1.2	Lack of up-to-date information	Establish and maintain long-term habitat monitoring programs, determine extent of marshes and economic value of ecosystem services.									P		P	P
12.1.3	Need to answer research question	Delineate the catchment areas for springs, seeps, and runs/headwater streams that support SGCN to improve effectiveness of conservation actions for those habitats.		X	X	X			X	X				P
12.2.2	Need to conduct environmental reviews	Incorporate habitat conservation actions and BMPs into project reviews and land use change decisions by local, state, and federal agencies.	P	P	P	P	P	P	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat conservation needs and actions into local, state, and federal land use planning efforts and land management plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P	P	P	P	P	P	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore wetlands on public lands and incorporate these measures in public land management plans, including forest stewardship plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P	P	P	P	P	P	P	P	X	P	P
<b>IUCN 14: Education/Outreach Needs</b>														
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Update information on rare wetland types by working with certified wetland delineators and agency regulators to more easily recognize these significant wetlands.	X	X	X	X	X	X	X	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding necessary conservation of wildlife habitats and their SGCN.	X	X	X	X	X	X	X	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Encourage landowners to reduce the use of fertilizers, such as through the Bay Wise Program.	X	X	X	X	X	X	X	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Increase public awareness of sensitivity of wetlands to encroachment of introduced plants, including native species.	X	X	X	X	X	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Promote guidelines for restoration of wetlands that incorporate natural processes and native natural communities.	X	X	X	X	X	X	X	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, extension service professionals, and other resource professionals to help educated private landowners on the value of wetlands and buffers and provide management guidance (BMPs) on how to best conserve important habitats.	P	P	P	P	P	P	P	P	P	P	P	P
<b>IUCN 15: Administrative Needs</b>														
15.1.2	Infrastructure needs: need to maintain or improve information management systems	Regularly update GIS layers that identify forest interior habitats, Wetlands of Special State Concern, and other significant resources for use in local, state, and federal land planning and management.	P	P	P	P	P	P	P	P	P	P	P	P
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts.	X	X	X	X	X	X	X	X	X	X	X	X
15.3.3	Need for updates to existing laws/regulations and enacting new laws/regulations	Modify the loblolly pine seed tree law so that forestry practices can more easily encourage the establishment of mixed deciduous-pine stands and more natural forest communities.						X	X	X	X	X	X	X
15.3.3	Need for increased legal protection	Modify, as needed, nontidal wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern, to better protect wetlands and surrounding wetlands	P	P	P	P	P	P	P	P	P		P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.	P	P	P	P	P	P	P	P	P	P	P	P

**Conservation Actions for Tidal Wetlands**

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
<b>IUCN 1-4: Urbanization/Development</b>							
1-4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P
1-4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P	P	P	P
1-4	Habitat loss (from various causes)	Establish and maintain appropriate buffers to wetlands through landowner incentive programs, acquisition, easements, regulatory means and implementation of BMPs. Expand buffers provided by regulation to afford adequate protection.	P	P	P	P	X
<b>IUCN 2: Agriculture and Aquaculture</b>							
2	Agriculture and aquaculture	Work with landowners, farming community, and MDA to develop and encourage the implementation of BMPs for agricultural practices and to conserve, restore, and protect wetlands through Farm Bill programs (e.g. Conservation Reserve Program) and other landowner incentives for the maintenance of habitats of SGCN.	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
2.4	Marine and freshwater aquaculture	Design and site aquaculture facilities in a manner that positively impacts estuarine and marine ecosystems.				X	X
<b>IUCN 3: Energy Production and Mining</b>							
3.3.1	Wind power	Site industrial wind development (including roads) in a manner that avoids or minimizes impacts to SGCN and habitat.	X	X	X	X	X
<b>IUCN 4: Transportation and Service Corridors</b>							
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MDOT to improve transportation planning for new roads to minimize loss and fragmentation of habitat and negative impacts to SGCN; explore options for off-site mitigation.	X	X	X	X	
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MDOT to construct roads in such a way that minimizes effects on movement patterns of SGCN, especially for amphibians and reptiles that use these wetlands year-round or seasonally as breeding habitat.	X	X	X	X	
4.2.1	Utility and service lines	Coordinate with utility companies to improve habitat management in wetlands and wetland buffers.	X				
<b>IUCN 5: Biological Resource Use</b>							
5.3	Logging and wood harvesting	Establish and maintain adequate forest buffers along streams and rivers using strategies such as working with watershed groups to encourage forest conservation.	P	P	X	X	
5.3	Logging and wood harvesting	Work with forestry community to improve and enforce timber harvest BMPs for private landowners that protect wetlands and, where appropriate, the surrounding forest matrix with adequate connectivity between wetlands.	P				
5.3.2	Logging and wood harvesting; intentional use – large scale	Utilize appropriate silvicultural treatments to ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls, downed wood, dense thickets, snags).	X				
<b>IUCN 6: Human Intrusions and Disturbance</b>							
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Reduce and, wherever possible, eliminate ORV use in wetlands and other fragile habitats; work with ORV industry to better inform riders of ecological impacts and responsibility; limit access when necessary.				X	



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
6.1.2	Recreational activities: boating	Limit access and educate the public about the value of these habitats to minimize human disturbance from boats and jet skis.		X	X	X	X
6.1.3	Recreational activities: use of beaches	Educate the public about the value of these habitats and their conservation to address human disturbance issues.		X	X	X	X
<b>IUCN 7: Natural Systems Modifications</b>							
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Implement BMPs and adaptive management methods for tidal marshes and associated impoundments.		X	X	X	
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Continue research on effects of fire on habitat, including loss of peat/soil substrate.			P	X	
7.2	Dams and water management/ use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology (includes beaver dams in wetland areas, which can be beneficial in small quantities, harmful when there are too many).	P	P	P	P	
7.2	Dams and water management/ use	Restore tidal flows to marshes by plugging ditches in a manner that minimizes conversion of marsh to open water.		P	P	P	
7.2.14	Dams and water management/ use: impervious Surfaces	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to wetland areas.		X			
7.3.3	Removal of coarse woody debris (streams, forests)	Establish and maintain effective natural buffers adjacent to wetlands by restoring natural communities.	P	P	P	P	
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>							
8	Invasive and other problematic species, genes, and diseases	Develop and implement protocols to control invasive species and prevent their establishment that is compatible with SGCN.	P	P	P	P	P
8.1.4	Terrestrial/ wetland animals	Manage the feral horse population on Assateague Island to reduce adverse impacts to habitats and SGCN.				P	



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
8.1.4	Terrestrial/ wetland animals	Work with partners to control or eradicate populations of invasive, non-native terrestrial /wetland animals, such as nutria and emerald ash borer, using appropriate BMPs and effective education campaigns.	P		P	P	
8.1.5	Terrestrial/ wetland plants	Work with partners to control or eradicate populations of invasive, non-native terrestrial /wetland plants, such as phragmites and purple loosestrife, using appropriate BMPs and effective education campaigns.	P	P	P	P	P
8.1.5	Terrestrial/ wetland plants	Develop and implement more effective methods of controlling phragmites.	X	X	X	X	X
8.2.2	Problematic native species: white-tailed deer	Work with partners to reduce and control white-tailed deer populations in riparian buffers to reverse browsing damage.	X				
<b>IUCN 9: Pollution</b>							
9	Pollution	Enhance point-source pollution control, such as upgrading wastewater treatment plants.	X	X	X		
9.1.1	Domestic and urban wastewater: sewage	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff to improve water quality within wetlands.	X	X	X	X	X
9.1.2	Domestic and urban wastewater: Run-off	Protect wetlands from contamination, siltation, and eutrophication by improving stormwater management practices and erosion control measures.	X	X	X	X	
9.1.3	Domestic and urban wastewater	Reduce impacts of water pollution from boats.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil and gas spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X	X	X	X
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian and wetland buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.	X	X	X	X	X
9.4.1	Garbage and solid waste	Reduce wetland degradation from filling and garbage dumping by educating the public.		X	X	X	





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
9.5.5	Air-borne pollutants: herbicides and pesticides	Promote use of only highly selective pesticides to control pest insect species.	X	X	X	X	
9.5.5	Air-borne pollutants: herbicides and pesticides	Prevent/minimize mosquito control impacts on wetlands; develop a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.	X	P	P	P	
<b>IUCN 11: Climate Change and Severe Weather</b>							
11.1.1	Habitat shifting or alteration: sea-level rise	Plan for landward "migration" or shifting of habitats in coastal areas, such as increasing emphasis on conserving buffers and migration corridors.	P	P	P	P	
11.1.1	Habitat shifting or alteration: sea-level rise	Develop new technologies to accelerate tidal marsh accretion, including the use of dredge spoil and thin-layering techniques.	X	P	P	P	
11.1.1	Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss compared to predicted changes due to sea level rise to better inform and improve models.	X	X	X	X	X
11.1.1	Habitat shifting or alteration: sea-level rise	Take measures to mitigate habitat change resulting from sea-level rise.	X	X	X	X	X
<b>IUCN 12: Resource Management Needs</b>							
12.1.1	Lack of initial baseline inventory	Complete a statewide inventory and ecological assessment of targeted wetlands, such as vernal pools, Delmarva bays, and intertidal flats.					X
12.1.2	Lack of up-to-date information	Establish and maintain long-term habitat monitoring programs, determine extent of marshes and economic value of ecosystem services.	X	X	X	X	X
12.1.3	Need to answer research question	Develop more effective methods to restore hydrology to wetlands degraded by ditching.	P	P	P	P	
12.2.2	Need to conduct environmental reviews	Incorporate habitat conservation actions and BMPs into project reviews and land use change decisions by local, state, and federal agencies.	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat conservation needs and actions into local, state, and federal land use planning efforts and land management plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate best BMPs into land management plans.	X	X	X	X	X
<b>IUCN 14: Education/Outreach Needs</b>							
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding necessary conservation of wildlife habitats and their SGCN.	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Encourage landowners to reduce the use of fertilizers, such as through the Bay Wise Program.	X	X	X	X	
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Promote guidelines for restoration of wetlands that incorporate natural processes and native natural communities.	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, extension service professionals, and other resource professionals to help educated private landowners on the value of wetlands and buffers and provide management guidance (BMPs) on how to best conserve important habitats.	P	P	P	P	P
<b>IUCN 15: Administrative Needs</b>							
15.1.2	Infrastructure needs: need to maintain or improve information management systems	Regularly update GIS layers that identify forest interior habitats, Wetlands of Special State Concern, and other significant resources for use in local, state, and federal land planning and management.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Collaborate with the implementation of the North American Waterfowl Plan.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Continue partnership with MDA to maintain a viable CREP agreement with FSA that achieves enrollment goals. Modify 2009 amendment and make changes as necessary.	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
15.3.2	Need for coordination for effective management	Coordinate efforts among agencies and NGOs to conserve habitat and maintain the integrity of aquatic and wetland systems across wide geographic areas and state boundaries, including targeting the highest quality areas.	P	P	P	P	P
15.3.2	Need for coordination for effective management	Develop Conservation Innovation Grants (CIG) with NRCS to stimulate development and adoption of innovative conservation approaches and technologies in conjunction with agricultural and forestry practices.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Develop Regional Conservation Partnership Program (RCPP) to leverage federal Farm Bill dollars with State and private funding to maximize effectiveness of conservation efforts.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Partner with National Association of Conservation Districts, National Association of State Conservation Agencies, National Association of Resource Conservation and Development Councils, National Conservation District Employees Association, and NRCS in developing the National Conservation Planning Partnership, a multi-year commitment to conservation planning.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Work with the Coastal Bay Program and other partnering entities to educate the public on land use and conservation issues	X	X	X	X	X
15.3.2	Need for coordination for effective management	Work with and utilize U.S. Army Corp of Engineers, MDE, and Critical Area Commission regulatory processes to protect habitat and ensure that appropriate resource protection measures are employed	P	P	P	P	P
15.3.2	Need for coordination for effective management	Work closely with USDA and Congressional representatives to develop and implement subsequent Farm Bills.	P	P	P	P	P
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts	X	X	X	X	X
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.	X	X	X	X	X



## Conservation Actions for Aquatic Habitats

### Conservation Actions for Streams and Rivers

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
<b>IUCN 1: Residential and Commercial Development</b>											
1	Residential and Commercial Development	Conserve and restore seepage, floodplain, and tidal wetlands associated with streams and rivers.	X	X	X	X	X	X	X	X	X
1	Residential and Commercial Development	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	P	P	P	P
1	Residential and Commercial Development	Pursue land protection/ conservation easements in stronghold watersheds and high quality aquatic habitats, and assess acquisition by evaluating SGCN and their key wildlife habitats.	P	P	P	P	P	P	P	P	P
1	Residential and Commercial Development	Use low impact development design, retrofits, and state-of-the-art storm water management and sediment erosion control practices to minimize development impacts.	P	P	P	P	P	P	P	P	P
1	Residential and Commercial Development	Preserve and enhance connectivity of critical habitats.	X	X	X	X	X	X	X	X	X
1.3.1	Land conversion from natural habitat to recreation or tourism areas (large and small)	Limit infrastructure development for recreation (such as trails, parking lots, etc.) in key areas for SGCN that are sensitive to disturbance (e.g., wood turtle, timber rattlesnake, salamanders).	X	X	X	X	X	P	X	X	X
<b>IUCN 2: Agriculture and Aquaculture</b>											
2	Agriculture and Aquaculture	Encourage farmers and landowners to become involved in Farm Bill programs and other landowner incentives, including the Conservation Reserve programs, for the maintenance of stream and riparian habitats and protection/conservation of wetlands, highly erodible lands, at-risk species and other wildlife on working lands.	P	P	P	X	X	X	X	X	X
2	Agriculture and Aquaculture	Work with landowners and farming community to develop and encourage BMPs for agricultural practices to conserve, restore and protect key wildlife habitats.	X	X	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
2.3	Livestock farming and ranching	Explore options to work with farmers to require stream buffers and livestock exclusion from streams.			X	X	X	X	P	X	X
<b>IUCN 3: Energy Production and Mining</b>											
3.1.2	Hydraulic fracturing	Site hydraulic fracturing development, gas extraction, and deep mining in a manner that avoids or minimizes impacts on SGCN and habitats.				X	X	X	X		
3.1.2	Hydraulic fracturing	Develop and implement BMPs for hydraulic fracturing that includes recommendations to address sediments and thermal pollution.				X		X	X		
3.1.2	Hydraulic fracturing	Limit groundwater and surface water withdrawals from industry, public consumption, and agriculture to maintain adequate stream flow and volume to sustain SGCN; use hydroassessments and permitting.	P	P	P	P	P	P	P	P	P
3.3.1	Wind power	Site industrial wind development (including roads) in a manner that avoids or minimizes species and habitat impacts.	X	X	X	X	X	X	X	X	X
<b>IUCN 4: Transportation and Service Corridors</b>											
4.1	Roads and railroads	Improve habitat connectivity in streams via blockage removal, culvert retrofit, and transportation BMPs; Prioritize these efforts into areas with the largest/best populations of SGCN and forage species supporting SGCN.	X		X	X	X	X		X	
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Incorporate state-of-the-art stream crossing design in planning for new roads to minimize geomorphic and hydrologic alterations and impacts to aquatic habitat and biota.	X	X	X	X	X	X	X	X	X
<b>IUCN 5: Biological Resource Use</b>											
5.1.3	Hunting and collecting terrestrial animals: persecution/ control	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating SGCN habitat; do so in a manner that avoids and minimizes nuisance issues and conflicts with other SGCN, unique natural communities, etc.	X	X	X	X	X	X	X	X	X
5.3.1	Logging and wood harvesting; intentional use - small scale	Work with foresters and land managers in implementing riparian habitat management guidelines.	X	X	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
<b>IUCN 7: Natural Systems Modifications</b>											
7.2	Dams and water management/use	Restore channelized streams to natural meanders.	X		X						
7.2	Dams and water management/use	Restore and conserve brook trout habitat in watersheds, especially in areas where populations are declining.				X					
7.2.3	Dams and water management/use: abstraction of surface water (domestic use)	Reduce stream channelization, ditching, impoundments which reduce access to spawning areas and take away habitat.	X	X	X	X	X	X	X	X	X
7.2.9	Dams and water management/use: small dams	Promote removal of dams and implement Executive Order 13508 that prompted the adoption of the 2014 Chesapeake Bay Watershed Agreement that included an outcome for opening 1000 miles of migratory fish passage by 2025.	P	P	P	X	P	X	X	P	P
7.2.14	Dams and water management/use: impervious surfaces	Limit impervious surfaces in watersheds; utilize MD DNR-developed impervious thresholds in land use planning to minimize SGCN and their habitats.	P	P	P	P	P	P	P	P	P
7.2.14	Dams and water management/use: impervious surfaces	Maintain and increase forest cover in watersheds including land acquisition.	P	P	P	P	P	P	P	P	P
7.2.3	Dams and water management/use: abstraction of surface water (agricultural use)	Minimize stream channelization and maintenance of ditched streams.	P		P	X	X	X		X	
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Reintroduce or augment certain SGCN in suitable habitats, when and where appropriate.	P	X	P	P	X	X	P	X	X
<b>IUCN 8: Invasive and other Problematic Species, Genes, and Diseases</b>											
8.1	Invasive non-native/alien species/diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P	P	P	P	P	P	P	P
8.1.2	Invasive non-native aquatic animals	Limit stocking of non-native trout in fall in streams that support hellbenders.				P			P		



