Chapter 3

Maryland's Species of Greatest Conservation Need

MARYLAND

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Table of Contents

Introduction 3-1
Distribution of Maryland's Wildlife 3-1
Conservation Status of Maryland's Wildlife 3-2
Maryland's Extinct and Extirpated Species 3-2
Endangered, Threatened, and In Need of Conservation Species 3-3
Additional Declining Species 3-4
Species of Greatest Conservation Need (SGCN) 3-5
State Assessment Priority Species (SAPS) 3-7
Changes to the Species Lists Since 2015 3-8
SGCN Selection: Conservation Ranks 3-9
Conservation Status Groups 3-12
Regional Context for Species of Greatest Conservation Need: 3-13
Mammals of Maryland 3-15
Mammal SGCN of Maryland 3-16
Montane Mammal SGCN 3-16
Bat SGCN 3-18
Marine Mammal SGCN 3-19
Threats to Mammal SGCN 3-21
Conservation Actions and Information Needs for Mammal SGCN 3-22
Birds of Maryland 3-25
Bird SGCN of Maryland 3-27
Montane Bird SGCN 3-27
Bird SGCN of the Piedmont 3-28
Bird SGCN of the Coastal Plain 3-29
Case Study: Maryland's Artificial Tern Raft 3-31
Marine Bird SGCN 3-33
Threats to Bird SGCN 3-34
Conservation Actions and Information Needs for Bird SGCN 3-38
Reptiles and Amphibians of Maryland 3-46
Reptiles 3-46
Amphibians 3-47
Reptile and Amphibian SGCN of Maryland 3-48
Freshwater Reptile and Amphibian SGCN 3-48

Reptile SGCN of Upland Habitats 3-49
Marine and Estuarine Reptile SGCN 3-50
Threats to Reptile and Amphibian SGCN 3-51
Conservation Actions and Information Needs for Reptile and Amphibian SGCN 3-53
Case Study: Maryland Amphibian and Reptile Atlas (MARA) 3-55
Fishes of Maryland 3-59
Marine and Estuarine Fishes 3-60
Freshwater Fishes 3-61
Fish SGCN of Maryland 3-61
Threats to Fish SGCN 3-64
Conservation Actions and Information Needs for Fish SGCN 3-66
Invertebrates of Maryland 3-68
Invertebrate SGCN of Maryland 3-70
Aquatic Invertebrate SGCN: Dragonflies and Damselflies (Odonates) 3-71
Aquatic Invertebrate SGCN: Mayflies, Stoneflies, and Caddisflies (EPT: Ephemeroptera, Plecoptera, Trichoptera) 3-72
Aquatic Invertebrate SGCN: Freshwater Mussels 3-72
Case Study: Planting Trees and "Planting" Mussels 3-74
Cave and Groundwater Invertebrate SGCN 3-75
Terrestrial Invertebrate SGCN: Butterflies 3-76
Terrestrial Invertebrate SGCN: Moths 3-76
Terrestrial Invertebrate SGCN: Bees 3-77
Terrestrial Invertebrate SGCN: Hoverflies (Syrphidae) 3-77
Terrestrial Invertebrate SGCN: Fireflies 3-77
Terrestrial Invertebrate SGCN: Tiger Beetles 3-78
Other Invertebrate SGCN of Maryland 3-78
Threats to Invertebrate SGCN 3-79
Conservation Actions and Information Needs for Invertebrate SGCN 3-82
Plants of Maryland 3-95
Plant SGCN of Maryland 3-96
Threats to Plant SGCN 3-97
Conservation Actions and Information Needs for Plant SGCN 3-97
Citations and Sources 3-118

List of Figures

Figure 3.1 Matrix used to categorize species into five conservation status categories..... 3-12
Figure 3.2 Importance of spring stopover hotspots 3-36
Figure 3.3 Importance of autumn stopover hotspots 3-36
Figure 3.4 Potential risk of mortality from collisions with anthropogenic structures 3-37
Figure 3.5 Seasonal importance of stopover hotspots 3-39
Figure 3.6 New Jersey chorus frog distribution map comparison 3-56