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
8.1.2	Invasive non-native aquatic animals	Work with partners to control populations of invasive, non-native aquatic plants and animals, such as hydrilla, zebra mussel, northern snakehead and blue/flathead catfish, using appropriate BMPs and effective education campaigns.	P	P	P	X	X	X	X	X	P
8.2.2	Problematic native species/diseases: white-tailed deer	Work with partners to reduce and control white-tailed deer populations to reverse browsing damage; advocate for more liberal doe season to control white-tailed deer populations in specific areas.	X	X	X	X	X	X	X	X	X
<b>IUCN 9: Pollution</b>											
9	Pollution	Reduce impacts of water pollution from boats.		X							X
9	Pollution	Direct TMDL development and implementation into watersheds that will have the greatest benefit to SGCN.	X	X	P	X	X	X	X	P	P
9.1	Domestic and urban wastewater	Enhance point source pollution control.	X	X	X				X		P
9.1, 9.2, 9.3	Domestic and urban wastewater; industrial and military effluents; agricultural and forestry effluents	Reduce pollution from urban, industrial and agricultural sources by promoting activities that effectively lower TMDL's and meet water quality standards, as agreed upon in the 2014 Chesapeake Bay Watershed Agreement.	X	X	X	X	X	X	X	X	X
9.1.1	Domestic and urban wastewater: sewage	Work with partners to reduce deleterious contaminant (e.g., endocrine disrupting compounds) concentrations and upgrade wastewater treatment plants to improve water quality.	X	P	X	X	X	X	P	X	P
9.1.2	Domestic and urban wastewater: run-off	Assess impacts of road salt and fly ash application to stream habitats and SGCN and develop abatement measures or alternatives for road salt and fly ash application in sensitive stream habitats. Conduct a comprehensive examination of state-to-state road salt use and policy, study trends in stream conductivity and chloride levels, identify regional SGCN most vulnerable to high chloride levels, and identify areas where rare aquatic habitats and species coincide with high levels of salt application.	P	P	P	P	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
9.1.2	Domestic and urban wastewater: run-off	Develop education and outreach efforts regarding impacts from road salt and promote possible BMPs and alternatives to use in sensitive stream habitats and propose to MDOT/SHA. Include public health in advocacy and outreach efforts.	P	P	P	P	P	P	P	P	P
9.2.1	Industrial and military effluents: oil spills	Minimize risk of oil and chemical spills and respond immediately to contain spills when they occur; improve capacity for eliminating spills.	X	X	X	X	X	X	X	X	X
9.2.2	Industrial and military effluents: seepage from mining	Minimize acid mine drainage and mitigate damages resulting from such drainage.				X		P	X		
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P	P	P	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Implement BMPs for livestock grazing near streams.	X	X	X	P	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Work with partners, such as watershed groups, to implement BMPs to reduce non-point nutrient inputs and nutrient loads to protect and restore aquatic/riparian communities.	X	X	X	X	X	X	X	X	X
9.3.2	Agricultural and forestry effluents: soil erosion and sedimentation	Improve sediment and erosion control practices.	X	X	P	X	X	X	X	X	X
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Work with landowners and farming community to implement BMPs for nutrient and pesticide application.	X	X	X	X	X	X	X	X	X
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Work with landowners and farming community to develop and encourage BMPs for agricultural practices to reduce and restrict the flow of pesticides and other toxic contaminants into aquatic systems.	X	X	X	X	X	X	X	X	X
9.4.1	Garbage and solid waste: fishing line and other trash	Reduce trash dumping and fishing line dumping by educating the public.	X	X	X	X	X	X	X	X	X
9.5.1	Air-borne pollutants: acid rain	Increase efforts to continue research and monitoring for impacts and causes of acidic atmospheric deposition into Chesapeake Bay with specific restoration goals established in the 2014 Chesapeake Bay Watershed Agreement.	X	X	X	X	X	X	X	X	X





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
9.6.2	Excess energy: thermal pollution	Work with power companies to address thermal pollution (e.g., warm water discharges, hypolimnetic releases, utility rights-of-way clearings from electric power generation.		X					X		X
<b>IUCN 11: Climate Change and Severe Weather</b>											
11.1.1	Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss to predicted changes in sea level.	X	X	X						
11.1.1	Habitat shifting or alteration: sea-level rise	Take measures to mitigate habitat change resulting from sea-level rise.	X	X	X						
11.3	Temperature extremes	Evaluate habitat change and loss predicted due to changes in thermal regime and precipitation patterns.	P	P	P	P	P	P	P	P	P
11.3	Temperature extremes	Take measures to mitigate habitat change resulting from changes in thermal regime and precipitation patterns, including limiting impervious surfaces, surface and groundwater abstraction, damming, and buffer encroachment in streams with sensitive species.	P	P	P	P	P	P	P	P	P
<b>IUCN 12: Resource Management Needs</b>											
12.1.1	Lack of initial baseline inventory	Assess stream habitats and identify areas where restoration is feasible with high likelihood of success and prioritize for biological recovery.	X	X	X	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Establish and maintain long-term habitat monitoring programs for health and condition of stream.	P	X	P	P	P	P	X	P	X
12.1.2	Lack of up-to-date existing information	Encourage and assist with the development of citizen science groups (e.g. Trout Unlimited) to participate in stream assessments, spawning surveys, etc.	X	X	X	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Continue annual stream surveys for water quality and rapid assessment of habitat conditions, with special focus on brackish, tannic, and freshwater habitats.	P	P	P	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Assess status of Maryland Coastal Bays and Assateague aquatic communities with MD DNR Stream Waders collection opportunities.	X	X	X						
12.2.3	Need for fish, wildlife and/or habitat planning	Work with watershed management plans to conserve streams and rivers.	P	P	P	P	X	P	P	X	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate conservation actions and BMPs into public land management plans by local, state, and federal agencies; include habitat protection, connectivity and restoration needs in public land management plans and overall improvement of managing state lands for the promotion and conservation of SGCN and their habitats.	P	P	P	X	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Develop a statewide survey to assess the chemical, physical, and biological condition of large rivers and prioritize areas for conservation.		X					X		X
12.2.3	Need for fish, wildlife and/or habitat planning	Target and promote stream restoration and associated BMPs in minimally-impaired, stronghold watersheds to improve conditions in MD's best-remaining stream habitats.	P	P	P	P	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Develop a 'watershed champion' program on a county/watershed level and develop a model for a high quality example (e.g. Mattawoman Creek).	X	X	X	X	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Conduct a partner-wide assessment of existing protection and restoration efforts to create an up-to-date record of programs.	X	X	X	X	X	X	X	X	X
<b>IUCN 14: Education/Outreach Needs</b>											
14.3.1	Outreach needs: need to develop or maintain a broad base of support	Develop and disseminate public educational materials and improve public outreach efforts, especially about 1) recreational impacts and ways to minimize them, 2) working with non-commercial residential landowners to implement BMPs for nutrient and pesticide application in their backyards & gardens.	X	X	X	X	X	X	X	X	X
14.3.1	Outreach needs: need to develop or maintain a broad base of support	Educate the public regarding necessary conservation of wildlife habitats and their SGCN; target behavior change outreach and education with watershed conservation through hands on, localized stewardship activities.	P	P	P	P	P	P	P	P	P
14.3.1	Outreach needs: need to develop or maintain a broad base of support	Develop a social marketing strategy to promote awareness and conservation of high quality watersheds.	X	X	X	X	X	X	X	X	X
14.3.1	Outreach needs: need to develop or maintain a broad base of support	Provide local governments with infrastructure or information needed to protect water quality and ensure standards in watersheds.	X	X	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
<b>IUCN 15: Administrative Needs</b>											
15.1.2	Need to maintain or improve information management systems	Improve completeness of maps for recognized blue line streams, including intermittent streams.	X	X	X	X	X	X	X	X	X
15.3.2	Need for coordination for effective program/project management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate stream conservation efforts.	P	P	P	P	P	P	P	P	P
15.3.2	Need for coordination for effective program/project management	Follow conservation implementation strategies from the North American Waterfowl Plan where/when appropriate.	X	X	X						
15.3.2	Need for coordination for effective program/project management	Coordinate efforts among agencies, counties, volunteer groups, and NGOs to conserve habitat and maintain the integrity of aquatic and wetland systems across wide geographic areas and state boundaries, including targeting the highest quality areas.	P	P	P	X	X	P	P	X	X
15.3.2	Need for coordination for effective program/project management	Utilize MCBP, USACE, MDE, and Critical Area Commission regulatory processes to protect habitat.	P	P	P						
15.3.2	Need for coordination for effective program/project management	Continue partnership with MDA to maintain a viable Conservation Reserve Enhancement Program agreement with Farm Service Agency that achieves enrollment goals. Modify 2009 amendment and make changes as necessary.	X	X	X						
15.3.2	Need for coordination for effective program/project management	Coordinate with partner organizations to develop a citizen science symposium statewide.	X	X	X	X	X	X	X	X	X
15.3.2	Need for coordination for effective program/project management	Support and promote local watershed groups for policy change and outreach. Continue the development and sustainability of these groups through grant writing, funding sources, and outreach.	P	P	P	P	P	P	P	P	P
15.3.2	Need for coordination for effective program/project management	Develop Conservation Innovation Grants (CIG) with NRCS to stimulate development and adoption of innovative conservation approaches and technologies in conjunction with agricultural and forestry practices.	X	X	X						



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
15.3.2	Need for coordination for effective program/project management	Develop Regional Conservation Partnership Program to leverage federal Farm Bill dollars with State and private funding to maximize effectiveness of conservation efforts.	X	X	X						
15.3.2	Need for coordination for effective program/project management	Work closely with USDA and Congressional representatives to develop and implement subsequent Farm Bills.	P	P	P						
15.3.2	Need for coordination for effective program/project management	Further encourage the development and implementation of Tier III CWA Anti-Degradation policy within DNR and MDE.	X	X	P	X	X	X	X	X	X
15.3.2	Need for coordination for effective program/project management	Coordinate and communicate with local Chesapeake Bay advisory groups. Support these groups with up to date, sound science data and assist in interpreting the data.	X	X	X	X	X	X	X	X	X
15.3.2	Need for coordination for effective program/project management	Partner with National Association of Conservation Districts, National Association of State Conservation Agencies, National Association of Resource Conservation and Development Councils, National Conservation District Employees Association, and NRCS in developing the National Conservation Planning Partnership, a multi-year commitment to conservation planning.	X	X	X						
15.3.3	Need for increased legal protection	Improve regulatory protection for intermittent streams.	P	P	P	P	P	P	P	P	P
15.3.3	Need for increased legal protection	Advocate for the adoption of revised water quality criteria standards for ammonia, chloride, and other pollutants that impact SGCN. Implement these guidelines and ensure adherence to legal standards.	P	P	P	P	P	P	P	P	P



Conservation Actions for Bays and Ocean

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
<b>IUCN 1: Residential and Commercial Development</b>							
1	Residential and Commercial Development	Preserve and enhance connectivity of critical habitats.	X	X	X	X	X
1	Residential and Commercial Development	Use low impact development design, retrofits, and state-of-the-art storm water management and sediment erosion control practices to minimize development impacts.	P	P	P	P	P
<b>IUCN 2: Agriculture and Aquaculture</b>							
2	Agriculture and Aquaculture	Encourage farmers and landowners to become involved in Farm Bill programs and other landowner incentives, including the Conservation Reserve programs, for the maintenance of stream and riparian habitats and protection/conservation of wetlands, highly erodible lands, at-risk species and other wildlife on working lands.	P	P	X	P	X
<b>IUCN 3: Energy Production and Mining</b>							
3.2.4	Mining and quarrying: sand dredging (outside shipping lanes)	Ensure sand mining activity is limited to areas of least impact.	P	P	P	X	X
3.3.1	Wind power	Site offshore wind energy development in a manner that avoids or minimizes impacts on SGCN and habitats.	P	P	P		
3.3.1	Wind power	Develop and implement BMPs for offshore wind that includes recommendations to address impacts to habitats and SGCN.	P	P	P		
3.3.1	Wind power	Determine potential impacts of offshore wind energy development and take measures to avoid and minimize these impacts.	P	P	P		
<b>IUCN 4: Transportation and Service Corridors</b>							
4.3.2	Shipping lanes: dredging impacts	Provide Environmental Review and resource managers with information on habitat use by species so that dredging of those habitats is strongly discouraged.	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
<b>IUCN 5: Biological Resource Use</b>							
5.4.2	Fishing and harvesting of aquatic resources: intentional use (large scale)	Assess impacts of fishing gear and practices to habitats and SGCN and develop BMPs to mitigate these effects.	X	X	X	X	X
<b>IUCN 6: Human Intrusions and Disturbance</b>							
6.1	Recreational activities	Reduce recreational impacts by educating the public about these impacts and ways to minimize them.	P	X	X	X	X
<b>IUCN 7: Natural Systems Modifications</b>							
7.2.9	Dams and water management/use: small dams	Promote removal of dams and implement executive order 13508 that prompted the adoption of the 2014 Chesapeake Bay Watershed Agreement that included an outcome for opening 1000 miles of migratory fish passage by 2025.	P				
7.2.14	Dams and water management/use: impervious surfaces	Limit impervious surfaces in watersheds; utilize MD DNR developed impervious thresholds in land use planning to minimize impacts on SGCN and their habitats.	P	P	P	P	P
7.3.1	Shoreline stabilization	Work with partners to implement compatible shore erosion techniques.	X	X	X	X	X
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Reestablish submerged aquatic vegetation beds in areas where they formerly occurred and where habitat conditions have improved since their disappearance.				X	X
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>							
8.1.2, 8.1.3	Invasive, non-native aquatic animals	Work with partners to control populations of invasive, non-native aquatic plants and animals using appropriate BMPs and effective education campaigns.	P	P	P	P	P
<b>IUCN 9: Pollution</b>							
9	Pollution	Identify types, sources, and effects of aquatic contaminants, including endocrine disrupting chemicals on SGCN and their habitats.	P	P	X	X	X
9	Pollution	Reduce presence of aquatic contaminants.	P	P	X	X	X
9.1	Pollution	Reduce impacts of water pollution from boats.	X	X	X	X	X
9.1, 9.2, 9.3	Domestic and urban wastewater; industrial and military effluents; agricultural and forestry effluents	Reduce pollution from urban, industrial and agricultural sources by promoting activities that effectively lower TMDL's and meet water quality standards, as agreed upon in the 2014 Chesapeake Bay Watershed Agreement.	P	P	P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
9.1.1	Domestic and urban wastewater: sewage	Work with partners to increase the number of pump-out stations.	X	X	X	X	X
9.1.1	Domestic and urban wastewater: sewage	Work with partners to reduce deleterious contaminant concentrations and upgrade wastewater treatment plants to improve water quality.	P	P	P	P	P
9.2	Industrial and military effluents	Enhance point source pollution control.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Maintain capacity for efficient wildlife oil spill response by training personnel in Incident Command System.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Respond to oil spills immediately and efficiently by maintaining reliable watercraft and train personnel in their safe operation.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Maintain contact with the Mid-Atlantic Regional Response Team.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Monitor key beach habitats and wildlife populations in areas vulnerable to oil spills and have a mechanism to share maps and data at short notice.	X	X	X	X	X
9.3.1	Agricultural and forestry effluents: nutrient loads	Work with landowners and farming community to implement BMPs for nutrient and pesticide application.	P	P	X	P	P
<b>IUCN 11: Climate Change and Severe Weather</b>							
11.1.1	Habitat shifting or alteration: sea level rise	Evaluate climate change (e.g., sea level rise, warming temperatures, brown tide) impacts to habitat quality and quantity; evaluate coastal resiliency information.	X	P	X	P	P
11.1.1	Habitat shifting or alteration: sea level rise	Take measures to mitigate habitat change resulting from sea-level rise.	X	P	X	P	P
11.1.1	Habitat shifting or alteration: sea level rise	Evaluate ocean acidification impacts to habitat quality and quantity and SGCN.	P	P	P	P	P
<b>IUCN 12: Resource Management Needs</b>							
12.1.1	Lack of initial baseline inventory	Characterize critical offshore habitat, migratory pathways, biological populations and ecological processes for use in long-term ecosystem-based management.	X	X	X		
12.1.2	Lack of up-to-date existing information	Maintain Coastal Bay water quality monitoring programs (and collaboration between listed partners) to assess nutrient loading ecosystem stressors and living resource responses.	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Monitor and assess harmful algae species, frequency, duration, and effects in aquatic habitats.	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
12.1.2	Lack of up-to-date existing information	Expand and update data and information in MD DNR's Coastal Atlas for use in coastal planning activities.	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Develop a cooperative management protection plan for Assateague Island that addresses SGCN seasonal needs.	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Implement recommendations in the Maryland Coastal Bays Management Plan.	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Implement required management actions in approved fishery management plans.	X	X		X	X
<b>IUCN 14: Education/Outreach Needs</b>							
14.3.1	Need to develop and/or maintain a broad base of support for agency goals and objectives	Improve and promote education and public outreach efforts to engage them in promoting conservation and restoration of high quality habitats and SGCN.	X	X	X	X	X
<b>IUCN 15: Administrative Needs</b>							
15.3.2	Need for coordination for effective program/project management	Coordinate conservation efforts between various interest groups and agencies and across states boundaries, especially in shared waterbodies.	X	X	X	X	X
15.3.2	Need for coordination for effective program/project management	Coordinate efforts with various programs including the Chesapeake Bay Foundation, Alliance for the Chesapeake Bay, Chesapeake Bay Program, etc. to initiate measures to protect, maintain and improve all species habitats and populations.	X	X	X	X	X
15.3.5	Need for changes in government policies	Establish policies that reduce oil spill likelihood (e.g., vessel mandates).	P	X	X	X	X





## Conservation Actions for Subterranean Habitats

### Conservation Actions for Cave and Karst

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Cave and Karst Habitats	Action Priority Type
<b>IUCN 1-4: Urbanization/Development</b>			
1-4	Habitat loss (from various causes)	Protect high priority cave ecosystems (e.g., Ecologically Significant Areas, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and groundwater aquifers.	P
1-4	Habitat loss (from various causes)	Restore and protect natural sinkholes as vital components of karst groundwater and cave ecosystems.	X
1-4	Habitat loss (from various causes)	Work with industry and regulators to improve regulations and implementation in order to avoid or minimize detrimental impacts to hydrology from drainage, ditching, filling, water withdrawal, mining, and other damaging practices resulting from land-use changes.	P
<b>IUCN 3: Energy Production and Mining</b>			
3.2	Mining and quarrying	Protect cave ecosystems and surrounding forested buffers from future mining by siting and configuring mining operations in a manner that avoids or minimizes impacts to priority habitats harboring SGCN.	P
<b>IUCN 5: Biological Resource Use</b>			
5.3	Logging and wood harvesting	Protect water quality within catchment basins of SGCN inhabited caves, sinkholes, and subterranean springs by maximizing forest cover and implementing appropriate forestry BMPs.	X
<b>IUCN 6: Human Intrusions and Disturbance</b>			
6.1.4	Recreational activities: exploration of caves/mines	Educate both the general public and spelunkers about the value of these habitats and the impacts of disturbance to caves and mines supporting SGCN.	P
6.1.4	Recreational activities: exploration of caves/mines	Install and maintain appropriate cave and mine entrance gates to protect cave fauna, especially SGCN.	P
6.1.4	Recreational activities: exploration of caves/mines	Limit access to minimize human disturbance in sensitive cave/mine/tunnel habitats harboring SGCN.	P
<b>IUCN 7: Natural Systems Modifications</b>			
7.2	Dams and water management/use	Protect groundwater supply feeding subterranean springs inhabited by SGCN.	P
7.2.14	Dams and water management/use: impervious surfaces	Improve stormwater management practices and sediment erosion control measures to avoid or minimize development impacts to groundwater aquifers.	P
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>			
8	Invasive and Other Problematic Species, Genes, and Diseases	Develop and implement protocols to control invasive species in a manner compatible with SGCN.	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions for Cave and Karst Habitats	Action Priority Type
8.1.2	Invasive non-native aquatic animals: white-nose syndrome	Rigorously perform protocols for decontamination of equipment and clothing to avoid the spread of fungal spores by humans.	P
<b>IUCN 9: Pollution</b>			
9.1, 9.3	Domestic and urban wastewater; agricultural and forestry effluents	Initiate measures to prevent pollution of sinking or losing streams associated with subterranean habitats through retention or development of adequate vegetated buffers.	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Protect water quality of cave ecosystems and surrounding buffer habitats by restricting livestock access to vital groundwater components, particularly sinkholes, springs, sinking streams and cave entrance areas.	X
9.3.2	Agricultural and forestry effluents: soil erosion and sedimentation	Minimize or eliminate soil disturbance in estimated catchment basins; restore forest cover to deforested catchment basins.	X
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.	X
<b>IUCN 12: Resource Management Needs</b>			
12.1.1	Lack of Initial Baseline Inventory	Determine the extent of groundwater aquifers for highest priority cave systems harboring SGCN.	P
12.1.2	Lack of up-to-date information	Continue research into the composition, distribution, and abundance of groundwater and cave obligate fauna in Maryland.	X
12.1.3	Need to answer research question	Determine reasons for bat survival in tunnels and extend knowledge to restore bat populations in caves.	P
12.2.1	Need to provide technical assistance	Work with MDE Mining Program to protect deep mines supporting SGCN.	P
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate habitat conservation actions and protection needs into land planning efforts and public land management plans by local, state, and federal agencies.	P



Conservation Actions for Other Habitats

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
<b>IUCN 1-4: Urbanization/Development</b>									
1 - 4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	X		P			P
1 - 4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	X	X	X	X			
1 - 4	Habitat loss (from various causes)	Establish and maintain appropriate buffers to wetlands through landowner incentive programs, acquisition, easements, regulatory means and implementation of BMP's.				X			
1-4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.				X			
1 - 4	Habitat loss (from various causes)	Avoid and minimize development impacts within wetland areas and their surrounding buffers.				X			
1 - 4	Habitat loss (from various causes)	Encourage implementation of BMP's that minimize and reduce habitat fragmentation in land use plans.	X	X	X	X			
<b>IUCN 2: Agriculture and Aquaculture</b>									
2	Agriculture and Aquaculture	Work with farmers to conserve and manage for this habitat for SGCN on marginal croplands and encourage beneficial agricultural practices (e.g., late mowing, grass forb buffers in agricultural settings, farm bill programs, other landowner incentives) through existing programs (Farm Bill and Conservation Reserve programs) and by developing new incentives.	P	P		P			



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
2	Agriculture and Aquaculture	Work with farming community to create and maintain ecologically functioning artificial wetlands.				X			
<b>IUCN 3: Energy Production and Mining</b>									
3.1.1	Drilling and distribution of petroleum and other liquid hydrocarbons	Avoid and minimize all impacts to wetlands and their surrounding buffers from gas and oil pipelines.				P			
3.1.2	Hydraulic fracturing	Ensure that sufficient regulatory protection is in place to prevent or minimize hydraulic fracturing impacts on wetlands and the surrounding forest matrix and watershed.				P			
3.2.1	Surface mining – coal strip mining	Site and configure industrial surface mines in a manner that avoids and minimizes impacts to SGCN and habitats.	X					X	
3.2.2	Surface mining – rock quarry	Prevent/minimize rock and sand quarrying to wetland areas and surrounding watersheds, including appropriate buffers.				X			
3.3.1	Wind power	Work to develop and implement operational BMPs to reduce impacts of wind farms on this habitat and associated SGCN.	X						
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes impacts to SGCN and habitats.	X						
<b>IUCN 4: Transportation and Service Corridors</b>									
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MD DOT to better plan and construct transportation infrastructure, including planning for new roads, to minimize habitat fragmentation, and to provide adequate dispersal/movement corridors for SGCN.	X	X		P			
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MD DOT to avoid and minimize wetland impacts and to better target offsite wetland mitigation.				P			
<b>IUCN 5: Biological Resource Use</b>									



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
5.3	Logging and wood harvesting	Work with the forestry community to develop timber harvest BMPs for private landowners that protect wetlands and other KWHs, and, where appropriate, the surrounding forest matrix with adequate connectivity between habitats.	P	X	P	P			X
5.3	Logging and wood harvesting	Protect water quality within catchment basins of SGCN inhabited caves, sinkholes, and subterranean springs by maximizing forest cover and implementing appropriate forestry BMPs.						X	
<b>IUCN 6: Human Intrusions and Disturbance</b>									
6.1.1	Recreational activities: off-road vehicles	Reduce and, wherever possible, eliminate off-road vehicle (ORV) use in wetlands and other fragile habitats; work with ORV industry to better inform riders of ecological impacts and responsibility; limit access when necessary.	X	P				X	P
6.1.4	Recreational activities: exploration of caves/mines	Educate spelunkers about the value of these habitats and the impacts of disturbance to mines supporting SGCN.						X	
6.1.4	Recreational activities: exploration of caves/mines	Install and maintain appropriate gates at entrances to mines and tunnels that support SGCN to minimize human disturbance.						P	
<b>IUCN 7: Natural Systems Modifications</b>									
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation.	X	X					X
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Utilize appropriate prescribed burning in or light disking of selected portions of individual fields to maintain early-successional seral stages and increase coverage of tall forbs.		X					



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
7.2	Dams and water management/use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology.				P			
7.2.5 & 7.2.6	Dams and water management/use: abstraction of ground water (domestic use; commercial use)	Protect groundwater supply feeding springs inhabited by SGCN from excessive withdrawal for both domestic and commercial uses.						X	
7.2.5-7.2.7	Dams and water management/use: abstraction of ground water (domestic use; commercial use; agricultural use)	Ensure that groundwater and surface water withdrawal for development and agriculture is adequately monitored and regulated such that these activities do not negatively impact SGCN and their habitats.				P			
7.2.9	Dams and water management/use: small dams	Work with landowners to encourage retention of natural emergent wetlands (e.g., careful review of proposals for new impoundments).				P			
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating SGCN habitat; do so in a manner that avoids and minimizes nuisance issues and conflicts with other SGCN, unique natural communities, etc.	P			X			
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Promote the establishment and growth of floating-leaved and submerged vegetation.				X			
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>									
8	Invasive and Other Problematic Species, Genes, and Diseases	Develop and implement protocols to control invasive plants in a manner compatible with SGCN; increase awareness outreach efforts.	P	P	X	P	X	X	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
8	Invasive and Other Problematic Species, Genes, and Diseases	Implement appropriate Integrated Pest Management practices to minimize the effects of serious forest animal and plant pest species while protecting non-target SGCN.	X		X				
8.1.2	Invasive non-native aquatic animals	Prohibit the use of non-native fish as BMPs for mosquito control and vegetation management in wetlands.				X			
8.1.2	Invasive non-native aquatic animals	Rigorously perform protocols for decontamination of equipment and clothing to avoid the spread of fungal spores by humans.						P	
8.1.5	Invasive non-native terrestrial/wetland plants	Implement training and operational BMPs to control and reduce the spread of invasive species by field personnel.	X	P		P		P	P
8.2.2	Problematic native species/diseases: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity; control populations to reduce negative browsing impacts in habitats with SGCN.	P	P	X	P			P
8.3.1	Introduced genetic material: herbicide resistant crops	Create and manage habitat for pollinators using locally native seed mixes; select these areas along roads and highways, adjacent to cropland, utility rights of way areas, and other habitat areas.	X	P		X			P
<b>IUCN 9: Pollution</b>									
9	Pollution	Initiate measures to prevent and minimize pollution by surrounding the habitat with adequate buffers of native plant communities.				X		X	
9	Pollution	Protect wetlands from contamination, siltation, and eutrophication. (improve stormwater management practices and emergent control measures).				P			
9.1	Domestic and urban wastewater	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff.				X			
9.1.2	Domestic and urban wastewater: run-off	Minimize runoff from roads, which contains silt, salt, and other contaminants.				X			



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
9.2.2	Industrial and military effluents: seepage from mining	Restore wetlands affected by acid mine drainage.				X			
9.2.3	Industrial and military effluents: hydraulic fracturing	Establish baseline and follow-up monitoring of streams and wetlands that may be impacted by hydraulic fracturing.				X			
9.3.1	Agricultural and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.				P			
9.3.3	Agricultural and forestry effluents: control of insect pests leading to mortality of non-target species	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.	X	P		X		X	P
9.5.5	Air-borne pollutants: herbicides and pesticides	Prevent/minimize mosquito control impacts on wetland ecosystems; establish a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.				X			
<b>IUCN 12: Resource Management Needs</b>									
12.1.1	Lack of initial baseline inventory	Work with the public and land managers to identify important KWH areas.	X	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Work with MDE to update the list of Wetlands of Special Concern, including high quality vernal pools, and improve regulatory protection of these areas.				P			
12.1.3	Need to answer research question	Determine reasons for bat survival in tunnels and extend knowledge to restore bat populations in caves.						P	
12.1.3	Need to answer research question	Determine historical range of this key wildlife habitat and target priority sites for monitoring and research.		X					





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
12.1.3	Need to answer research question	Conduct habitat research to determine BMPS, effects from fire, and natural fire regime.		X					
12.1.3	Need to answer research question	Delineate watersheds for mines and tunnels with springs harboring rare subterranean aquatic invertebrates.						X	
12.2.1	Need to provide technical assistance	Encourage management for grassland species on reclaimed mine lands. Encourage the use of native seed stock for warm season grass plantings.		P					
12.2.1	Need to provide technical assistance			P					P
12.2.1	Need to provide technical assistance	Develop and assist with implementation of habitat management guidelines for use by foresters and land managers including forest stewardship plans.	P	P	X	X			P
12.2.3	Need for fish, wildlife, and/or habitat planning	Incorporate BMPs and habitat protection needs into land management plans to benefit SGCN.	X	X	P	P	X	P	P
12.2.3	Need for fish, wildlife, and/or habitat planning	Incorporate conservation actions and BMPs into land use change decisions, land planning efforts, and public land management plans by local, state, and federal agencies.	X	P		X	X	X	P
<b>IUCN 14: Education/Outreach Needs</b>									
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public on best practices to create and maintain artificial structures highly beneficial to SGCN.					X		
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, extension service professionals, and other resource professionals to educate private landowners on the value of wildlife habitats and on BMPs to conserve them.	X	X	X	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Increase environmental education opportunities and training for the general public with Key Wildlife Habitats; coordinate with UME and conduct Master Naturalist Trainings.	X	X	X	X	X	X	X
<b>IUCN 15: Administrative Needs</b>									
15.3.2	Need for coordination for effective management	Work with Bureau of Mines to protect mines supporting SGCN.						X	
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, federal programs, and all conservation partners to expand and coordinate conservation efforts for key wildlife habitats.	X	X	X	X	X	X	X
15.3.3	Need for increased legal protection	Modify, as needed, nontidal wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern, to better protect wetlands and surrounding wetlands.				P			
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.				X			X
15.3.5	Need for changes in government policies	Work with other resources professionals and partners to modify practices on artificial wetlands being managed for waterfowl to improve habitat for SGCN.				P			
15.3.5	Need for changes in government policies	Encourage the conversion of agricultural fields and mowed lawns on public lands to meadows and grassland habitat where feasible.		P					



## Conservation Actions for Species of Greatest Conservation Need

Conservation actions for implementation specific to SGCN taxa groups and individual species are organized below by seven main taxa groups: mammals, birds, reptiles and amphibians, fish, insects, crayfish, and freshwater mussels. The actions listings move from broad to narrow in scope, with actions for the overall taxa group listed first. Individual species for which the action applies are listed under each conservation action. The following organizational chart lists the taxa groups as divided for the conservation actions listing. The priority conservation actions listings follow this system.

### Organization of Maryland’s Species of Greatest Conservation Need for Conservation Actions

#### Mammals

- Insectivores
- Lagomorphs and rodents
- Carnivores
- Bats
- Marine mammals

#### Birds

- Mature upland forest birds
- Grassland early successional birds
- Colonial and coastal birds
- Wetland birds
- Aquatic birds
- Miscellaneous birds

#### Reptiles and Amphibians

- Salamanders
- Frogs and toads
- Sea turtles
- Turtles
- Snakes

#### Fishes

- Estuarine/large river fishes
- Piedmont/Coastal Plain fishes
- Highland fishes

#### Insects

- Ash-dependent insects
- Tiger beetles
- Other beetles
- Bees
- Ants
- Moths
- Butterflies (skippers)
- Butterflies (lycaenids)
- Butterflies (other)
- Dragonflies and damselflies
- Stoneflies
- Other insects

#### Crayfish

#### Freshwater mussels



## Conservation Actions for Mammal SGCN

### Overall Conservation Actions for ALL Mammal SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – ALL</b>				
<b>IUCN 14: Education/Outreach Needs</b>				
14.2 14.3	Education/Outreach Needs	Improve and develop new public education and outreach efforts to increase public understanding of mammal conservation issues.	X	ALL mammals
<b>IUCN 15: Administrative Needs</b>				
15.1.2	Need to maintain or improve information management systems	Create and maintain a publicly accessible database that houses information on MD mammal distribution, inventory, monitoring, and research.	P	ALL mammals
15.3.2	Need for coordination for effective program/ project management	Establish a MD mammal working group to help coordinate, promote, and conduct MD mammal research, inventory, monitoring, education/outreach, and on-the-ground conservation.	P	ALL mammals

## Conservation Actions for Insectivore SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Insectivores</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect large, contiguous forested landscapes that are connected by effective movement/dispersal corridors.	P	Southeastern star-nosed mole, smoky shrew, long-tailed shrew, southern pygmy shrew, southeastern shrew, southern water shrew
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	Long-tailed shrew, smoky shrew, southern pygmy shrew, southern water shrew
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes impacts on species and their habitats.	P	Long-tailed shrew, smoky shrew, southern pygmy shrew, southern water shrew



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Insectivores</b>				
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on species and their habitats.	P	Long-tailed shrew, smoky shrew, southern pygmy shrew, southern water shrew
<b>IUCN 5: Biological Resource Use</b>				
5.3.1	Logging and wood harvesting; intentional use – small scale	Protect populations on public lands through streamside and watershed-scale habitat protection and restoration, and by providing habitat connectivity between drainages.	P	Southeastern star-nosed mole, southern water shrew
5.3.3	Logging and wood harvesting; intentional use – large scale	Protect populations on private lands through streamside and watershed-scale habitat protection and restoration, and by providing habitat connectivity between drainages.	P	Southeastern star-nosed mole, southern water shrew
<b>IUCN 7: Natural Systems Modification</b>				
7.2.6	Dams and water management/use: abstraction of groundwater (commercial use)	Avoid and minimize impacts of hydraulic fracturing-related groundwater extraction on stream and wetland habitats that support these species.	P	Southeastern star-nosed mole, southern water shrew
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1.4	Invasive non-native terrestrial/wetland animals: hemlock woolly adelgid	Determine the effects of adelgid-related loss of eastern hemlock forest in the Piedmont and Ridge and Valley physical provinces on species populations and identify measures that can be taken to minimize these effects.	X	Smoky shrew
<b>IUCN 9: Pollution</b>				
9.2.3	Industrial and military effluents: hydraulic fracturing	Monitor biological, chemical and physical stream parameters to assess potential impacts of hydraulic fracturing on stream and wetland habitats.	P	Southern water shrew
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Identify the types of pesticide use (e.g., mosquito control, gypsy moth control, various forms of agricultural pest control) that are known to or could potentially impact mammalian insectivore populations and take measures to avoid or minimize those impacts.	X	ALL lagomorphs and rodents
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	ALL lagomorphs and rodents
12.1.3	Need to answer research question	Resolve taxonomic uncertainty of subspecies occurring in Maryland.	X	Southeastern star-nosed mole, southern pygmy shrew



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Insectivores</b>				
12.1.3	Need to answer research question	Determine home range, dispersal behavior/capabilities, extent of gene flow between populations, and habitat connectivity needs.	P	Long-tailed shrew, southern water shrew
12.1.3	Need to answer research question	Determine reproductive ecology.	X	Long-tailed shrew, southern water shrew
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection, connectivity and restoration needs in public land management plans.	P	ALL lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	ALL lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	Least shrew, long-tailed shrew, smoky shrew, southern water shrew
12.1.4	Need to develop new technique	Developing more effective survey and monitoring techniques including live capture methods.	P	ALL lagomorphs and rodents
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need to answer research question	Work more collaboratively on priority inventory, monitoring and research needs.	X	ALL lagomorphs and rodents
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	P	ALL lagomorphs and rodents

**Conservation Actions for Lagomorph and Rodent SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Lagomorphs and Rodents</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect large, contiguous forested landscapes that are connected by effective movement/dispersal corridors.	P	Appalachian cottontail, northern flying squirrel, Delmarva fox squirrel, southern rock vole, Allegheny woodrat, North American porcupine
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other	Site hydraulic fracturing development in a manner that avoids or	P	Appalachian cottontail, southern rock vole,



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Lagomorphs and Rodents</b>				
	natural gas extraction and distribution processes	minimizes impacts on species and their habitats.		Allegheny woodrat
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes impacts on species and their habitats.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on species and their habitats.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
<b>IUCN 7: Natural Systems Modification</b>				
7.2.6	Dams and water management/use: abstraction of groundwater (commercial use)	Avoid and minimize impacts of hydraulic fracturing-related groundwater extraction on stream and wetland habitats that support this species.	P	Southern rock vole
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore high elevation, red spruce-dominated forests.	P	Northern flying squirrel, southern rock vole
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.2.2	Problematic native species/diseases: eastern cottontail	Use habitat protection and management practices that minimize the risk of encroachment by eastern cottontails.	P	Appalachian cottontail
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing information	Complete on-going acoustic surveys and refine/expand as needed to determine species' presence in Maryland.	P	Northern flying squirrel
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat, eastern harvest mouse, southern bog lemming, North American porcupine
12.1.2	Lack of up-to-date existing information	Establish or continue monitoring (vet surveys for some species - porcupine).	P	Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat, North American porcupine
12.1.3	Need to answer research question	Determine cause of apparent population declines and what measures are needed to ensure recovery.	P	Allegheny woodrat, southern bog lemming
12.1.3	Need to answer research question	Determine extent of gene flow between populations, dispersal behavior/capabilities, and habitat connectivity needs.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
12.1.4	Need to develop new technique	Use genetic analyses of fecal samples to differentiate between Eastern and Appalachian cottontails.	P	Appalachian cottontail



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Lagomorphs and Rodents</b>				
12.2.1	Need to provide technical assistance	Work with landowners and public land managers to minimize nuisance issues and need for control.	P	North American porcupine
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection, connectivity and restoration needs in public land management plans.	P	All lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	All lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Consideration of wildlife plans within stewardship forestry plans, including taking SGCN list into consideration (forest/wildlife plans -outreach).	X	All lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat
<b>IUCN 15: Administrative Needs</b>				
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	P	Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat

**Conservation Actions for Carnivore SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Carnivores</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect large, contiguous and diverse forested landscapes that are connected by adequate movement/dispersal corridors.	P	ALL SGCN carnivores
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and habitats.	X	Eastern spotted skunk, bobcat
3.3.1	Wind power	Site industrial wind development in a manner that avoids or	P	Eastern spotted skunk, bobcat





IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Carnivores</b>				
		minimizes species and habitat impacts.		
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on species and their habitats.	P	Eastern spotted skunk, bobcat
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	ALL SGCN carnivores
12.1.2	Lack of up-to-date existing information	Improve understanding of species home range, dispersal and movement patterns.	P	Eastern spotted skunk, bobcat
12.1.4	Need to develop new technique	Develop more effective survey and monitoring techniques.	P	Least weasel
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection, connectivity and restoration needs in public land management plans.	P	ALL SGCN carnivores
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	X	Eastern spotted skunk, bobcat
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	Eastern spotted skunk, bobcat
<b>IUCN 15: Administrative Needs</b>				
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	P	Eastern spotted skunk, bobcat