List of Tables

Table 3.1 Summary of all listed species in Maryland..... 3-4
Table 3.2 Categories considered for inclusion on Maryland's SGCN list 3-5
Table 3.3 Categories considered for inclusion on Maryland's SAPS list 3-7
Table 3.4 Comparison of 2015 and 2025 species lists..... 3-8
Table 3.5 Definitions of global (G) and state (S) conservation ranks and rank qualifiers 3-10
Table 3.6 Cross-reference of conservation status ranks and their use in SGCN listing 3-11
Table 3.7 Definitions of the five conservation status categories from Figure 3.1 3-12
Table 3.8 RSGCN by major taxonomic group..... 3-14
Table 3.9 Existing federal recovery plans for mammal SGCN 3-23
Table 3.10 Mammal SGCN in Maryland..... 3-24
Table 3.11 Existing federal recovery plans for bird SGCN..... 3-40
Table 3.12 Bird SGCN in Maryland 3-40
Table 3.13 Existing federal recovery plans for reptile SGCN 3-57
Table 3.14 Reptile and amphibian SGCN in Maryland..... 3-57
Table 3.15 Existing federal recovery plans for fish SGCN 3-67
Table 3.16 Fish SGCN in Maryland 3-67
Table 3.17 Existing federal recovery plans for invertebrate SGCN 3-83
Table 3.18 Invertebrate SGCN in Maryland..... 3-83
Table 3.19 Existing federal recovery plans for plant SGCN 3-98
Table 3.20 Plant SGCN in Maryland..... 3-98

List of Appendices

3a. Species of Greatest Conservation Need (SGCN)
3b. State Assessment Priority Species (SAPS)
3c. Species removed since 2015
3d. Wildlife Diversity Sources of Information

Introduction

The State Wildlife Action Plan (SWAP or Plan) compiles, evaluates, and presents summary status information for Species of Greatest Conservation Need (SGCN) (**Element #1**). This chapter describes the process used to select SCGN and summarizes the best available information regarding the conservation status, distribution, and abundance of all major taxonomic groups that occur in Maryland. It also addresses regional SGCN (RSGCN), as they were considered in the selection of Maryland's SGCN, and introduces the new State Assessment Priority Species (SAPS) list.

Numerous experts and sources of information (e.g., scientific literature, databases, agency reports) on Maryland's wildlife abundance and distribution were consulted during the planning process and are listed throughout the Plan. More detailed information regarding the status and relative abundance of Maryland's SGCN is provided in Appendices 3a and 3b, which includes each species' state and global conservation ranks as well as state and federal legal status. Distributions of species are included by association with one or more Key Wildlife Habitats (KWHs), which are discussed in detail and mapped in Chapter 4.

To provide easier distinction between SGCN and non-SGCN, in-text scientific names are included for SGCN the first time they are referenced per chapter; non-SGCN are referred to only by their common name. Exceptions are made for plants, which can be difficult to reference without using scientific names. A full list of scientific names for SGCN and SAPS can be found in Appendices 3a and 3b, respectively.

Distribution of Maryland's Wildlife

Despite its small size, Maryland's wildlife is remarkably diverse. This is due in large part to the wide range of habitats that are found in the state, from the Atlantic Ocean in the east to the Allegheny Mountains in the west. Native fauna documented in the state include 97 mammals, 463 birds, 89 reptiles and amphibians, at least several hundred freshwater and marine fishes, and over 20,000 species of invertebrates. Additionally, Maryland has recognized over 3,000 distinct native plant species. For a list of where these numbers come from, please see Appendix 3d.