**Conservation Actions for Bat SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Bats</b>				
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and habitats.	P	Big brown bat, silver-haired bat, eastern red bat, hoary bat, Seminole bat, tricolored bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Bats</b>				
3.3.1	Wind power	Monitor industrial wind development sites for mortality.	P	ALL SGCN bats
3.3.1	Wind power	Use mist net and acoustic surveys to determine migratory timing on the Delmarva peninsula.	P	Silver-haired bat, eastern red bat, hoary bat, Seminole bat, tricolored bat
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P	ALL SGCN bats
3.3.1	Wind power	Curtail turbine operation at low wind speeds at industrial wind development sites.	P	ALL SGCN bats
<b>IUCN 5: Biological Resource Use</b>				
5.3.3	Logging and wood harvesting; unintentional effects – small scale	Promote timber management practices on private lands that minimize impacts on bats.	P	ALL SGCN bats
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1.4	Recreational activity: exploration of caves/mines	Protect hibernating bats from disturbance.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1.6	Invasive non-native fungal/bacterial diseases: white nose syndrome	Use acoustic surveys to monitor effect of white-nose Syndrome on summer populations.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
8.1.6	Invasive non-native fungal/bacterial diseases: white nose syndrome	Assist research related to white-nose syndrome, including potential methods for abating its effects.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
8.1.6	Invasive non-native fungal/bacterial diseases: white nose syndrome	Promote the use of roosting boxes and regularly monitor to determine bat use and track population recovery; increase education and outreach efforts.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
<b>IUCN 9: Pollution</b>				
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Identify the types of pesticide use (e.g., mosquito control, gypsy moth control, various forms of agricultural pest control) that are known to or could potentially impact bat populations and take measures to avoid or minimize those impacts.	P	ALL SGCN bats



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Bats</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing information	Cautiously monitor populations in hibernacula.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.1.2	Lack of up-to-date existing information	Monitor maternity colonies.	P	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	ALL SGCN bats
12.1.2	Lack of up-to-date existing information	Use acoustic surveys, mist net surveys and other techniques to better determine status, distribution and habitat associations in MD.	P	ALL SGCN bats
12.1.3	Need to answer research question	Investigate WNS bat resistance in MD tunnels and extend knowledge to partners.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.2.1	Need to provide technical assistance	Protect maternity colonies by working with land owners and land managers.	P	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.2.3	Need for fish, wildlife and/or habitat planning	Include bat conservation needs in public land management plans.	P	ALL SGCN bats
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	ALL SGCN bats
12.2.3	Need for fish, wildlife and/or habitat planning	Develop forest BMPs for bats.	P	ALL SGCN bats
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/ project management	Coordinate inventory, monitoring, and research across MD and surrounding states; form a Mid-Atlantic Bat Working Group.	P	ALL SGCN bats
15.3.3	Need for increased legal protection	Increase ability to protect habitat through application and modification, if needed, of existing laws.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat



Conservation Actions for Marine Mammal SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Marine Mammals</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1.1-3.1	Urbanization/ Development Land conversion	Site coastal developments in a manner that avoids or minimizes impacts to important coastal and estuarine habitats.	P	Bottlenose dolphin
<b>IUCN 2: Agriculture and Aquaculture</b>				
2.4.2	Marine and freshwater aquaculture: industrial aquaculture	Site aquaculture facilities in a manner that avoids or minimizes impacts to important coastal and estuarine habitats.	P	Bottlenose dolphin
<b>IUCN 3: Energy Production and Mining</b>				
3.1.1	Oil and gas drilling and distribution of petroleum and other liquid hydrocarbons	Site oil and gas drilling to minimize impacts on marine species.	P	ALL marine mammals
3.3.1	Wind power	Site offshore wind developments so as to minimize impacts on species and their habitats.	P	ALL marine mammals
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of offshore wind development on species and their habitats.	P	ALL marine mammals
<b>IUCN 4: Transportation and Service Corridors</b>				
4.3.1	Movement of large ships in shipping lanes	Reduce disruption of movement corridors and ship strikes.	P	North Atlantic right whale, fin whale, humpback whale, sperm whale, bottlenose dolphin
<b>IUCN 5: Biological Resource Use</b>				
5.4.4	Fishing and harvesting of aquatic resources: unintentional effects	Reduce entanglements in fishing nets.	P	Fin whale, humpback whale, sperm whale, Gervais’ beaked whale, True’s beaked whale, Cuvier’s beaked whale, bottlenose dolphin
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1.2	Recreational activities: boating	Raise awareness of boaters to reduce conflicts.	P	Sperm whale, bottlenose dolphin
6.2.1	Military exercises	Reduce impacts to marine species through military exercises.	P	ALL marine mammals
6.3.1	Work and other activities	Reduce impacts to marine species from geological and geophysical surveys.	P	ALL marine mammals



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Mammals – Marine Mammals</b>				
<b>IUCN 7: Natural Systems Modification</b>				
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Understand impacts of recent species population declines to ecosystem.	P	Bottlenose dolphin
<b>IUCN 8: Invasive and Other Problematic Species and Genes</b>				
8.2.2	Problematic native species/diseases: cetacean morbillivirus	Understand anthropogenic triggers for cetacean morbillivirus.	P	Bottlenose dolphin
<b>IUCN 9: Pollution</b>				
9.2.3	Toxic chemicals from factories, illegal dumping of chemicals, other industrial effluent, ship waste discharge	Reduce dumping of toxic chemicals in ocean.	P	ALL marine mammals
9.4.1	Plastics	Reduce garbage dumping in oceans.	P	Fin whale, sperm whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin
9.6.3	Excess energy: noise pollution	Reduce noise where possible, especially in migration corridors and other areas of known habitat use.	P	Blue whale, humpback whale, sperm whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin
<b>IUCN 11: Climate Change and Severe Weather</b>				
11.3.1	Temperature extremes and phenology shifts related to predator-prey ecology	Understand impacts of climate change on movements and key food resources.	P	Blue whale, fin whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin



**Conservation Actions for Bird SGCN**

**Overall Conservation Actions for All Bird SGCN and Habitats**

<b>IUCN Threat Code</b>	<b>IUCN Threat Description</b>	<b>Conservation Actions for ALL Birds</b>	<b>Action Priority Type</b>	<b>Species of Greatest Conservation Need</b>
<b>IUCN 1: Residential and Commercial Development</b>				
1.1.2	Residential development using materials that cause collision hazards	Encourage practices that minimize bird window strikes, including lighting and use of glass in buildings.	X	ALL SGCN birds
1.2.2	Commercial development using materials that cause collision hazards	Encourage practices that minimize bird window strikes, including lighting and use of glass in buildings.	X	ALL SGCN birds
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site and operate hydraulic fracturing in a manner that avoids/minimizes impacts on SGCN and their habitats.	X	ALL SGCN birds
3.3.1	Wind power	Minimize lighting at industrial wind development sites to reduce mortality of migrating birds.	X	ALL SGCN birds
3.3.1	Wind power	Monitor industrial wind development sites for mortality.	X	ALL SGCN birds
3.3.1	Wind power	Site industrial wind development in a manner that minimizes both direct (e.g., bird strike, habitat loss) and indirect (e.g., habitat fragmentation) impacts on SGCN and their habitats.	X	ALL SGCN birds
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1	Recreational activities	Protect information on known occurrences of sensitive SGCN birds to protect breeders from disturbance.	X	ALL SGCN birds
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1.4	Invasive non-native terrestrial/wetland animals	Work with county governments to determine how to address impacts of feral cats on birds.	X	ALL SGCN birds
8.1.5	Invasive non-native terrestrial/wetland plants	Manage invasive non-native plants impacting key wildlife habitats.	X	ALL SGCN birds
8.2.2	Problematic native species/diseases	Manage invasive native plants impacting key wildlife habitats.	X	ALL SGCN birds
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing	Follow-up Breeding Bird Atlas project with detailed studies to	X	ALL SGCN birds



IUCN Threat Code	IUCN Threat Description	Conservation Actions for ALL Birds	Action Priority Type	Species of Greatest Conservation Need
	information	investigate reasons for population decline, extirpation, and/or loss of former (county) range (for species where this is true).		
12.1.2	Lack of up-to-date existing information	Establish a volunteer monitoring program for bald eagle nests.	X	ALL SGCN birds
12.1.2	Lack of up-to-date existing information	Establish volunteer monitoring programs for selected SGCN.	X	ALL SGCN birds
12.2.3	Need for wildlife and/or habitat planning	Develop formal species recovery plans.	X	ALL SGCN birds
12.2.3	Need for wildlife and/or habitat planning	Include habitat protection needs in public land management plans.	X	ALL SGCN birds
<b>IUCN 14: Education/Outreach Needs</b>				
14.2.1	Need for improved knowledge of wildlife and their habitats	Educate the public on best backyard practices to support breeding, wintering, and migrant birds.	X	ALL SGCN birds
14.2.2	Lack of aquatic resources and wildlife education facilities	Educate the public on impacts of feral cats on birds.	X	ALL SGCN birds
14.3.1	Need to develop and/or maintain a broad base of support for agency goals and objectives	Implement public outreach efforts for SGCN.	X	ALL SGCN birds
<b>IUCN 15: Administrative Needs</b>				
15.1.2	Need to maintain or improve information management systems	Begin to include uncommon (i.e., species ranked S3) birds in Natural Heritage Program database and/or develop database for SGCN not currently tracked.	X	ALL SGCN birds
15.3.2	Need for coordination for effective program/project management	Continue working with other states on range-wide conservation projects.	X	ALL SGCN birds
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	X	ALL SGCN birds
15.3.3	Need for increased legal protection	Limit impacts of feral cats on bird populations by changing or establishing state and local regulations.	X	ALL SGCN birds
15.3.4	Need for increased enforcement of laws	Increase enforcement of poaching laws and regulations.	X	ALL SGCN birds



Conservation Actions for Mature Upland Forest Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
<b>IUCN 1: Residential and Commercial Development</b>							
1.1.1	Land conversion from natural habitat to urban and other residential areas	Site housing developments in a manner that minimizes fragmentation of large forest blocks and impacts to migratory stopover hotspots by establishing zoning laws and adjusting relevant policies.	P		P	P	P
1.2.1	Land conversion from natural habitat to commercial and urban areas	Site commercial and industrial developments in a manner that minimizes fragmentation of large forest blocks and impacts to migratory stopover hotspots.	P		P	P	P
<b>IUCN 3: Energy Production and Mining</b>							
3.1.2	Hydraulic fracturing	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and habitats.	X	X	X		
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P	P	P		P
<b>IUCN 4: Transportation and Service Corridors</b>							
4.1.1	Land conversion from natural habitat to roads and railroads	Site transportation corridors in a manner that minimizes fragmentation of large forest blocks.	P	P	P	P	P
4.2.1	Land conversion from natural habitat to utility and other service lines	Site utility lines in a manner that minimizes fragmentation of large forest blocks.	P	P	P	P	P
<b>IUCN 5: Biological Resource Use</b>							
5.3.1	Logging and wood harvesting; intentional use – small scale	Protect and manage forested habitats on small private and public lands to support SGCN.	X	X	X	X	X





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
5.3.2	Logging and wood harvesting; intentional use – large scale	Encourage landowners to avoid the establishment of loblolly pine monocultures in favor of longer rotation mixed pine-hardwood stands. Educate foresters in habitat/ecosystem management and sustainable development.					P
5.3.2	Logging and wood harvesting; intentional use – large scale	Protect remaining old growth forest (including adequate no-cut buffers) on public and private lands, and where possible, expand these areas and promote the establishment of additional extensive tracts of old growth forest. Educate foresters in habitat/ecosystem management and sustainable development.	P	P	P	P	P
5.3.2	Logging and wood harvesting; intentional use – large scale	Work with private landowners, state forests, and industry to retain large trees, and increase presence of snags and vertical structure complexity.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Work with private landowners, state forests, and industry to maintain and promote a species composition found in natural communities.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Whenever possible, encourage timber harvesting to occur outside the nesting season to minimize impacts on nesting birds.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Determine the effects of various timber harvest practices on SGCN, including forest interior birds.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Conserve and encourage older conifer forests in three western counties.		X			
5.3.2	Logging and wood harvesting; intentional use – large scale	On lower Eastern Shore public lands and private lands, where possible, work towards the restoration of large tracts of pine-dominated old growth forest so that red-cockaded woodpecker may someday be reintroduced to the state.					X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
<b>IUCN 7: Natural Systems Modifications</b>							
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Re-establish natural fire regimes to restore and maintain habitats.		X	X	X	X
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Develop and implement a comprehensive, holistic plan to restore high elevation, conifer-dominated forests, especially red spruce and white pine.		X			
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>							
8.1.4	Invasive non-native terrestrial/wetland animals: hemlock woolly adelgid	Determine the degree of threat and spectrum of impacts to species populations resulting from hemlock loss due to hemlock woolly adelgid. Encourage Integrated Pest Management through training and good practice.		X		X	
8.1.4	Invasive non-native terrestrial/wetland animals: hemlock woolly adelgid	Where appropriate, control hemlock-woolly adelgid infestations using methods that have minimal non-target impacts including rare species.		X		X	
8.2.2	Problematic native species/diseases: white-tailed deer	Control overabundant white-tailed deer populations to reduce impacts to forested ecosystems by partnering with medical groups regarding disease control; encouraging native predators; providing incentives for culling by hunters; and providing education programs.	P		P	P	P
<b>IUCN 9: Pollution</b>							
9.5.5	Air-borne pollutants: herbicides and pesticides	Limit pesticide applications that reduce food resources or could directly impact birds, such as gypsy moth control chemicals.	X	X	X	X	
<b>IUCN 12: Resource Management Systems</b>							
12.1.1	Lack of initial baseline inventory	Determine distribution, relative abundance, and breeding sites for rare species such as breeding and wintering long-eared owl and breeding yellow-bellied sapsucker, Swainson's thrush, olive-sided flycatcher, northern saw-whet owl, and Wayne's black-throated green warbler.		X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
12.1.2	Lack of up-to-date existing information	Conduct long-term monitoring programs for priority SGCN and/or indicators of ecologically significant areas. Link with information from the Breeding Bird Atlas.	P	P	P	P	P
12.1.2	Lack of up-to-date existing information	Identify additional important migratory stopover sites for neotropical migrants.		X	X	X	X
12.1.3	Need to answer research question	Determine cause of apparent population declines for whip-poor-wills and other forest birds, including what measures are needed to ensure recovery.	P	P	P	P	P
12.2.1	Need to provide technical assistance	Develop habitat management guidelines for use by foresters, private land owners, and public land managers, and work with them to incorporate appropriate forest management practices into forest stewardship plans. Promote the idea of "steward foresters".	P	P	P	P	P
12.2.3	Need for fish, wildlife, and/or habitat planning	Manage state-owned forest land for conserving biodiversity.	P	P	P	P	P
12.2.3	Need for fish, wildlife, and/or habitat planning	Incorporate forest conservation actions into land planning efforts by local, state, and federal agencies.	P	P	P	P	P
<b>IUCN 14: Education/Outreach Needs</b>							
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Develop a private lands registry program to incentivize private landowners to maintain suitable forested habitat.	X	X	X	X	X
<b>IUCN 15: Administrative Needs</b>							
15.1.2	Need to maintain or improve information management systems	Regularly update GIS layer that identifies forest interior-dwelling species habitats for use in planning/zoning.	X				
15.3.3	Need for increased legal protection; updating existing laws and regulations	Modify the loblolly pine seed tree law to more easily allow for a mixed pine - hardwood forest.					P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
15.3.4	Need for increased enforcement of laws	Identify additional legal needs for forest bird protection	X	X	X	X	X

**Conservation Actions for Grassland Early Successional Birds**

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
<b>IUCN 1: Residential and Commercial Development</b>						
1.1.1	Land conversion from natural habitat to urban and other residential areas	Protect and restore natural grassland and shrubland habitats.	P			
<b>IUCN 2: Agriculture and Aquaculture</b>						
2.1.2; 2.1.3	Small-holder farming; agro-industry	Work with farming community and agricultural agencies to provide breeding habitat for SGCN where appropriate via existing landowner incentive programs.		P		P
<b>IUCN 4: Transportation and Service Corridors</b>						
4.4.1	Airplane flight paths	Work with airfields to minimize bird strikes through habitat management, monitoring, and other techniques.		X		X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
<b>IUCN 5: Biological Resource Use</b>						
5.1.3	Hunting and collecting terrestrial animals: persecution/control	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating early successional forest habitats; do so in a manner that avoids and minimizes nuisance issues and conflicts with non-bird SGCN, unique natural communities, etc.			X	
5.3.2	Logging and wood harvesting; intentional use – large scale	Where appropriate, manage state lands on the Eastern Shore for early successional habitat for northern bobwhite.		P	P	P
<b>IUCN 7: Natural Systems Modifications</b>						
7.1.2	Fire and fire suppression: increase in fire frequency/intensity	Re-establish natural fire regimes to restore and maintain habitats	P		P	
7.3.2	Inappropriate timing of mowing	Implement a delayed haying scheme to protect nests from being destroyed (example - program in Vermont).		P		
<b>IUCN 9: Pollution</b>						
9.5.5	Air-borne pollutants: herbicides and pesticides	Avoid impacts to SGCN bird species and key food resources from the application of pesticides and herbicides, and from crops engineered for specific chemical use.		P		P
<b>IUCN 12: Resource Management Needs</b>						
12.1.2	Lack of up-to-date existing information	Better assess the distribution, abundance and habitat associations of northern bobwhite, especially in current areas with stable populations and areas that historically had stable populations.	P	P	P	P
12.1.2	Lack of up-to-date existing information	Better determine extent of breeding habitat use, abundance, and distribution of SGCN on reclaimed strip mines in western Maryland.		P		P
12.1.2	Lack of up-to-date existing information	Conduct surveys for loggerhead shrike in vicinity of recent sightings and in other areas with potential habitat. Coordinate work to extent possible with neighboring states and regional efforts.	P	P		
12.1.2	Lack of up-to-date existing information	Monitor effects of management actions for one species on all SGCN present, including potential impacts on long-term habitat suitability for multiple SGCN.		X		X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
12.1.2	Lack of up-to-date existing information	Monitor known breeding sites of upland sandpiper, conduct surveys to document new sites.		X		
12.1.2	Lack of up-to-date existing information	Determine current distribution and relative abundance of breeding short-eared owls.	X	X		
12.1.3	Need to answer research question	Conduct research to understand the decline of American kestrel.	X	X		
12.1.3	Need to answer research question	Determine relative importance of natural communities and anthropogenic grasslands as breeding habitat for SGCN.	X	X		
12.1.3	Need to answer research question	Determine relative importance of natural communities and managed early successional forest as breeding habitat for SGCN, including habitat created by gypsy moth damage.			X	X
12.1.3	Need to answer research question	Continue to investigate causes of decline of northern bobwhite.	X	X	X	X
12.1.4	Need to develop new technique	Determine whether managed habitats are functioning as ecological traps.		X		X
12.2.1	Need to provide technical assistance	Work with landowners to maintain suitable habitat and minimize disturbance to nesting upland sandpipers.	P	P		
12.2.1	Need to provide technical assistance	Develop BMPs that support multiple SGCN.	P	P	P	P
12.2.1	Need to provide technical assistance	Conduct an overall forest inventory to determine current and likely future "early successional" habitat on public lands.			P	P
12.2.1	Need to provide technical assistance	Work with utilities to manage vegetation in transmission line corridors for early successional SGCN birds such as yellow-breasted chat, golden-winged warbler, etc. Wherever possible, do so in a manner that also benefits non-bird SGCN (e.g., rare and declining butterflies, tiger beetles, bees).		P		P
12.2.1	Need to provide technical assistance	Develop BMPs for the management of reclaimed strip mines for SGCN shrubland and grassland nesting birds.		P		P
12.2.1	Need to provide technical assistance	Identify areas on public lands that could be used to demonstrate outcomes of land management techniques to aid in private land technical assistance efforts.	X	X	X	X



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
12.2.1	Need to provide technical assistance	Work with Department of Defense to provide and maintain existing grassland and early successional habitats.		X		X
12.2.1	Need to provide technical assistance	Work with airfields to manage vegetation for early successional SGCN birds. Wherever possible, do so in a manner that also benefits non-bird SGCN (e.g., rare and declining butterflies, bees).		X		X
12.2.1	Need to provide technical assistance	Establish a cooperative barn owl nest box program.	X	X		
12.2.3	Need for fish, wildlife and/or habitat planning	Create and maintain landscapes containing suitable habitat that are sufficiently large to sustain viable source populations of northern bobwhite; where possible, do so in a natural ecosystem context.	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Develop a comprehensive conservation plan for the restoration and management of reclaimed strip mines in a manner that provides habitat, where appropriate, for SGCN shrubland and grassland birds while minimizing long-term mining impacts on natural forest and aquatic ecosystems.		X		
<b>IUCN 14: Education/Outreach Needs</b>						
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Where appropriate, maintain large grasslands on reclaimed strip mines through education and outreach to private landowners.		P		
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Inform the public about the importance of grassland and early successional habitats.	P	P	P	P
<b>IUCN 15: Administrative Needs</b>						
15.3.3	Need for increased legal protection	Evaluate the need for changing mine reclamation standards to better support creation of habitat.		X		X



Conservation Actions for Colonial and Coastal Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
<b>IUCN 3: Energy Production and Mining</b>							
3.3.1	Wind Power	Determine potential impacts of offshore wind energy development and take measures to avoid and minimize these impacts.			X		
<b>IUCN 5: Biological Resource Use</b>							
5.1.1	Hunting and collecting terrestrial animals: intentional use	Continue to closely regulate take of passage peregrine falcons.			X		
<b>IUCN 6: Human Intrusions and Disturbance</b>							
6.1.2	Recreational activities: boating	Protect colony sites from human disturbance.	X	X			X
6.1.3	Recreational activities: use of beaches	Minimize off road vehicle use in sensitive habitats and at critical times of year (breeding season, seasonal migrations/movements).	X		X		
6.1.3	Recreational activities: use of beaches	Protect sandflats, mudflats and shallow tidal water habitats from human disturbance.	X		X		X
<b>IUCN 7: Natural Systems Modifications</b>							
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Determine the impact of the frequency and extent of winter burning practices on obligate salt marsh breeding bird species.					X
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Reduce frequency of arson fires in salt marshes.					X
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Restore tidal flows to marshes and create tidal open water flats.					P
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Determine the impact of the Open Marsh Water Management on obligate salt marsh breeding bird species.					X





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>							
8.1.5	Invasive non-native terrestrial/wetland plants: <i>Phragmites</i>	Control common reed ( <i>Phragmites</i> ) wherever practical in large wetland complexes. Target new invasions vs. those that are long-established and identify best locations to expend efforts and funds.					P
8.2.2	Problematic native species: nesting gulls	Manage nuisance roof top nesting gull colonies.				P	
8.2.2	Problematic native species: gulls	Manage predator pressure (gulls) in critical colonies of listed species.	P	P		P	
8.2.2	Problematic native species: foxes, crows, gulls	Manage predator pressure (fox, crow, gull) in areas of critical nesting habitat.	P	P			
8.2.2	Problematic native species/diseases: double-crested cormorant	Manage nuisance double-crested cormorant colonies.				X	
<b>IUCN 9: Pollution</b>							
9.5.5	Air-borne pollutants: herbicides and pesticides	Determine the impact of mosquito control pesticide use on obligate salt marsh breeding bird species and take measures to avoid/minimize impacts.					P
<b>IUCN 11: Climate Change and Severe Weather</b>							
11.1.1	Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss to predicted changes in sea level.	P	P		P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Take measures to mitigate habitat change resulting from sea-level rise.	P	P		P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Prevent conversion of tidal high marsh to tidal low marsh due to sea level rise or create additional shallow marsh habitat via thin layering or similar technologies.					P
11.1.1	Habitat shifting or alteration: sea-level rise	Develop new technologies to accelerate tidal marsh accretion.					X
11.1.4	Storms and flooding	Create replacement nesting habitat for royal tern, common tern and black skimmer using dredged material.	P	P			



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
<b>IUCN 12: Resource Management Needs</b>							
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for black rails.					P
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for saltmarsh and Coastal Plain swamp sparrows.					X
12.1.2	Lack of up-to-date existing information	Monitor breeding populations of listed species and species of special conservation interest (brown pelican, double-crested cormorant) - annually.	P	P		P	
12.1.2	Lack of up-to-date existing information	Monitor breeding populations of wading birds, gulls and non-listed species - 5 year intervals (except great blue heron).		P		P	P
12.1.2	Lack of up-to-date existing information	Monitor breeding populations of great blue herons - 10 year intervals.		P		P	
12.1.2	Lack of up-to-date existing information	Use existing and new information to identify important migratory stopover sites for shorebirds.			P		P
12.1.2	Lack of up-to-date existing information	Monitor breeding population of American oystercatchers every 5 years.	P	P			
12.1.2	Lack of up-to-date existing information	Monitor breeding, migrating, and wintering shorebirds in coordination with regional surveys.	P	P			
12.1.2	Lack of up-to-date existing information	Monitor breeding distribution and relative abundance of rails, bitterns, grebes - 5 year intervals.					P
12.1.2	Lack of up-to-date existing information	Continue surveys of birds using the offshore zone during periods of migration and during winter.			X		
12.1.3	Need to answer research question	Investigate potential biological causes of population declines in common tern and black skimmer.	P	P			
12.1.3	Need to answer research question	Determine life history requirements of black rails in Chesapeake Bay marshlands.		P		P	P
12.1.3	Need to answer research question	Determine habitat requirements of Coastal Plain swamp, saltmarsh and sharp-tailed sparrows.					P
12.2.1	Need to provide technical assistance	Encourage management practices that maintain extensive areas of high marsh as essential habitat for black rail and other high marsh species.					P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
12.2.1	Need to provide technical assistance	Manage roof top nesting least tern colonies.				X	
12.2.1	Need to provide technical assistance	Establish a cooperative barn owl nest box program in Chesapeake Bay salt marsh habitats.					X
<b>IUCN 15: Administrative Needs</b>							
15.3.2	Need for coordination for effective program/project management	Regularly update Critical Area information on colonial waterbird nesting colony locations.				P	P
15.3.4	Need for increased enforcement of laws	Improve enforcement of colony closures in the coastal bays.	X	X			

**Conservation Actions for Wetland Birds**

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Wetlands Birds	Bogs, Fens, Seepage Swamps (higher elevation)	Swamps, Floodplain Wetlands, and Tidal Forests	Tidal Freshwater Marsh	Wetlands in Impoundments
<b>IUCN 5: Biological Resource Use</b>						
5.1.3	Hunting and collecting terrestrial animals: persecution/control	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating SGCN habitat; do so in a manner that avoids and minimizes nuisance issues and conflicts with non-bird SGCN, unique natural communities, etc.	X	X		



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Wetlands Birds	Bogs, Fens, Seepage Swamps (higher elevation)	Swamps, Floodplain Wetlands, and Tidal Forests	Tidal Freshwater Marsh	Wetlands in Impoundments
5.3.2	Logging and wood harvesting; intentional use – large scale	Restore floodplain forests including reestablishment of old growth, natural hydrology, and improved water quality.		P		
5.3.2	Logging and wood harvesting; intentional use – large scale	Promote retention of, or creation of snags for nesting habitat in floodplain areas.	X	X	X	X
<b>IUCN 7: Natural Systems Modification</b>						
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Restore tidal flows to marshes and create tidal open water flats.			P	
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Protect known wetland breeding sites for alder flycatcher.	X			
7.2.3	Dams and water management/use: abstraction of surface water (agricultural use)	Develop and implement methods to restore hydrology to wetlands degraded by ditching.		X	X	
7.2.3	Dams and water management/use: abstraction of groundwater (commercial use)	Minimize impacts of hydraulic fracturing on hydrology and wetlands.	X	X		
7.2.9	Dams and water management/use: small dams	Work with landowners to encourage retention of emergent wetlands rather than impounding them.	X	X	X	
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>						
8.1.5	Invasive non-native terrestrial/wetland plants: <i>Phragmites</i>	Control common reed ( <i>Phragmites</i> ) and other invasive plants wherever practical in large wetland complexes.			P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Wetlands Birds	Bogs, Fens, Seepage Swamps (higher elevation)	Swamps, Floodplain Wetlands, and Tidal Forests	Tidal Freshwater Marsh	Wetlands in Impoundments
<b>IUCN 9: Pollution</b>						
9.1.2	Domestic and urban wastewater: run-off	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to forested wetland areas.		X		
9.2.2	Industrial and military effluents: seepage from mining	Restore wetlands affected by acid mine drainage.	X	X		
9.3.1	Agricultural and forestry effluents: nutrient loads	Minimize inputs of point and non-point nutrients to maintain water quality.		X	X	X
<b>IUCN 12: Resource Management Needs</b>						
12.1.1	Lack of initial baseline inventory	Identify key wintering areas for rusty blackbird.		X	X	
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for uncommon species of rails (king and sora).	X		X	X
12.1.2	Lack of up-to-date info	Monitor changes in relative breeding population level and distribution for common gallinule.			X	X
12.1.2	Lack of up-to-date info	Monitor breeding, migrating, and wintering shorebirds in coordination with regional surveys.		X	X	X
12.1.2	Lack of up-to-date info	Monitor change in relative breeding population level and distribution of pied-billed grebe.			X	X
12.1.2	Lack of up-to-date info	Monitor populations of alder flycatcher, Nashville warbler, and northern waterthrush and document additional breeding sites.	X	X		
12.1.3	Need to answer research question	Understand critical resource needs for different parts of the life cycle for American black duck.		X	X	X
12.1.3	Need to answer research question	Determine relative importance of Appalachian Plateau wetlands for golden-winged warbler.	X			
12.2.1	Need to provide technical assistance	Work with public land managers and private landowners to manage impoundments to support a diversity of SGCN wetland species, including marshbirds, waterfowl, and migratory shorebirds.		P	P	P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Wetlands Birds	Bogs, Fens, Seepage Swamps (higher elevation)	Swamps, Floodplain Wetlands, and Tidal Forests	Tidal Freshwater Marsh	Wetlands in Impoundments
12.2.1	Need to provide technical assistance	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.	P	P	P	P
12.2.3	Need for fish, wildlife, and/or habitat planning	Protect and restore Appalachian Plateau wetlands that support SGCN.	X			
12.1.3	Need to answer research question	Investigate potential new taxon of prairie warbler in Pocomoke swamp area, including taxonomic status, breeding ecology and habitat requirements, population size, migratory routes, stopover and wintering sites (full life cycle conservation needs).		X		
12.1.3	Need to answer research question	Determine causes of suspected declines in northern waterthrush and Nashville warbler.	X	X		
12.1.3	Need to answer research question	Investigate breeding ecology and habitat requirements, population size, migratory routes, stopover and wintering sites (full life cycle conservation needs) of Swainson's warbler.		X		
<b>IUCN 15: Administrative Needs</b>						
15.3.2	Need for coordination for effective program/project management	Work with U.S. Army Corp of Engineers, Maryland Department of the Environment, and Critical Area Commission to understand how to best utilize regulatory processes to protect habitat.	X	X	X	
15.3.2	Need for coordination for effective program/project management	Pursue North American Wetland Conservation Act grants for habitat conservation by coordinating partners.		X	X	X



Conservation Actions for Aquatic Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Aquatic Birds	Streams and Rivers	Artificial Impoundments and Ponds	Coastal Bays and Chesapeake Bay-Shellfish and SAV Beds	Chesapeake Bay - Open Water	Ocean - Nearshore	Ocean - Offshore (including seaweed mats)
<b>IUCN 3: Energy Production and Mining</b>								
3.3.1	Wind power	Determine potential impacts of offshore and other industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P			P	P	P
<b>IUCN 4: Transportation and Service Corridors</b>								
4.4.1	Airplane flight paths	Work with military to avoid bird strikes from wintering flocks.			X	X		
<b>IUCN 5: Biological Resource Use</b>								
5.1.3	Hunting and collecting terrestrial animals: persecution/control	Maintain natural beaver populations to create SGCN habitats.	X					
5.3.2	Logging and wood harvesting; intentional use – large scale	Maintain water quality and food base for SGCN through streamside and watershed-scale habitat protection.	X					
5.4.1	Fishing and harvesting of aquatic resources; intentional use – small scale	Determine what, if any, threats exist for hunted waterfowl species overwintering in Maryland, especially sea ducks (including harvest level)			X	X	X	
5.4.1	Fishing and harvesting of aquatic resources; intentional use – small scale	Minimize bycatch impacts to seabirds.					X	X
<b>IUCN 9: Pollution</b>								
9.1.2	Domestic and urban wastewater: run-off	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts on water quality.	P		P			
9.2.1	Industrial and military effluents: oil spills	Minimize risk of oil spills and respond immediately to contain spills when they occur.	P		P	P	P	P
9.1.2	Domestic and urban wastewater: run-off	Minimize runoff from roads, including silt, salt, and contaminants.	X	X	X			



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Aquatic Birds	Streams and Rivers	Artificial Impoundments and Ponds	Coastal Bays and Chesapeake Bay - Shellfish and SAV Beds	Chesapeake Bay - Open Water	Ocean - Nearshore	Ocean - Offshore (including seaweed mats)
9.2.1	Industrial and military effluents: oil spills	Reduce impacts of water pollution from recreational boats.	X		X	X	X	
9.3.1	Agricultural and forestry effluents: nutrient loads	Minimize inputs of nutrients to maintain water quality.	P		P	P		
9.2.4	Industrial and military effluents: industrial toxic settling ponds	Prevent access by bald eagles and other birds to toxic settling ponds.		X				
<b>IUCN 12: Resource Management Needs</b>								
12.1.1	Lack of initial baseline inventory	Document breeding locations of common merganser.	X					
12.1.2	Lack of up-to-date existing information	Continue regular monitoring of wintering waterfowl populations.	P	P	P	P	P	
12.1.2	Lack of up-to-date existing information	Continue surveys of birds using the offshore zone during periods of migration.					P	P
12.1.2	Lack of up-to-date existing information	Continue surveys of birds using the offshore zone during winter.					P	P
12.1.2	Lack of up-to-date existing information	Monitor distribution and number of overwintering horned grebe, and compare with historical records.			X	X		
12.1.2	Lack of up-to-date existing information	Compile information for forest interior songbirds, neotropical migrants, colonial waterbirds, waterfowl, and shorebirds in the Coastal Bays watershed from existing databases and produce a status and trends report and habitat improvement recommendations.			X			
12.1.2	Lack of up-to-date existing information	Use existing data and game harvest information to characterize colonial waterbird nesting sites and bird migratory stopover areas in the Coastal Bays watershed area.			X			
12.1.3	Need to answer research question	Determine critical resource needs and major threats to wintering waterfowl.	P	P	P	P	P	
12.2.1	Need to provide technical assistance	Promote retention of or creation of snags for nesting habitat along waterways.	X					





IUCN Threat Code	IUCN Threat Description	Conservation Actions For Aquatic Birds	Streams and Rivers	Artificial Impoundments and Ponds	Coastal Bays and Chesapeake Bay - Shellfish and SAV Beds	Chesapeake Bay - Open Water	Ocean - Nearshore	Ocean - Offshore (including seaweed mats)
<b>IUCN 14: Education/Outreach Needs</b>								
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Identify and implement enhancement techniques for landowners interested in providing habitat for songbirds and other species through native plantings and other restoration techniques in the Coastal Bays watershed.			X			
<b>IUCN 15: Administrative Needs</b>								
15.3.2	Need for coordination for effective program/project management	Work with U.S. Army Corp of Engineers, Maryland Department of the Environment, and Critical Area Commission to understand how to best utilize regulatory processes to protect habitat.	P		P	P		
15.3.4	Need for increased enforcement of laws	Influence regulatory mechanisms to enforce mitigating measures.	X		X	X	X	

**Conservation Actions for Other Miscellaneous Birds**

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Miscellaneous Birds	Ridgetops	Cliffs	Banks	Artificial Structures (buildings, bridges, etc.)
<b>IUCN 1: Residential and Commercial Development</b>						
1.1.1	Land conversion from natural habitat to urban and other residential areas	Protect important migratory stopover sites on ridgetops from development.	X			
<b>IUCN 3: Energy Production and Mining</b>						
3.2.2	Surface mining - rock quarry	Work with mining interests to protect or create nesting habitat for bank swallows.			X	



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Miscellaneous Birds	Ridgetops	Cliffs	Banks	Artificial Structures (buildings, bridges, etc.)
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P	P		
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on breeding SGCN birds.	X	X		
3.3.1	Wind power	Identify relative importance of Appalachian ridgetops as migratory corridors for golden eagles to assess risk from wind power developments.	X			
<b>IUCN 6: Human Intrusions and Disturbance</b>						
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Limit access to minimize human disturbance at key locations for SGCN.	X	X		
6.1.4	Recreational activities: exploration of caves//cliffs	Work with climbing clubs to minimize degradation and disturbance.		X		
<b>IUCN 7: Natural Systems Modifications</b>						
7.3.1	Shoreline stabilization	Develop and implement shore erosion control practices that are compatible with cliff maintenance and the needs of SGCN.			X	
<b>IUCN 9: Pollution</b>						
9.3.3	Control of insect pests leading to mortality of non-target species	Where possible, reintroduce peregrine falcons at appropriate cliff sites or surrogate habitats.		X		X
<b>IUCN 12: Resource Management Needs</b>						
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for bank swallows.			X	
12.1.2	Lack of up-to-date info	Monitor known mourning warbler breeding sites and conduct surveys to document additional breeding sites.	X			
12.2.1	Need to provide technical assistance	Develop habitat management guidelines for use by foresters and land managers.	P		P	
12.2.1	Need to provide technical assistance	Partner with large flat-top commercial building owners to manage for roof-top nesters.				P
12.2.1	Need to provide technical assistance	Work with agricultural landowners to support nesting barn owls through retaining barns for nesting and roosting.				P



IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Miscellaneous Birds	Ridgetops	Cliffs	Banks	Artificial Structures (buildings, bridges, etc.)
<b>IUCN 14: Education/Outreach Needs</b>						
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Develop a private lands registry program to incentivize private landowners to maintain suitable habitats.	X	X	X	