Carpenter frog (Lithobates virgatipes)
(Peter Jayne, MD DNR)

The state's physiographic provinces and their associated habitats and climates have a profound influence on the distribution of wildlife species. While many wildlife species occur throughout the state—such as the eastern box turtle *(Terrapene carolina)* and black-and-white warbler *(Mniotilta varia)*—others are restricted to a particular region, watershed, or habitat. For example, species like the seal salamander *(Desmognathus monticola)* and nesting Canada warbler *(Cardellina canadensis)* are limited to high-elevation habitats in the far western part of the state, in the Appalachian Plateau physiographic region. Maryland populations of fish such as the Allegheny pearl dace *(Margariscus margarita)*

and checkered sculpin *(Cottus sp. 7)* are confined to spring-fed coldwater streams in the Blue Ridge physiographic province. Other species, including the carpenter frog *(Lithobates virgatipes)* and nesting saltmarsh sparrow *(Ammospiza caudacuta)*, occur only on Maryland's Eastern Shore. For more information on these regions of Maryland and their characteristics, please see Chapter 2.

Some of the state's most imperiled species are confined to just a handful of sites and, in some cases, single locations. For example, the only remaining breeding areas in Maryland for the beach-nesting piping plover *(Charadrius melodus)* are on Assateague Island, while several subterranean crustaceans are single-site endemics, whose only known populations in the world are restricted to a single cave or spring. Details on the associated habitat distributions of SGCN can be found in Chapter 4 and Appendix 3a.

Conservation Status of Maryland's Wildlife

The Maryland Department of Natural Resource's (MD DNR) Natural Heritage Program (NHP), part of the Wildlife and Heritage Service (WHS), is one of the state's lead programs for biodiversity conservation. NHP identifies, ranks, conserves, and conducts status assessments of all rare and endangered species and natural communities throughout the state. It currently monitors the status of over 1,250 native plants and animals. Species status assessments play a critical role in conservation work: they help set NHP and partner conservation priorities, support state and federal species listing decisions and related regulatory processes, and help inform the public of key conservation issues. These status assessments, along with other data provided by NHP and various partners, helped shape the revised SGCN list for the 2025 SWAP revision.

The criteria used to select Maryland's SGCN are described in the following sections. First, a summary of species that are currently either extinct or extirpated is presented, followed by an overview of state-listed species and non-listed but declining species. Conservation status rank (i.e., global [G1, G2, etc.] and state ranks [S1, S2, etc.]), legal protection status (Endangered, Threatened, In Need of Conservation), and other criteria used to select SGCN are then reviewed.

Maryland's Extinct and Extirpated Species

Congress recognized human impacts on wildlife over 40 years ago in its preamble to the Endangered Species Act: "The Congress finds and declares that various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation" (USFWS 1973). Since European settlement, nearly 100 species of plants and animals have become extinct or extirpated from the state (i.e., no longer in Maryland but still present elsewhere) (COMAR 08.03.08.06). Those species now gone entirely include the Carolina parakeet, passenger pigeon, and greater prairie chicken. Habitat loss and overhunting were largely responsible for their demise and eventual extinction during the first half of the twentieth century (Cornell Lab of Ornithology 2008).

Today, 62 plants and 32 animals (10 birds, 6 mammals, 1 amphibian, 4 fishes, and 11 invertebrates [5 butterflies, 1 beetle, 3 dragonflies, 1 snail, and 1 crustacean] [COMAR 08.03.08.06], Table 3.1) are state-listed as Endangered Extirpated. This legal status indicates that these species were once viable components of the state's flora and fauna but no longer occur in Maryland and, if rediscovered, would be afforded the legal status of Endangered. Six of the 32 animals listed as Endangered Extirpated are mammals. These include gray wolves, which historically occurred throughout the state but were eliminated by the late 1800s as a result of indiscriminate hunting and trapping, habitat loss, and increasingly scarce prey populations.

American bison (National Park Service)

American bison and elk ranged throughout central and western Maryland when Europeans colonized the state. Maryland's last American bison was shot in 1775 in Garrett County (Paradiso 1969) and the last elk, also eliminated by overhunting, vanished around 1850 (Lee 1984). The American pine marten's range included western Maryland until the early 1900s. The snowshoe hare also historically occurred in high-elevation red spruce-dominated forests of western Maryland; there have been no reliable Maryland records in over 50 years (Paradiso 1969).

As with some of the mammals mentioned above, habitat loss was the primary cause for the extirpation of many bird species that once nested in Maryland. The Endangered Extirpated Swainson's thrush *(Catharus ustulatus)* historically nested in high-elevation red-spruce dominated forest (Robbins & Blom 1996) but was eliminated following extensive logging and the nearly complete loss of red spruce in the nineteenth and early twentieth centuries. The red-cockaded woodpecker *(Leuconotopicus borealis)*—also Endangered Extirpated in Maryland—disappeared due in large part to the loss of expansive tracts of old growth forest containing large pine trees that provided nest cavities (Robbins & Blom 1996; USFWS 2003). Bachman's sparrow, a species that formerly nested in some of Maryland's open pine woodlands, is also extirpated in Maryland due in part to habitat loss. Habitat loss may also have been the main factor leading to the extirpation of several other species listed as Endangered Extirpated.

However, even after a species has become extirpated in Maryland, there may be a chance of its reestablishment. For example, the once-extirpated fisher was eventually able to return to Maryland due to the release of 23 animals in West Virginia near the Maryland border in the winter of 1969. Certain species listed as Endangered Extirpated in Maryland, including two of the three bird species discussed above, remain SGCN because there is still hope for their reintroduction.

Endangered, Threatened, and In Need of Conservation Species

Currently, 476 species and subspecies are listed in state regulations as Endangered, Threatened, or In Need of Conservation in Maryland (COMAR 08.03.08). Most of the species that are state-listed as Endangered are plants (241) and 98 are animals. An additional 83 plants and 18 animals are recognized as Threatened in the state. Thirty-six animal species are listed as In Need of Conservation in Maryland. A fraction of these plant and animal species (40) are also federally

listed as Endangered or Threatened, including two plant and seven animal species considered to be extirpated in Maryland.

A broad overview of these numbers can be found below in Table 3.1. For additional details on state-listed species, please refer to later subsections of this chapter. Appendices 3a, 3b, and 3c also list each species' state and federal legal status.

Table 3.1 Summary of all listed species in Maryland. Source: NatureServe and COMAR 08.03.08.

Federally Listed Species		
Category	**Plants**	**Animals**
Endangered	5	22
Threatened	4	9
Total	**9**	**31**

State-listed Species[1]		
Category	**Plants**	**Animals**
Endangered	241	98
Threatened	83	18
In Need of Conservation	n/a	36
Endangered Extirpated	62	32
Total	**386**	**184**

[1] Summary of state-listed species only includes species listed in COMAR 08.03.08.

Additional Declining Species

Although the state officially recognizes 184 animal species in its protected species regulations, many other species are declining and may warrant listing in the future. This holds true for nearly every taxonomic group represented in Maryland.

Amphibians, for example, are exhibiting alarming rates of decline, with more than 40% of species globally threatened (Luedtke et. al. 2023). Reptiles are also exhibiting dramatic declines similar to that of amphibians, with 21% of the world's reptiles estimated to be threatened with extinction (Cox et al. 2022). Habitat loss and degradation, environmental pollution, unsustainable use, diseases, introduced invasive species, and global climate change are the leading causes for these declining populations (Gibbons et al. 2000).

Numerous bird species are also showing population declines nationally, regionally, and locally. A recent assessment of U.S. bird populations has noted that, since 1980, overall grassland bird populations have declined by 43%, shorebird populations have declined by 33%, and eastern forest birds have declined by 27% (North American Bird Conservation Initiative 2025). While this report documented an increase of 24% in dabbling and diving duck populations and an increase of 18% in waterbird populations, progress is hindered by continuing loss and degradation of wetlands, especially for southern species such as the king rail *(Rallus elegans)*. In addition to these more general trends, Partners in Flight (PIF) keeps track of priority bird species for conservation based on region. Maryland falls within two of these regions: the Appalachian Mountains and Atlantic Coast. For the Appalachian Mountains region, PIF ranked 9 forest birds, 5 grassland birds, and 2 habitat generalist birds as priority species; for the Atlantic Coast region, 3 coastal saltmarsh birds, 16 forest birds, 5 grassland birds, and 2 habitat generalist birds were

ranked (Rosenberg et al., 2016). Declining population trends remain a concern for most of these species today.