**Conservation Actions for Reptile and Amphibian SGCN**

**Overall Conservation Actions for ALL SGCN Reptiles and Amphibians**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>ALL Reptile and Amphibian SGCN</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect known occupied habitat, or largest/best populations.	P	ALL reptile and amphibian SGCN
1 - 4	Habitat loss (from various causes)	Create new vernal pools and other wetland habitats for aquatic SGCN.	X	ALL reptile and amphibian SGCN
1 - 4	Habitat fragmentation	Develop site conservation design to better connect core populations into functioning metapopulations, especially on state and NGO lands.	P	ALL reptile and amphibian SGCN
1 - 4	Habitat fragmentation	Minimize and reduce habitat fragmentation.	P	ALL reptile and amphibian SGCN
<b>IUCN 3: Energy and Mining</b>				
3.1.2	Oil and gas drilling/pipelines; hydraulic fracturing	Evaluate the threats posed by hydraulic fracturing to western MD SGCN.	P	ALL reptile and amphibian SGCN
3.1.2	Oil and gas drilling/pipelines; hydraulic fracturing	Minimize direct and indirect impacts of energy development to SGCN, especially on state lands.	P	ALL reptile and amphibian SGCN
3.3.1	Wind power	Evaluate the threats posed by wind farms.	P	ALL reptile and amphibian SGCN



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>ALL Reptile and Amphibian SGCN</b>				
<b>IUCN 4: Transportation</b>				
4.1.2	Roads and railroads: vehicles	Identify potential high road-kill crossing areas statewide by conducting a GIS-based "causeway" study similar to NY/Cornell effort (wetlands within 100 meters of both sides of road) followed by field verification. These would then be areas to focus mitigation efforts.	X	ALL reptile and amphibian SGCN
4.1.2	Roads and railroads: vehicles	Improve connectivity of habitat by addressing conservation of movement corridors between breeding areas, including improved road crossings, low-rise curbing, wildlife passage tunnels, wildlife crossing signage, and temporary closure of park roads (during seasonal migrations), especially on roads within or bisecting state and NGO lands.	P	ALL reptile and amphibian SGCN
<b>IUCN 5: Biological Use</b>				
5.3.2	Logging and wood harvesting – large scale	Manage public and private conservation lands to benefit SGCN found in specific, limited microhabitats.	P	ALL reptile and amphibian SGCN
5.3.2	Logging and wood harvesting – large scale	Manage State lands for native forest communities (i.e., limit extent of loblolly pine plantations).	P	ALL reptile and amphibian SGCN
5.3.2	Logging and wood harvesting – large scale	Consider time-of-year restrictions for timber harvests and identify no-cut zones as needed to minimize impacts on SGCN on state lands.	P	ALL reptile and amphibian SGCN
<b>IUCN 6: Human Disturbance</b>				
6.1.1	Recreational activities: off-road vehicles (motorized & non-motorized)	Minimize off-road vehicle use in sensitive habitats and at critical times of year (breeding season, seasonal migrations/movements).	P	ALL reptile and amphibian SGCN
<b>IUCN 7: Natural Systems Modification</b>				
7.2	Water management	Restore known occupied habitat of aquatic species, especially in areas where populations are declining.	P	ALL reptile and amphibian SGCN
7.3.3	Removal of coarse woody debris	Retain coarse woody debris in all natural areas.	P	ALL reptile and amphibian SGCN
7.3.4	Natural Systems modifications	Implement appropriate habitat management practices.	P	ALL reptile and amphibian SGCN
<b>IUCN 8: Invasive and Other Problematic Species, Genes, Diseases</b>				
8.1.5, 8.2.2	Invasive non-native terrestrial/wetland plants	Manage invasive non-native and problematic native plants impacting key wildlife habitats.	P	ALL reptile and amphibian SGCN
8.2.2	Problematic native species	Control overabundant white-tailed deer populations to reduce impacts to forested ecosystems and other key wildlife habitats.	P	ALL reptile and amphibian SGCN
8.5.2	Viral disease: <i>Ranavirus</i>	Distribute NE PARC Disease Working Group educational materials regarding <i>Ranavirus</i> management to public properties; especially those	P	ALL reptile and amphibian SGCN



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>ALL Reptile and Amphibian SGCN</b>				
		known to have the disease present		
8.5.2	Viral disease: <i>Ranavirus</i>	Promote NE PARC decontamination protocols; include these protocols in permit reviews for wetland activities	P	ALL reptile and amphibian SGCN
<b>IUCN 9: Pollution</b>				
9	Pollution	Maintain or increase water quality and wetland hydrology through various methods, including improved sediment and erosion control.	P	ALL reptile and amphibian SGCN
9.1.2	Domestic and urban waste water: run-off	Assess impacts from road salt and develop abatement measures including changes to Maryland Department of the Environment's chloride criteria.	X	ALL reptile and amphibian SGCN
9.3.3, 9.5.5	Agricultural and forestry effluents: herbicides and pesticides; Airborne pollutants: herbicides and pesticides	Develop strict protocols for restricting the use of pesticides, such as for mosquito control, in SGCN habitats.	P	ALL reptile and amphibian SGCN
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status for those SGCN for which this information is lacking, inadequate, or out-of-date.	P	ALL reptile and amphibian SGCN
12.1.2	Lack of up-to-date existing information	Conduct long-term studies to monitor population health (e.g., abundance, demographics, reproduction, etc.) at known locations for which there is no current (last 10 years) data.	P	ALL reptile and amphibian SGCN
12.1.2	Lack of up-to-date existing information	Follow-up Maryland Amphibian and Reptile Atlas (MARA) project with detailed studies to investigate reasons for population decline, extirpation, and/or loss of former (county) range (for species where this is true).	X	ALL reptile and amphibian SGCN
12.1.3	Need to answer research question	Assess feasibility of reintroducing species into historical locations.	X	ALL reptile and amphibian SGCN
12.1.3	Need to answer research question	Determine impacts of emerging pathogens.	P	ALL reptile and amphibian SGCN
12.1.3	Need to answer research question	Study impacts of sea-level rise and climate change on coastal SGCN.	X	ALL reptile and amphibian SGCN
12.2.3	Need for fish, wildlife, and/or habitat planning	Develop formal species recovery plans.	X	ALL reptile and amphibian SGCN
12.2.3	Need for fish, wildlife, and/or habitat planning	Re-evaluate state conservation status (i.e., S-ranks) for many SGCN.	P	ALL reptile and amphibian SGCN
<b>IUCN 14: Education/Outreach Needs</b>				
14.2	Education needs	Increase decontamination protocol education on emerging diseases.	P	ALL reptile and amphibian SGCN
14.3.1	Outreach needs: support for	Implement public outreach efforts for SGCN.	P	ALL reptile and amphibian SGCN



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>ALL Reptile and Amphibian SGCN</b>				
	agency goals and objectives			
<b>Administrative Needs</b>				
15.1.2	Need to maintain or improve information management systems	Begin to include uncommon (i.e., species ranked S3) herpetofauna in Natural Heritage Program database and/or develop database for SGCN not currently tracked. Database would also be used for Environmental Review project screening.	P	ALL reptile and amphibian SGCN
15.3.2	Need for coordination for effective program/project management	Continue working with other states on range-wide conservation projects.	P	ALL reptile and amphibian SGCN
15.3.3	Needs for increased legal protection	Re-evaluate state legal status for many SGCN herpetofauna.	P	ALL reptile and amphibian SGCN

**Conservation Actions for Salamander SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Salamanders</b>				
<b>IUCN 7: Natural Systems Modifications</b>				
7.2	Dams and water management/use	Restore known occupied habitat by removal of encroaching trees/saplings.	P	Eastern tiger salamander
7.2.9	Dams and water management/use: small dams	Maintain/improve aquatic hydrology by working with Exelon for proper water flow for species needs.	X	Eastern hellbender
7.2.12	Dams and water management/use: culverts	Maintain/improve aquatic hydrology by retrofitting culverts, etc. Maintain stream buffers through environmentally sensitive designs.	X	Eastern hellbender, seal salamander, eastern two-lined salamander, northern spring salamander, eastern mud salamander, northern red salamander
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status ( <i>de novo</i> surveys).	P	Eastern tiger salamander, green salamander, eastern hellbender,



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Salamanders</b>				
				southern two-lined salamander, northern spring salamander, common mudpuppy, valley and ridge salamander, Wehrle's salamander, eastern mud salamander, undetermined siren
12.1.1	Lack of baseline inventory	Conduct eDNA surveys in subwatersheds to determine presence/absence.	X	Eastern hellbender, common mudpuppy, undetermined siren
12.1.3	Information collection: answer research question	Conduct sufficient DNA analyses to determine species identity of Prince George's County population.	P	Undetermined siren
12.1.3	Information collection: answer research question	Assess feasibility of captive-breeding, head-starting +/- or moving egg masses to reintroduce or expand populations.	P	Eastern tiger salamander, eastern hellbender, common mudpuppy

**Conservation Actions for Frogs and Toad SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Frogs and Toads</b>				
<b>IUCN 7: Natural Systems Modifications</b>				
7.3	Dams and water management/use	Restore known occupied habitat, especially in areas where populations are declining, by removal of encroaching trees/saplings.	P	Barking treefrog, carpenter frog
<b>IUCN 9: Pollution</b>				
9.1.2	Domestic waste water: run-off	Assess impacts from road salt and develop abatement measures.	X	Mountain chorus frog, upland chorus frog
<b>IUCN 11: Climate Change</b>				
11.1.1	Habitat shifting or alteration: sea-level rise	Assist marsh migration due to sea-level rise impacts.	X	Eastern narrow-mouthed toad, Atlantic coast leopard frog, carpenter frog



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Frogs and Toads</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of baseline data	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	P	ALL frogs and toads SGCN
12.1.1	Lack of baseline data	Conduct road-side chorus surveys and monitor annually.	P	Eastern narrow-mouthed toad, barking treefrog, Atlantic coast leopard frog, carpenter frog, upland chorus frog
12.1.1	Lack of baseline data	Determine habitat partitioning/distribution between southern leopard frog and Atlantic coastal leopard frog.	X	Atlantic coast leopard frog
12.1.2	Lack of current data	Follow-up MARA project with detailed studies to investigate loss of former range (fore species where this is true).	X	Mountain chorus frog, upland chorus frog
12.1.3	Information collection: answer research question	Determine impacts of emerging pathogens.	X	Barking treefrog, carpenter frog, Atlantic coast leopard frog, upland chorus frog
12.1.3	Information collection: answer research question	Assess feasibility of reintroducing species into historical locations.	X	Mountain chorus frog
12.1.3	Information collection: answer research question	Determine reasons for apparent population decline/extirpation in the state.	X	Mountain chorus frog, upland chorus frog
12.1.3	Information collection: answer research question	Study impacts of sea-level rise and climate change on coastal species.	X	Eastern narrow-mouthed toad, Atlantic leopard frog, carpenter frog

**Conservation Actions for Sea Turtle SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Sea Turtles</b>				
<b>IUCN 5: Biological Resource Use</b>				
5.4.3	Fishing and harvesting of aquatic resources: unintentional effects (subsistence/small scale)	Implement effective regulations related to bycatch in fishing/crabbing gear.	X	Loggerhead sea turtle





IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Sea Turtles</b>				
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1.2	Recreational activities: boating	Implement effective methods to reduce mortality from boat strikes.	X	Loggerhead sea turtle, Kemp's Ridley sea turtle
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Continue efforts to gather and centrally compile sightings data to determine important areas for conservation.	P	ALL SGCN sea turtles
12.1.2	Lack of up-to-date existing information	Create a system to report propeller strikes.	X	Loggerhead sea turtle
12.1.2	Lack of up-to-date existing information	Partner with watermen to collect demographic data on sea turtles (live & dead) captured in gear.	X	ALL SGCN sea turtles
12.1.2	Lack of up-to-date existing information	Continue surveys for nests and protecting nest locations from humans and predators.	P	Loggerhead sea turtle
12.1.3	Need to answer research question	Determine if nesting females are just laying late-term eggs or if they are unique individuals reacting to climate change.	X	Loggerhead sea turtle
12.1.3	Need to answer research question	Determine potential impacts from offshore wind energy development through research and survey means.	X	ALL SGCN sea turtles
12.1.3	Need to answer research question	Continue system for reporting of dead sea turtles and getting them necropsied to determine cause of death.	P	ALL SGCN sea turtles
12.1.3	Need to answer research question	Conduct a satellite transmitter study of juvenile movements and habitat use in Chesapeake Bay.	X	Kemp's Ridley sea turtle

**Conservation Actions for Turtle SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Turtles</b>				
<b>IUCN 1: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect and restore nesting and/or basking habitat.	P	Bog turtle, wood turtle, northern map turtle, northern diamond-backed terrapin



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Turtles</b>				
1 - 4	Habitat loss (from various causes)	Protect breeding beach habitat by limiting rip-rap and bulkheads along shorelines.	P	Northern diamond-backed terrapin
<b>IUCN 5: Biological Resource Use</b>				
5.1.2	Hunting and collecting terrestrial animals: unintentional effects	Promote the use of cull rings and Turtle Exclusion Devices on all recreational pots to avoid bycatch.	X	Northern diamond-backed terrapin
5.3.2	Logging and wood harvesting; intentional use - large scale	Manage State lands for native forest communities (i.e. limit extent of loblolly pine plantations).	X	Spotted turtle, eastern box turtle
5.4.3	Fishing and harvesting of aquatic resources: unintentional effects – small scale	Reduce mortality (as bycatch) in recreational and commercial crab pots.	P	Northern diamond-backed terrapin
<b>IUCN 7: Natural Systems Modifications</b>				
7.2	Dams and water management/use	Monitor changes in hydrology at most important known locations to inform future management of these areas.	X	Bog turtle
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Manage vegetation at most important known locations.	X	Bog turtle
7.3.5	Imbalanced predator/prey dynamics	Control predators at known nesting sites.	P	Bog turtle, northern map turtle
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.5.2	Viral disease: <i>Ranavirus</i>	Prohibit use of wild turtles in Turtle Derbies.	P	Spotted turtle, wood turtle, eastern box turtle
<b>IUCN 9: Pollution</b>				
9.1.2	Domestic and urban waste water: run-off	Maintain and increase water quality through various methods, including improved sediment and erosion control.	X	Bog turtle, wood turtle
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	X	ALL SGCN turtles
12.1.2	Lack of up-to-date existing information	Monitor population health (e.g., abundance, reproduction, etc.) at known locations.	P	Wood turtle
12.1.2	Lack of up-to-date existing information	Piedmont populations should be studied and conserved; study outside of core range.	X	Eastern box turtle



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Turtles</b>				
12.1.3	Need to answer research question	Monitor spread of individuals infected with <i>Ranavirus</i> ; determine impact of emerging pathogens.	X	Northern diamond-backed terrapin
12.1.3	Need to answer research question	Determine efficacy of head-starting.	X	Northern diamond-backed terrapin
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Continue to coordinate efforts of MD Terrapin Working Group.	P	Northern diamond-backed terrapin
15.3.2	Need for coordination for effective program/project management	Continue working with other states on range-wide conservation projects.	P	Bog turtle, wood turtle, northern diamond-backed terrapin

**Conservation Actions for Lizard SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Lizards</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	X	Northern coal skink
12.1.2	Lack of up-to-date existing information	Follow-up MARA project with detailed study to evaluate whether range contraction and population declines are occurring.	X	Eastern six-lined racerunner
12.1.3	Need to answer research questions	Evaluate effects of shale barren habitat restoration projects on populations.	X	Northern coal skink



Conservation Actions for Snake SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Snakes</b>				
<b>IUCN 1: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect known occupied habitat, or largest/best populations.	X	Northern scarletsnake, timber rattlesnake, rainbow snake, mole kingsnake, coastal plain milksnake, plain-bellied watersnake, red cornsnake, mountain earthsnake,
<b>IUCN 1: Residential and Commercial Development</b>				
1.3	Tourism and recreational areas	Implement additional protection measures for populations on public lands (e.g., rerouting hiking trails, educational signs).	P	Timber rattlesnake
<b>IUCN 5: Biological Resource Use</b>				
5.1.1	Hunting and collection terrestrial animals: intentional use	Ensure species is included on Natural Heritage Program's Vulnerable Species list and implement exemption to Public Information Act.	P	Timber rattlesnake, coastal plain milksnake, red cornsnake
5.3.2	Logging and wood harvesting; intentional use - large scale	Develop time-of-year restrictions for timber harvests and identify no-cut zones (if any).	P	Timber rattlesnake, rainbow snake
5.3.2	Logging and wood harvesting; intentional use - large scale	Manage State lands for native forest communities (i.e., limit extent of loblolly pine plantations).	X	Coastal plain milksnake, eastern ribbonsnake
<b>IUCN 7: Natural Systems Modifications</b>				
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Prevent shading of specific rookeries by canopy closure.	X	Timber rattlesnake
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	P	ALL SGCN snakes
12.1.2	Lack of up-to-date existing information	Monitor population health (e.g., abundance, reproduction, etc.) at known locations.	P	ALL SGCN snakes
12.1.2	Lack of up-to-date existing information	Follow-up MARA project with detailed study to evaluate whether range contraction and population declines are occurring.	X	Northern scarletsnake, smooth green snake, eastern ribbonsnake
12.1.3	Need to answer research question	Determine impact of poaching.	X	Timber rattlesnake, red cornsnake, eastern kingsnake
12.1.3	Need to answer research question	Conduct radio telemetry study to determine extent of area required	X	Rainbow snake



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Snakes</b>				
		for protection, microhabitats used, behavior, etc.		
12.2.3	Need for fish, wildlife, and/or habitat planning	Consider threats on a mountain-by-mountain basis to preserve current range.	X	Timber rattlesnake
12.2.3	Need for fish, wildlife, and/or habitat planning	Consider management plan for Southern Frederick County location, which may be at a critically low population level.	X	Timber rattlesnake
<b>IUCN 14: Education/Outreach Needs</b>				
14.3.1	Outreach needs: need to develop and/or maintain a broad base of support for agency goals and objectives	Implement public outreach effort on snakes, including signage on venomous and Rare, Threatened, and Endangered species in parks.	X	Timber rattlesnake
<b>IUCN 15: Administrative Needs</b>				
15.3.4	Need for increased enforcement of laws	Increase enforcement of poaching laws & regulations.	P	Northern scarletsnake, timber rattlesnake, coastal plain milksnake, red cornsnake, eastern kingsnake

### Conservation Actions for Fish SGCN

#### Conservation Actions for ALL Fish SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Fishes – ALL</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Assess population strongholds and identify areas with successful/feasible restoration and prioritize for biological recovery.	X	ALL SGCN fishes
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient; restore and protect these areas that are most vulnerable and most resilient.	X	ALL SGCN fishes
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for	Ensure that the conservation requirements of SGCN fishes are met in all	P	ALL SGCN fishes



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
	effective program/project management	management projects (e.g., timber harvest plans) on state lands. As part of this, establish general set of land and water management principles for living resources benefit such as limiting impervious surfaces to watershed, limiting (or removing if possible) migration barriers, etc.		