Nearly every taxonomic group represented in Maryland is facing issues that are negatively affecting populations. Pollinating insects are threatened by pesticide use, invasive plant species, and overly frequent mowing; bats are threatened by white-nose syndrome, hibernacula disturbance, and obtrusive recreational activities; and aquatic species are threatened by invasive animals, rising temperatures, and water pollution. The SWAP represents an opportunity to reverse these declining population trends for numerous species in greatest need of conservation. By incorporating existing conservation ranks, population assessments, and conservation plans into the development of the Maryland SWAP, MD DNR and its conservation partners have the opportunity to implement conservation actions that will have positive effects on species that truly have the greatest conservation need, even for those that do not yet have regulatory protections.

Species of Greatest Conservation Need (SGCN)

Maryland wildlife species vary in their need and urgency for conservation. Some more obviously warrant conservation attention than others. State- and federally listed species are clearly high priorities, but the Plan also provides the opportunity to consider species that, while not currently listed, are declining or at risk of decline. In determining which species warrant SGCN status, Congress allows states to consider the "distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife" (**Element #1**). By considering all species and their requisite habitats in this assessment, the broader interrelationships of wildlife conservation can be addressed.

The criteria that were used during the assessment process and to ultimately identify these species were very similar to that of the previous SWAP revision, which were adopted from national and regional guidelines developed by the Association of Fish and Wildlife Agencies and found in the *Best Practices for State Wildlife Action Plans* (AFWA 2012). Additional guidelines provided by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) were organized into the Northeast Lexicon document (Crisfield & NEFWDTC 2022), which is a set of common metrics and terminology developed by the Northeast states to facilitate interstate collaboration.

Fundamental considerations for assessing a species' conservation need and inclusion or exclusion from the SGCN list include species abundance and trend; threats (e.g., number, immediacy, extent, reversibility); state responsibility (i.e., relative importance of the state to conservation of the species); and habitat trend (i.e., changes in the extent or condition of habitat, which may be closely related to threats). In addition to these considerations and existing Maryland conservation status ranks, numerous state, regional, national, and global ranking systems that prioritize or rank species for each wildlife taxa group were used during this evaluation process. The criteria from all of these sources are included in Table 3.2.

Table 3.2 Categories considered for inclusion on Maryland's SGCN list

Special Conservation Status
Federally listed Threatened and Endangered species
State-listed Threatened and Endangered species

Wildlife species listed as In Need of Conservation
Globally rare species ranked by NatureServe
MD DNR Natural Heritage Program tracked and watchlist species
IUCN Red List species
Northeast Regional Species of Greatest Conservation Need (RSGCN)
Species recognized as endangered from international trade (CITES)
Recognized Bird Priority Status
Partners in Flight and all bird conservation plan priority species
U.S. Fish & Wildlife Service's migratory birds of conservation and management concern
Colonial waterbirds
Forest interior breeding birds
Shrubland successional breeding birds at risk
Grassland breeding birds at risk
Shorebirds with significant migratory concentrations and declining populations
Marshland breeding birds (e.g., rails, bitterns, sedge wren) at risk
Marine birds in decline
Other Terrestrial Conservation Status Priorities
Reptiles and amphibians at risk
Bats at risk
Small mammals at risk
Terrestrial invertebrates at risk
Aquatic Conservation Status Priorities
Aquatic invertebrates at risk
Freshwater and marine fish at risk
American Fisheries Society's species of concern
Depleted anadromous fish (e.g., shad spp., sturgeon)
Depleted marine invertebrates (e.g., horseshoe crab)
Additional Selection Criteria
Endemic species
Disjunct species
Vulnerable species (to a variety of threats, particularly impacts from climate change and invasive species impacting host plant species)
Species with limited dispersal
Species with fragmented or isolated populations
Focal species (e.g., keystone species, species with specific needs)
Indicator species of high quality habitat
"Responsibility" species (i.e., species that have their center of range within Maryland)
Species that aggregate in concentration areas (e.g., migratory stopover sites, bat roosts/maternity sites)

Identifying SGCN in Maryland began with reviewing the previous SGCN list. Review of these species, using the guidance criteria explained above, provided an introductory understanding of species population changes over the last ten years. Decisions about which species to include on the draft 2025 SGCN list relied heavily on a review of the species' current conservation status, based on both state and global conservation ranks. The best available quantitative and qualitative

data regarding status, abundance, distribution, and population trends for many species in the state were considered to confirm conservation status and preliminary SGCN selection. Further justification for changes (i.e., additions and deletions) to the 2015 SGCN list, other than changes in conservation or legal status, included new discoveries and research findings since 2015; an increase (or decrease) of existing threats (e.g., illegal trade, habitat loss/fragmentation); and new, emerging threats (e.g., novel pathogens, energy sector changes, loss of host species due to non-native pests). In addition, species on the Northeast RSGCN list and priority species from taxa-specific groups, conservation partners, and regional conservation plans were evaluated for inclusion on Maryland's 2025 SGCN list. For further explanation of this review process, please refer to "The Process for Identifying SGCN for the 2025 SWAP" in Chapter 8.

State Assessment Priority Species (SAPS)

New to the 2025 SWAP is the State Assessment Priority Species (SAPS) list. The inclusion of this list was recommended by the 2022 Northeast Lexicon (Crisfield & NEFWDTC 2022). It is essentially a list for data deficient species for which more information is needed to fully understand their status, trends, and associated threats and actions. Unlike species on the SGCN list, species on the SAPS list do not have associated habitats, threats, or actions. The threat for these species is lack of information; the action is to obtain that information.

The SAPS list addresses several needs. First, it allows Maryland to refine its SGCN list, ensuring that it truly reflects the flora and fauna most in need of conservation. Second, it allows the 2025 SWAP revision to elevate data deficient species to a category of their own, ensuring that species most in need of information (e.g., life history, population distribution, threat assessment, climate vulnerability) do not get overshadowed by the SGCN list. Third, it more closely mirrors the categorization of the RSGCN database, which includes a comparable "watchlist" category. Finally, it provides a way to include the pursuit, acquisition, and allocation of funding to address knowledge gaps for a variety of species that may otherwise not be included in the SWAP.

Part of the SGCN list review involved the selection of which data deficient species from the 2015 SWAP belonged on the SAPS list, as well as which new species should be added. Considerations for which species belonged on the SAPS list are articulated below in Table 3.3.

Table 3.3 Categories considered for inclusion on Maryland's SAPS list

Considerations for SAPS
Data deficient SGCN from Maryland's 2015 SWAP
Species with non-numeric state or global conservation ranks (e.g., SU, SNA, GNR)
Newly described species
Species with taxonomic uncertainty
Species with unclear habitat needs
Species with very few records in Maryland (i.e., unclear if vagrant)
Species with dubious or unconfirmed records in Maryland
Species found in adjacent states that are not yet confirmed in Maryland
Species expected to shift range to Maryland as a result of climate change (or other factors)
Potentially extirpated species that may be rediscovered in the near future
Species that are difficult to survey and/or identify, especially invertebrates
"Watchlist" RSGCN

Some species on the SGCN list may appear to belong on the SAPS list upon initial assessment. This is because each species was reviewed on an individual basis; for example, rather than simply moving all species with non-numeric state conservation ranks to the SAPS list (see the "SGCN Selection: Conservation Ranks" section of this chapter for additional details), species with some information needs were allowed to remain on the SGCN list if MD DNR and its partners could articulate specific threats, actions, and habitat associations for that species. If all three of these associations could not be made, a species was moved to the SAPS list.

Changes to the Species Lists Since 2015

Species from the 2015 SGCN list that fell outside the review guidelines were removed, and new species that met the guidelines were added. Additionally, data deficient species from the 2015 SWAP that met the criteria for the SAPS list were moved to this new list.