**Conservation Actions for Estuarine/Large River Fishes**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Estuarine/Large River Fishes</b>				
<b>IUCN 5: Biological Resource Use</b>				
5.4.1	Fishing and harvesting of aquatic resources: intentional use (small scale)	Establish sustainable harvest levels.	X	Horseshoe crab
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1.3	Recreational activities: use of beaches	Identify spawning and nursery habitat and implement a spawning survey.	P	Horseshoe crab
<b>IUCN 8: Invasive and Other Problematic Species, Genes and Diseases</b>				
8.1.2	Invasive non-native aquatic animals	Assess impacts from invasive fishes (e.g., blue catfish).	P	White catfish
8.1.2	Invasive non-native aquatic animals	Ban importation and use of Asian horseshoe crabs.	P	Horseshoe crab
8.1.3	Invasive non-native aquatic animals	Limit/prevent the spread of invasive fish.	X	Bowfin, white catfish
<b>IUCN 12: Resource Management Needs</b>				
12.2	Resource management decision needs	Re-evaluate the species' state rank/status using all recent data available.	X	Bowfin, white catfish
12.1.1	Lack of initial baseline	Document tributaries with spawning populations.	X	Atlantic sturgeon



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Estuarine/Large River Fishes</b>				
	inventory			
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from MD and adjacent states when possible) to focus survey efforts.	X	Bowfin, spotfin killifish, thorny skate, barndoor skate, smooth skate
12.1.2	Lack of up-to-date existing information	Compile all recent distribution records.	X	Bowfin, spotfin killifish, white catfish, thorny skate, barndoor skate, smooth skate
12.1.3	Need to answer research question	Evaluate efficacy of sampling gears and identify most appropriate sampling gear and study design to use for targeted status assessment surveys.	P	Bowfin, spotfin killifish
12.1.3	Need to answer research question	Design and conduct radio telemetry study to determine extent of area required for protection, habitats used, etc.	X	Bowfin
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient.	X	ALL SGCN estuarine/large river fishes
12.2.3	Need for fish, wildlife, and/or habitat planning	Implement and promote conservation actions outlined in Federal and State fisheries management plans.	P	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, white catfish, horseshoe crab
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Hickory shad, American shad

**Conservation Actions for Piedmont/Coastal Plain Fish SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Piedmont/Coastal Plain Fishes</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.2	Resource management decision needs	Re-evaluate the species' state rank/status using all recent data available.	X	Swamp darter, banded sunfish



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Piedmont/Coastal Plain Fishes</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from MD and adjacent states when possible) to focus survey efforts.	X	American brook lamprey, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, Maryland darter, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish
12.1.2	Lack of up-to-date existing information	Conduct annual surveys to detect trends in population size, size structure, etc. in watersheds under threat of development, resource extraction, etc.	X	American brook lamprey, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Maryland darter, glassy darter, mud sunfish, flier, banded sunfish
12.1.3	Need to answer research question	Evaluate need for and feasibility of propagation, population augmentation, translocation, and/or reintroduction (and, if needed, establish fish propagation program to meet these needs); Consider "experimental/non-essential" population status.	X	Bridle shiner, stripeback darter, blackbanded sunfish
12.1.3	Need to answer research question	Assess connectivity among populations - metapopulation; understand gene flow among populations.	P	
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	P	Stripeback darter, Chesapeake logperch, blackbanded sunfish
12.1.3	Need to answer research question	Complete genetic assessment to determine intra- and inter-population genetic variation of MD and Delaware populations.	X	American brook lamprey, ironcolor shiner, stripeback darter, glassy darter, mud sunfish, flier, blackbanded sunfish
12.1.3	Need to answer research question	Seek funding to develop mitochondrial and/or nuclear DNA primers for targeted eDNA surveys.	X	Blackbanded sunfish
12.1.3	Need to answer research question	Identify populations most threatened based on county development plans, etc.	X	Blackbanded sunfish, Maryland darter
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts.	X	American brook lamprey, bridle shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish
12.2.3	Need for species/ habitat planning	Evaluate feasibility of re-introduction of species into historical locations; consider "experimental/non-essential" population status reintroduction via translocation from Pennsylvania stock.	X	Bridle shiner





IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Piedmont/Coastal Plain Fishes</b>				
12.2.3	Need for fish, wildlife, and/or habitat planning	Implement and promote conservation actions outlined in federal and state fisheries management/recovery plans.	P	Maryland darter
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Chesapeake logperch, blackbanded sunfish

**Conservation Actions for Highland Fishes**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Highland Fishes</b>				
<b>IUCN 3: Energy Production and Mining</b>				
3.2.3	Mining and quarrying; deep mining	Monitor population size and age structure in Casselman River to assess impacts from recently permitted coal deep mine.	X	Stonecat
<b>IUCN 11: Climate Change and Severe Weather</b>				
11.3	Temperature extremes	Evaluate habitat change and loss predicted due to changes in thermal regime and precipitation patterns.	P	Brook trout
<b>IUCN 12: Resource Management Needs</b>				
12.2	Resource management decision needs	Re-evaluate the species' state rank/status using all recent data available.	X	Brook trout, checkered sculpin
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from MD and adjacent states when possible) to focus survey efforts.	X	Striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter
12.1.2	Lack of up-to-date existing information	Conduct annual surveys to detect trends in population size, size structure, etc. in watersheds under threat of development, resource extraction, etc.; use this knowledge to support	X	Stonecat, brook trout, striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Highland Fishes</b>				
		sustainable harvests.		
12.1.2	Lack of up-to-date existing information	Develop methods of volunteer recreational harvest sampling (e.g. logbooks and online surveys).	X	
12.1.3	Need to answer research question	Identify at risk populations using current data and prioritize list of populations to be protected.	X	Brook trout
12.1.3	Need to answer research question	Evaluate need for and feasibility of propagation, population augmentation, translocation, and/or reintroduction (and, if needed, establish fish propagation program to meet these needs); Consider "experimental/non-essential" population status.	X	Stonecat, longnose sucker
12.1.3	Need to answer research question	Identify suitable habitats for reintroduction.	X	Brook trout, stonecat
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	P	Stonecat, striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter
12.1.3	Need to answer research question	Identify populations most threatened based on county development plans, etc.	X	
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Stonecat, brook trout, striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter



## Conservation Actions for Insect SGCN

### Overall Conservation Actions for ALL Insect SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects - ALL</b>				
<b>IUCN 1 - 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various sources)	Protect and manage high quality habitat through land acquisition and conservation easements.	P	ALL SGCN insects
<b>IUCN 7: Natural Systems Modifications</b>				
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Restore areas of known, occupied habitat, especially where populations are declining; monitor population response.	P	ALL SGCN insects
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1	Invasive non-native/alien species/diseases	Assess threats from invasive species and control invasives when feasible.	P	ALL SGCN insects
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to determine or refine species distribution.	P	ALL SGCN insects
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, abundance, status, and habitat requirements through monitoring and research.	P	ALL SGCN insects
12.1.2	Lack of up-to-date existing information	Increase knowledge of population dynamics and dispersal.	P	ALL SGCN insects
12.1.3.	Need to answer research question	Estimate population size and evaluate trends.	P	ALL SGCN insects
12.1.3.	Need to answer research question	Assess threats that may be contributing to population declines or negatively impacting sites.	P	ALL SGCN insects
<b>IUCN 14: Education/Outreach Needs</b>				
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Engage in efforts and develop new public education and outreach to the general public, students, etc. about insect conservation issues and incentives for training new taxonomists.	P	ALL SGCN insects



Conservation Actions for Ash-dependent Insect SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Ash-dependent Insects</b>				
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1.4	Invasive non-native terrestrial/wetland animals: emerald ash borer	Do not remove all ash trees as a preventative measure	X	Ashleaf gall mite, ashleaf flowergall mite, ash bullet gall midge, ash midrib gall midge, ash plant bug, Eastern ash bark beetle, northern ash bark beetle, white-banded ash bark beetle, ash seed weevil, blackheaded ash sawfly, brownheaded ash sawfly, Grote’s swallow, ash pyralid, purple plagodis, banded ash clearwing moth
8.1.4	Invasive non-native terrestrial/wetland animals: emerald ash borer	Parks/areas that are going to do canopy sprays or injections should leave some untreated for native species (preferably trees that are in natural settings over open grown or edge trees).	X	Ashleaf gall mite, ashleaf flowergall mite, ash bullet gall midge, ash midrib gall midge, ash plant bug, Eastern ash bark beetle, northern ash bark beetle, white-banded ash bark beetle, ash seed weevil, blackheaded ash sawfly, brownheaded ash sawfly, Grote’s swallow, ash pyralid, purple plagodis, banded ash clearwing moth
8.1.4	Invasive non-native terrestrial/wetland animals: emerald ash borer	Maintain small groves/fields of ash seedlings (<1 inch in diameter) that are too small for EAB but might be hosts for our natives.	X	Ashleaf gall mite, ashleaf flowergall mite, ash bullet gall midge, ash midrib gall midge, ash plant bug, Eastern ash bark beetle, northern ash bark beetle, white-banded ash bark beetle, ash seed weevil, blackheaded ash sawfly, brownheaded ash sawfly, Grote’s swallow, ash pyralid, purple plagodis, banded ash clearwing moth

Conservation Actions for Tiger Beetle SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Tiger Beetles</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect known occupied habitat, or largest/best populations.	X	Eastern Pinebarrens tiger beetle, northeastern beach tiger beetle, white tiger beetle, Northern Barrens tiger beetle, Puritan tiger beetle



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Tiger Beetles</b>				
1 - 4	Habitat loss (from various causes)	Protect habitat by working with the regulatory process through the modification or application of existing laws, specifically with mitigation project policies.	P	Northeastern beach tiger beetle, Puritan tiger beetle
1-4	Habitat loss (from various causes)	Protect shoreline habitat through pursuing land acquisition and conservation easements.	P	Northeastern beach tiger beetle, Puritan tiger beetle
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6	Human Intrusions and Disturbance	Limit disturbance of occupied, suitable habitat.	X	White tiger beetle, ghost tiger beetle
<b>IUCN 7: Natural Systems Modification</b>				
7.3.1	Shoreline stabilization	Restore areas of known, occupied shoreline habitat, especially where populations are declining; monitor population response.	P	Northeastern beach tiger beetle, white tiger beetle, ghost tiger beetle, Puritan tiger beetle
7.3.1	Shoreline stabilization	Evaluate impacts of shoreline erosion control structures.	P	Northeastern beach tiger beetle, Puritan tiger beetle
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing information	Refine understanding of larval habitat requirements so that sections of shoreline cliffs most important to protect can be identified	X	Eastern Pinebarrens tiger beetle, Appalachian tiger beetle, Northern Barrens tiger beetle
12.1.2	Lack of up-to-date existing information	Conduct population viability analyses to help guide habitat protection and restoration efforts	X	Eastern Pinebarrens tiger beetle, northeastern beach tiger beetle, Appalachian tiger beetle, Northern Barrens tiger beetle, Puritan tiger beetle
12.1.3.	Need to answer research question	Determine reasons for population decline on Western shore.	X	Northeastern beach tiger beetle, Northern Barrens tiger beetle
12.1.3.	Need to answer research question	Resolve taxonomic issues regarding subspecies.	X	Northeastern beach tiger beetle, white tiger beetle
12.1.3.	Need to answer research question	Evaluate impacts of climate change.	X	Northeastern beach tiger beetle, white tiger beetle, Northern Barrens tiger beetle, Puritan tiger beetle
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate watershed habitat conservation efforts with neighboring states.	X	Appalachian tiger beetle



**Conservation Actions for Other Beetle SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Other Beetles</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.1.3	Need to answer research question	Determine if species is extant in MD.	X	Bethany Beach firefly
12.1.3.	Need to answer research question	Seek taxonomist assistance to describe new species.	X	A cave beetle ( <i>Pseudanophthalmus sp 15</i> )
12.2.3	Need for wildlife and habitat planning	Determine habitat protection needs.	X	Six-banded longhorn beetle, a tenebrionid beetle ( <i>Helops cisteloides</i> ), Seth Forest water scavenger beetle, Bethany Beach firefly, a tenebrionid beetle ( <i>Schoenicus puberulus</i> )

**Conservation Actions for Bee SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Bees</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Create bee habitat along roads and highways.	P	ALL SGCN bees (pollinators)
<b>IUCN 2: Agriculture and Aquaculture</b>				
2	Agriculture and Aquaculture	Create lists of plants that native bees will pollinate and create seed mixes for various habitats that Maryland Department of Transportation (MDOT) or utility companies can use.	P	ALL SGCN bees (pollinators)
<b>IUCN 4: Transportation and Service Corridors</b>				
4.2.1	Utility and service lines: land conversion from natural habitat to utility and other service lines	Manage utility (powerline) rights of way as bee habitat.	P	ALL SGCN bees (pollinators)



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Bees</b>				
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.4	Problematic species/diseases of unknown origin	Ensure that commercial bumble bee colonies are pathogen free.	P	Bumblebees ( <i>Bombus</i> spp.)
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Target survey work for spring deciduous forest species ( <i>Osmia</i> , <i>Andrena</i> , <i>Nomada</i> ) before leaf out.	P	Mining bees ( <i>Andrena</i> spp.), a cuckoo bee ( <i>Nomada rubicunda</i> ), a mason bee ( <i>Osmia chalybea</i> )
12.1.1	Lack of initial baseline inventory	Target survey work for specialists (on a specific genus or species of plant) when those plants are in flower.	P	Oil-collecting bees ( <i>Macropis</i> spp.)
12.1.1	Lack of initial baseline inventory	Target survey work to collect wetland habitat specialists.	P	ALL SGCN bees
12.1.2	Lack of up to date existing information	Develop and implement citizen science program monitoring.	X	ALL SGCN bees
12.1.3.	Need to answer research question	Determine if still extant in Maryland.	X	Macropis cuckoo bee
12.2.2	Need for fish, wildlife, and/or habitat planning	Create bee habitat refugia adjacent to croplands.	P	ALL SGCN bees (pollinators)

**Conservation Actions for Ant SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Ants</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect pitcher plant bogs on private and public lands.	X	ALL SGCN ants
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct initial surveys to collect baseline data; distribution data and habitat associations data is necessary.	P	ALL SGCN ants



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Ants</b>				
12.1.1	Lack of initial baseline inventory	Focus surveys and protection on isolated pockets of habitats (bogs, barrens, dunes, etc.) for specialist species.	P	ALL SGCN ants
12.1.1	Lack of initial baseline inventory	Focus attention on parasitic ants as this is the most data deficient group of ants.	X	ALL SGCN ants

**Conservation Actions for Moth SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Moths</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various causes)	Protect pitcher plant bogs on private and public lands.	X	ALL SGCN moths
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.2.1	Invasive non-native diseases: chestnut blight	Plant blight-resistant chestnut trees to restore chestnut as a forest component.	X	ALL SGCN moths
8.2.2	Problematic native species/diseases: white-tailed deer	Increase efforts to control deer including targeting specific areas for controlled hunts, creating deer exclusion areas, and creating incentives to increase hunting efforts.	X	ALL SGCN moths
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Target rare communities for initial survey focal areas: in the following key wildlife habitats: (1) coastal plain oak-pine forests (2) coastal plain seepage bogs and fens (3) tidal and nontidal shrub wetlands (4) grasslands (5) barrens and glades (6) coastal beaches and dunes (7) maritime forests and shrublands. Follow-up surveys by ranking habitat/communities by threats/rarity and look for common patterns between different taxa groups, such as bees and moths.	P	ALL SGCN moths
12.1.2	Lack of up to date information	Assess quality and results of existing baseline data and consolidate to inform survey and monitoring efforts. Suggestions for implementation include: mapping existing element occurrence data and overlay with habitat maps and physiographic province/soil maps; rank habitats/communities by SGCN abundance; add Glaser et al. data to moth database; try to assess collection years;	P	ALL SGCN moths





IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Moths</b>				
		etc. Use Glaser et al., Smithsonian database and, Bryant Books for reference.		
12.1.3	Need to answer research question	Research and evaluate the impacts of Broadcast spray programs (mosquito control, gypsy moth, cankerworm, etc.). Evaluate the impacts of target host pesticide programs (emerald ash borer and Hemlock woolly adelgid). If current research is inadequate, partner with academics to design and implement an effective, measurable study that could lead to a regulatory change in pesticide/herbicide application practices.	P	ALL SGCN moths (pollinators)

**Conservation Actions for Butterfly (skippers) SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Butterflies (skippers)</b>				
<b>IUCN 4: Transportation and Service Corridors</b>				
4.2.1	Utility and service lines: land conversion	Work with energy companies to restrict herbicide use on powerlines rights of way and transmission lines, and create a management regime for seasonal mowing and successional stage planning (e.g. mowing back).	P	Cobweb skipper, southern grizzled skipper (pollinators)
<b>IUCN 7: Natural Systems Modifications</b>				
7.3.2	Inappropriate timing of mowing	Work with state highways and county road crews to alter mowing regimes use along roads and medians to benefit pollinators.	P	Chermock’s mulberry wing, Delaware skipper (pollinators)
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.2.2	Problematic native species: white-tailed deer	Protect host plant from deer browse with fencing.	X	Mottled duskywing
<b>IUCN 9: Pollutants</b>				
9.5.5	Airborne pollutants: herbicides and pesticides	Increase ability to protect habitat and species through modification or application of existing laws that will better regulate broadcast spray programs regulations to avoid impacts to non-target Lepidoptera.	P	ALL SGCN skippers (pollinators)
<b>IUCN 12: Resource Management Needs</b>				
12.1	Resource information collection needs	Coordinate with Delaware Natural Heritage Program to conduct inventory, monitoring, and survey projects and protect habitat in both states.	X	Chermock’s mulberry wing, mottled duskywing



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Butterflies (skippers)</b>				
12.1.1	Lack of initial baseline inventory	Collect data on habitat requirements.	X	Chermock’s mulberry wing, mottled duskywing, mulberry wing
12.1.2	Lack of up-to-date existing information	As this species is likely extirpated, change conservation rank to SH (historically known from Maryland).	X	Chermock’s mulberry wing, mottled duskywing, southern grizzled skipper
12.1.3	Need to answer research question	Determine if species is extant in Maryland.	P	Chermock’s mulberry wing, mottled duskywing, southern grizzled skipper, two-spotted skipper
12.1.3	Need to answer research question	Research and evaluate the impacts of broadcast spray programs (mosquito control, gypsy moth, cankerworm, etc.). Evaluate the impacts of target host pesticide programs (emerald ash borer and hemlock woolly adelgid). If current research is inadequate, partner with academics to design and implement an effective, measurable study that could lead to a regulatory change in pesticide/herbicide application practices.	P	Rare skipper (pollinators)

**Conservation Actions for Butterfly (lycaenids) SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Butterflies (lycaenids)</b>				
<b>IUCN 4: Transportation and Service Lines</b>				
4.2.1	Utility and service lines: land conversion	Work with energy companies to restrict herbicide use on powerlines rights of way and transmission lines, and create a management regime for seasonal mowing and successional stage planning (e.g. mowing back).	P	All SGCN lycaenids (pollinators)
<b>IUCN 6: Human Intrusions and Disturbance</b>				
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Determine potential impacts of recent bike park proposal in Frederick County watershed.	X	Edward’s hairstreak