Compared to the 1,360 species listed in the previous SWAP, this process resulted in the inclusion of 1,796 species in Maryland's 2025 SWAP revision: 975 on the SGCN list and 821 on the SAPS list. 454 of the 975 species on the SGCN list comprise a refined version of the previous plant SGCN list; see page 3-96 for an explanation of this refining process. Finally, of the 610 animal species reviewed from the 2015 SGCN list, 66 were removed from the SWAP. See Table 3.4 below for an overview of these numbers. For a species-by-species account of which species were kept from the 2015 SGCN list, which were moved to the SAPS list, which are new additions, and which were removed entirely, please refer to Appendices 3a, 3b, and 3c.

Table 3.4 Comparison of 2015 and 2025 species lists

Taxonomic Group[1]	2015 SGCN List	2025 SGCN List	2025 SAPS List	Removed Since 2015
Mammals	41	34	16	5
Birds	143	146	5	3
Reptiles	26	29	1	2
Amphibians	19	19	4	0
Fish	31	34	15	5
Plants	750[2]	454	0	296[2]
Insects				
Beetles	22	26	44	0
Bees, Wasps and Ants	36	48	225	6
Butterflies and Moths	101	70	294	22
Dragonflies and Damselflies	93	47	37	16
Stoneflies, Mayflies, and Caddisflies	14	8	66	1
Other Insects	6	9	78	2
Other Invertebrates				
Crustaceans and Allies	40	27	23	1
Snails	14	6	7	3
Freshwater Mussels	14	13	1	0
Flatworms	10	5	5	0
TOTALS	**1,360[3]**	**975**	**821**	**66**

[1]As the 2025 SWAP uses slightly different species groupings than the 2015 SWAP, the 2025 categories have been crosswalked to the 2015 categories for the sake of comparison in this table.

[2] The plant SGCN list from the previous SWAP included all rare, threatened, and endangered plant species in Maryland. The new list has been refined, hence the reduction in number of species. Plant species that were removed from the previous version of the SGCN list are *not* included in Appendix 3c.

[3] Total number includes 610 animal species and 750 plant species.

The species on the final 2025 SGCN list are at risk of disappearing from Maryland in the foreseeable future if appropriate conservation actions (Chapter 6, Appendices 6a and 6b) are not implemented; species on the SAPS list must be further researched to determine the extent of this risk. All major taxonomic groups were considered for the SGCN and SAPS screening process: mammals, birds, reptiles, amphibians, fishes, insects, freshwater mussels, and other invertebrate groups, such as snails and flatworms. Complete SGCN lists with status ranking information can be found in this chapter under each taxonomic group. There are also separate appendices that list SGCN and SAPS alphabetically by scientific name (Appendices 3a and 3b).

SGCN Selection: Conservation Ranks

The species ranks assigned and maintained by MD DNR NHP are the most complete list and accounting of wildlife species conservation status in Maryland. Data maintained by NHP represents the best available summary of information on the abundance, distribution, threats, and conservation status of wildlife species for the state, and these data were reviewed as one of the initial steps to determine which species are of greatest conservation need.

Conservation status ranks (i.e., the global rank [G-rank] and state rank [S-rank]) are determined by state natural heritage programs and NatureServe in consultation with numerous biologists, taxonomic experts, and other members of the scientific community; other state, federal, and local agencies; and non-governmental organizations (NGOs). Definitions for these ranks can be found in Table 3.5. A variety of factors are considered when assessing a species' conservation status rank. These factors fall into three groups—rarity, threats, and trends—which together provide a composite assessment of a species' vulnerability to decline and extirpation (state ranks) or extinction (global ranks). These factors include:

- Total number and condition/viability of occurrences (e.g., populations)
- Population size
- Range extent and area of occupancy
- Short-term and long-term population trends
- Scope, severity, and immediacy of threats
- Intrinsic vulnerability
- Environmental specificity

Most conservation status ranks follow a simple numerical scale of 1–5. When a status assessment is completed, the most appropriate numeric rank is assigned from 1 (critically imperiled) to 5 (abundant, widespread, or demonstrably secure). Some additional non-numeric ranks may be appropriate for a given species or subspecies, including "SH" for historically occurring species or "SX" for species thought to be extirpated with little hope of rediscovery within Maryland.