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Butterflies (lycaenids)</b>				
<b>IUCN 7: Natural Systems Modifications</b>				
7.3.2	Inappropriate timing of mowing	Work with state highways and county road crews to alter mowing regimes use along roads and medians to benefit pollinators.	P	Bronze copper, frosted elfin, great purple hairstreak, hickory hairstreak, northern hairstreak, silvery blue (pollinators)
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.2.2	Problematic native species: white-tailed deer	Protect host plant from deer browse with fencing or deer control.	P	Appalachian blue, frosted elfin, northern hairstreak
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Note occurrence data when doing inventory and monitoring work for other higher priority species.	X	Appalachian blue
12.1.2	Lack of up-to-date existing information	Monitor habitat for successional changes.	X	Hoary elfin
12.1.2	Lack of up-to-date existing information	Encourage and partner with citizen scientist groups to initiate and participate in counts with the North American Butterfly Association (NABA); or conduct other rigorous census work annually.	P	Great purple hairstreak
12.1.3.	Need to answer research question	Determine density of larval host plant required to support a viable population.	X	Great purple hairstreak
12.1.3.	Need to answer research question	Evaluate measures to promote population revival and maintenance.	X	Bronze copper
12.1.3.	Need to answer research question	Determine if still extant in Maryland.	X	Hessel’s hairstreak, hickory hairstreak
<b>IUCN 15: Administrative Needs</b>				
15.3.3	Need for increased legal protection	Increase ability to protect habitat and species through modification or application of existing laws that will better regulate broadcast spray programs regulations to avoid impacts to non-target Lepidoptera.	P	Silvery blue (pollinators)



Conservation Actions for Butterfly (other) SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Butterflies (other)</b>				
<b>IUCN 1 - 4: Urbanization/Development</b>				
1 - 4	Habitat loss (from various sources)	Protect habitat through conservation easements and other means, coordinating with neighboring states as needed.	X	Baltimore checkerspot
<b>IUCN 4: Transportation and Service Corridors</b>				
4.2.1	Utility and service lines: land conversion	Work with energy companies to restrict herbicide use on powerlines rights of way and transmission lines, and create a management regime for seasonal mowing and successional stage planning (e.g. mowing back).	P	Atlantis fritillary, Baltimore checkerspot, monarch, northern metalmark, Olympia marble (pollinators)
<b>IUCN 7: Natural Systems Modifications</b>				
7.3.2	Inappropriate timing of mowing	Work with state highways and county road crews to alter mowing regimes use along roads and medians to benefit pollinators.	P	Atlantis fritillary, monarch, northern metalmark (pollinators)
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1	Invasive non-native/alien species/diseases: garlic mustard	Control garlic mustard in Potomac Garrett State Forest.	X	West Virginia white
8.2.2	Problematic native species: white-tailed deer	Manage deer population due to overbrowse.	X	Baltimore Checkerspot, giant swallowtail
<b>IUCN 9: Pollutants</b>				
9.5.5	Airborne pollutants: herbicides and pesticides	Work with state highways and county road crews to limit pesticide use along roads and medians.	P	Monarch (pollinators)
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Note occurrence data when doing inventory and monitoring work for other higher priority species.	X	Compton tortoiseshell, grey comma, northern metalmark
12.1.1	Lack of initial baseline inventory	Evaluate host plant distribution and habitat.	X	Olympia marble
12.1.2	Lack of up-to-date existing information	Note and monitor important migration stopover areas.	X	Monarch
12.1.3.	Need to answer research question	Determine if still extant in Maryland.	X	Pink-edged sulphur



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Butterflies (other)</b>				
<b>IUCN 15: Administrative Needs</b>				
15.3.3	Need for increased legal protection	Increase ability to protect habitat and species through modification or application of existing laws that will better regulate broadcast spray programs regulations to avoid impacts to non-target Lepidoptera.	P	Olympia marble (pollinators)

**Conservation Actions for Dragonfly and Damselfly SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Dragonflies and Damselflies</b>				
<b>IUCN 1-4: Urbanization/Development</b>				
1-4	Habitat loss (from various causes)	Work with watershed groups, watershed-based initiatives, landowners, and state and federal programs to protect and restore stream and wetland habitats.	P	ALL SGCN dragonflies and damselflies
1-4	Habitat loss (from various causes)	Protect high priority streams and wetlands through land acquisition and conservation easements.	P	ALL SGCN dragonflies and damselflies
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	ALL SGCN dragonflies and damselflies
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Monitor biological (including benthic macroinvertebrate populations), chemical and physical stream parameters to assess potential impacts of hydraulic fracturing on stream and wetland habitats.	P	ALL SGCN dragonflies and damselflies
3.2.3	Mining and quarrying; deep mining	Monitor rare odonate populations in the Casselman River to help assess potential coal mining impacts.	P	ALL SGCN dragonflies and damselflies
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Continue surveys to better assess odonate status, distribution and conservation needs, focusing on taxa that are currently or potentially state (S1-S2S3, SH, SX) or globally rare (G1-G3G4).	P	ALL SGCN dragonflies and damselflies
12.1.2	Lack of up to date existing information	Improve understanding of life history, dispersal, ecological requirements and threats/stressors.	P	ALL SGCN dragonflies and damselflies



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Dragonflies and Damselflies</b>				
12.1.3	Need to answer research question	Complete genetic and morphometric analyses to help determine the taxonomic status of St. Croix Clubtail populations in the Potomac River and elsewhere.	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and restoration needs in public land management plans.	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate stream and wetland protection measures in local, county and state land planning efforts.	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Use odonate inventory and monitoring data to help identify high priority wetlands, streams and watersheds for conservation.	P	ALL SGCN dragonflies and damselflies
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate watershed-scale stream and wetland conservation efforts with neighboring states.	P	ALL SGCN dragonflies and damselflies

**Conservation Actions for Stonefly SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Stoneflies</b>				
<b>IUCN 1-4: Urbanization/Development</b>				
1-4	Habitat loss (from various causes)	Work with watershed groups, watershed-based initiatives, landowners, and state and federal programs to protect and restore stream and wetland habitats.	P	ALL SGCN plecoptera
1-4	Habitat loss (from various causes)	Protect high priority streams and wetlands through land acquisition and conservation easements.	P	ALL SGCN plecoptera
<b>IUCN 3: Energy Production and Mining</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	ALL SGCN plecoptera



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Stoneflies</b>				
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Monitor biological (including benthic macroinvertebrate populations), chemical and physical stream parameters to assess potential impacts of hydraulic fracturing on stream and wetland habitats.	P	ALL SGCN plecoptera
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Determine status and distribution of stoneflies in Maryland.	P	ALL SGCN plecoptera
12.1.2	Lack of up to date existing information	Improve understanding of life history, dispersal, ecological requirements and threats/stressors.	P	ALL SGCN plecoptera
12.1.3	Need to answer research question	Improve understanding of the role stoneflies may play in helping to assess stream biotic integrity and identify priority streams for protection and restoration.	X	ALL SGCN plecoptera
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and restoration needs in public land management plans.	P	ALL SGCN plecoptera
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	ALL SGCN plecoptera
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate stream and wetland protection measures in local, county and state land planning efforts.	P	ALL SGCN plecoptera
12.2.3	Need for fish, wildlife and/or habitat planning	Use odonate inventory and monitoring data to help identify high priority wetlands, streams and watersheds for conservation.	P	ALL SGCN plecoptera
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate watershed-scale stream and wetland conservation efforts with neighboring states.	P	ALL SGCN plecoptera



**Conservation Actions for Other Insect SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Insects – Other Insects</b>				
<b>IUCN 1 – 4: Urbanization/Development</b>				
1 – 4	Habitat loss (from various causes)	Protect pitcher plant bogs.	P	Diptera (ash bullet gall midge, ash midrib gall midge, pitcher plant mosquito)
<b>IUCN 7: Natural Systems Modifications</b>				
7.1.2	Fire and fire suppression: suppression of fire frequency / intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation.	X	Hemiptera (eastern sedge barrens leaf hopper, ash plant bug)
<b>IUCN 12: Resource Management Needs</b>				
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, abundance, status, and habitat requirements through monitoring and research.	X	Hemiptera (eastern sedge barrens leaf hopper, ash plant bug)
12.1.3	Need to answer research question	Seek taxonomist assistance to describe new species.	X	Collembola (crabtree cave springtail)

**Conservation Actions for Crayfish SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Invertebrates – Crayfish</b>				
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1.2	Invasive non-native aquatic animals	Assess impacts from invasive crayfishes.	P	ALL SGCN crayfish
8.1.2	Invasive non-native aquatic animals	Limit/prevent the spread of invasive crayfishes via anglers by banning or restricting their possession/use as bait.	P	ALL SGCN crayfish
8.1.2	Invasive non-native aquatic animals	Address the pathways of invasive crayfishes including pet, bait, biological supply, and live seafood industries using education/outreach and other vector management techniques.	P	ALL SGCN crayfish





IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Invertebrates – Crayfish</b>				
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution of the species; use landscape, water chemistry, and habitat data (from Maryland and adjacent states when possible) to focus survey efforts.	P	Digger crayfish, acuminate crayfish
12.1.2	Lack of up-to-date existing information	Conduct annual surveys to detect trends in population size in watersheds under threat of development, resource extraction, etc.	P	Acuminate crayfish, Allegheny crayfish, rock crawfish
12.1.3	Need to answer research question	Identify at risk populations using current data and prioritize list of populations to be protected.	P	ALL SGCN crayfish
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	X	ALL SGCN crayfish
12.1.3	Need to answer research question	Identify populations most threatened based on county development plans, etc.	P	ALL SGCN crayfish
12.1.3	Need to answer research question	Evaluate efficacy of sampling gears and identify most appropriate sampling gear and study design to use for targeted status assessment surveys.	P	Digger crayfish
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient.	X	Digger crayfish, acuminate crayfish
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	X	ALL SGCN crayfish
12.1.3	Need to answer research question	Complete genetic assessment to determine intra-population variation within Maryland populations and inter-population similarity to populations in Virginia, Pennsylvania, and North Carolina.	P	Acuminate crayfish
12.1.3	Need to answer research question	Seek funding to develop mitochondrial and/or nuclear DNA primers for targeted eDNA surveys.	X	Digger crayfish, acuminate crayfish
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	X	ALL SGCN crayfish



**Conservation Actions for Freshwater Mussel SGCN**

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Invertebrates – Mussels</b>				
<b>IUCN 2: Agriculture and Aquaculture</b>				
2	Agriculture and Aquaculture	Protect and restore ecological integrity of streams where species is extant through prioritized land acquisition, revegetation, and cooperative landowner agreements to reduce effects from agricultural practices (fertilizer, pesticides/herbicides), development (storm water run-off), and climate change (thermal and hydrologic alteration).	P	Dwarf wedgemussel, triangle floater, creeper
<b>IUCN 3: Energy Production and Mixing</b>				
3.2.3	Mining and quarrying; deep mining	Continue population monitoring in Casselman River to assess impacts from recently permitted coal deep mine.	P	Creeper
<b>IUCN 4: Transportation and Service Corridors</b>				
4.3.2	Shipping lanes; dredging impacts	Evaluate potential impacts of coastal river dredging and work with appropriate regulatory agencies to avoid impacts.	X	Tidewater mucket, eastern pondmussel
<b>IUCN 7: Natural Systems Modifications</b>				
7.2	Dams and water management/use	Improve habitat connectivity with migratory fish hosts in streams via blockage removal, culvert retrofit, and transportation BMPs.	X	Alewife floater, eastern lampmussel, tidewater mucket, eastern pondmussel
7.2.12	Dams and water management/use: culverts	Improve connectivity of habitat within streams for mussels and host fishes by addressing poorly designed or failing culverts with State Highway Administration and the U.S. Fish and Wildlife Service. Conduct a new culvert assessment in entire Northeast to prioritize culvert work by North Atlantic Landscape Conservation Cooperative – University of Massachusetts-The Nature Conservancy (connectivity assessment).	P	Dwarf wedgemussel
<b>IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases</b>				
8.1.2	Invasive non-native aquatic animals: zebra mussels	To extent possible, prevent/minimize further spread of zebra mussels in Susquehanna River drainage and other watersheds.	P	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel
8.1.2	Invasive non-native aquatic animals	Determine impacts from non-native predators (e.g., blue catfish).	X	Tidewater mucket, eastern pondmussel, alewife floater
<b>IUCN 12: Resource Management Needs</b>				
12.1.1	Lack of initial baseline inventory	Continue surveys to document new populations. To help target surveys, use recent eDNA findings (via Environmental Protection Agency study), MD	P	Tidewater mucket, eastern pondmussel, green floater, alewife



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Invertebrates – Mussels</b>				
		Biological Stream Survey (MBSS) stream monitoring data, recent/historical mussel distribution data (as compiled by Natural Heritage Program, MBSS) and eDNA techniques if possible.		floater, brook floater, dwarf wedgemussel
12.1.2	Lack of up-to-date existing information	Monitor extant populations and stream conditions. Re-evaluate goals, methods, efficacy, and scheduling, of recent population and habitat monitoring efforts and make improvements where needed.	P	Green floater, brook floater, dwarf wedgemussel
12.1.2	Lack of up-to-date existing information	Determine species' status in streams/watersheds where its continued presence is in question. Employ combination of eDNA techniques and traditional survey methods.	P	Dwarf wedgemussel
12.1.2	Lack of up-to-date existing information	Re-evaluate species' status in Maryland; resurvey recent/historical locations and potential habitat. Employ combination of eDNA techniques, if possible, and traditional survey methods.	P	Triangle floater, yellow lance, creeper, eastern lampmussel
12.1.2	Lack of up-to-date existing information	Complete a detailed inventory in the Potomac River, initially focusing on the upper Ridge and Valley portion, to better determine the species' distribution and abundance and establish a baseline for future monitoring.	X	Green floater, brook floater
12.1.2	Lack of up-to-date existing information	Conduct surveys and monitoring as needed to re-evaluate status, distribution and conservation needs.	X	Alewife floater, northern lance, Atlantic spice, yellow lampmussel
12.1.2	Lack of up-to-date existing information	Monitor known populations as needed to help re-evaluate status, distribution and conservation needs.	P	Tidewater mucket, eastern pondmussel
12.1.2	Lack of up-to-date existing information	Conduct surveys and monitoring as needed to re-evaluate status, distribution and conservation needs; focus on lentic habitats such as millponds and other small impoundments which are under-surveyed.	X	Paper pondshell
12.1.3	Need to answer research question	Confirm fish host requirements for Maryland populations, extent to which fish host needs are limiting populations, and conservation measures needed to maintain this life history link.	X	Dwarf wedgemussel
12.1.3	Need to answer research question	To extent possible, determine population-specific causes of decline and major threats (on-going and future), and identify specific measures to recover and protect populations.	P	Dwarf wedgemussel
12.1.3	Need to answer research question	Evaluate need for population augmentation and reintroduction.	P	Dwarf wedgemussel, triangle floater
12.1.3	Need to answer research question	Evaluate need to establish mussel propagation program to meet population augmentation and reintroduction goals.	X	Dwarf wedgemussel, triangle floater



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Invertebrates – Mussels</b>				
12.1.3	Need to answer research question	Continue to use MBSS stream monitoring data to better determine ecological requirements.	X	Dwarf wedgemussel
12.1.3	Need to answer research question	In addition to Town Creek, develop and implement reintroduction plans for streams/watersheds identified as priorities.	X	Brook floater
12.1.3	Need to answer research question	Improve understanding of fish host requirements, stressors and ecological requirements.	X	Brook floater, green floater, triangle floater, creeper, yellow lance, Atlantic spike, yellow lampmussel
12.1.3	Need to answer research question	Develop and implement reintroduction plan for this species in Town Creek, including a feasibility study.	P	Brook floater, Atlantic spike
12.1.3	Need to answer research question	Improve understanding of fish host relationships and factors that may be limiting mussel reproduction.	X	Alewife floater, tidewater mucket
12.1.3	Need to answer research question	Improve understanding of fish host requirements; to date, all known or suspected fish hosts are non-native.	X	Northern lance
12.1.3	Need to answer research question	Resolve taxonomic confusion regarding this and other lanceolate <i>Elliptio</i> species.	P	Northern lance, yellow lance, Atlantic spike
12.1.3	Need to answer research question	Resolve taxonomic confusion; refine techniques to identify, distinguish from <i>Lampsilis cardium</i> .	P	Yellow lampmussel
12.1.3	Need to answer research question	Determine extent, demographics, size, and habitat associations of population in fresh tidal portion of Potomac; by far the largest known Maryland population resides here.	X	Tidewater mucket
12.1.3	Need to answer research question	Improve understanding of sea-level rise impacts.	P	Tidewater mucket, eastern pondmussel
12.1.3	Need to answer research question	Determine extent, demographics, size, and habitat associations of population in fresh tidal portion of Potomac River; only known Maryland population.	X	Eastern pondmussel
12.1.3	Need to answer research question	Improve understanding of fish host relationships and factors that may be limiting mussel reproduction.	X	Eastern pondmussel
12.1.3	Need to answer research question	Assess efficacy of Deer Creek mussel relocation to help develop policy and management guidelines for future freshwater mussel impact avoidance/mitigation, relocation, and monitoring (on-going).	P	Creeper
12.1.3	Need to answer research question	Evaluate need for propagation, population augmentation and reintroduction and, as needed, establish mussel propagation program to meet these needs.	X	Creeper
12.1.4	Need to develop new technique	Continue Maryland Department of Natural Resources (MBSS, Natural Heritage Program) collaboration/support of EPA study to develop eDNA techniques to passively survey and monitor populations.	P	Dwarf wedgemussel



IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
<b>Invertebrates – Mussels</b>				
12.1.4	Need to develop new technique	Develop propagation techniques.	P	Brook floater, yellow lampmussel, eastern lampmussel
12.1.4	Need to develop new technique	Develop eDNA techniques to passively survey and monitor populations.	P	Brook floater, alewife floater, yellow lance, Atlantic spike, eastern lampmussel, green floater, creeper, triangle floater
12.1.4	Need to develop new technique	Develop eDNA techniques to passively survey and monitor populations. (May not be as effective in tidal water.)	X	Tidewater mucket, eastern pondmussel
12.2.2	Need to conduct environmental reviews	Ensure that future transportation related activities of state and local jurisdictions do no further harm to habitat and species; develop cooperative agreement between agencies to proactively address potential conflicts and avoid impacts.	X	Dwarf wedgemussel
12.2.3	Need for fish, wildlife, and/or habitat planning	Evaluate potential for reintroduction into Maryland portion of Susquehanna River drainage.	X	Yellow lampmussel
12.2.3	Need for fish, wildlife, and/or habitat planning	Develop holistic conservation plan to protect or rehabilitate existing populations and their habitat, and identify and prioritize steams/watersheds where population augmentation or reintroduction is needed.	P	Green floater, brook floater
<b>IUCN 15: Administrative Needs</b>				
15.3.2	Need for coordination for effective program/project management	Further encourage the development and implementation of Tier III Clean Water Act Anti-Degradation policy within Maryland Department of Natural Resources and Maryland Department of the Environment.	P	Dwarf wedgemussel
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Brook floater, green floater



This chapter provides information pertinent to **Element #4** regarding conservation actions determined to be necessary to conserve the identified species, habitats, and priorities for implementing such actions. An overview of the importance of and major sources of conservation actions in Maryland is presented, followed by an extensive listing of conservation actions developed by SWAP committees for SGCN and key wildlife habitats. All conservation actions are listed in Chapter 7 Appendices. Chapter 8 will provide information pertinent to **Element #5** regarding the establishment of a monitoring framework, including an overview of some of the more extensive monitoring programs currently in place within Maryland.

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