Table 3.5 Definitions of global (G) and state (S) conservation ranks and rank qualifiers

Rank	Definitions (Global / State)
GX or SX	**Presumed Extirpated**—Species believed to be extirpated from the jurisdiction (i.e. global, or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
GH or SH	**Historical (Possibly Extirpated)**—Known only from historical records, but with still some hope of rediscovery. There is evidence that the species may no longer be present in the jurisdiction, (i.e. global, or state/province) but not enough to state this with certainty.
G1 or S1	**Critically Imperiled/Highly State Rare**—At very high risk of extinction or extirpation due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors. Typically occurring in fewer than five populations.
G2 or S2	**Imperiled/State Rare**—At high risk of extinction or extirpation due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors. Typically occurring in 6–20 populations.
G3 or S3	**Vulnerable/Watchlist**—At moderate risk of extinction or extirpation due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors. Typically occurring in 21–80 populations.
G4 or S4	**Apparently Secure**—At fairly low risk of extinction or extirpation due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
G5 or S5	**Demonstrably Secure—**At very low risk of extinction or extirpation due to a very extensive range, abundant populations or occurrences, or little to no concern from declines or threats.
GU or SU	**Status Uncertain**—A numerical rank cannot be established with confidence for reasons including lack of historical records, low survey effort, cryptic nature of the species, or concerns that the species may not be native to the state. Uncertainty spans a range of 4–5 ranks as defined above.
GNR or SNR	**Not ranked—**Conservation status has not yet been fully assessed.
SNA	**Not a conservation target—**Species is not a suitable target for most conservation actions because of its transient occurrence or other factors.
Global Qualifiers	
Q	**Questionable—**Indicates that the taxon has questionable, controversial, or uncertain taxonomic standing (e.g., treated by some taxonomic authors as a species, whereas others treat it as a subspecies or variety or not at all).
T	**Taxon—**Indicates the rank of a subspecies or variety (i.e., an infraspecific taxon).
State Qualifiers	
?	**Questionable—**Indicating uncertainty that may span 2–3 numeric S-ranks, as defined above.
B	**Breeding**—Conservation status refers to Maryland's breeding population of a migratory animal.
N	**Non-breeding**—Conservation status refers to Maryland's non-breeding population of a migratory animal.
M	**Migrant**—Migrant animal that occurs regularly during migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating migrant population of the species in the state.

Both global and state conservation ranks were very valuable in the process of selecting SGCN, as the factors used to calculate the ranks address several aspects of the SGCN definition. Table 3.6 describes the guidelines related to state and global ranks that were used in the initial steps of determining the SGCN list for Maryland. Consideration of other factors in Table 3.2 and input from conservation partners and stakeholders, all in addition to this initial assessment, led to the final decisions as to what species are in greatest need of conservation in the state. More information on the SGCN selection process, especially relating to working with partners and stakeholders, can be found in Chapter 8. More information regarding wildlife diversity sources of information can be found in Appendix 3d.

Table 3.6 Cross-reference of conservation status ranks and their use in SGCN listing

Ranking	Explanation for SGCN Listing
G1 & G2 species that occur in Maryland	All confirmed present in Maryland are included because of their global imperilment and Maryland's responsibility in conserving the species.
G3 species that occur in Maryland	Many are included because of their global vulnerability and likelihood that they are of conservation value within the state due to their affinity with rare, declining, high quality or other significant habitats, or their importance as indicator species.
S1 and S2 species (either breeding or wintering for migrant species)	All confirmed present in Maryland are included because of their limited population size within Maryland and their elevated risk of loss from the state due to stochastic events or human-made habitat changes.
S3 species	Some are included based on limited or declining populations, or the threats they face are of sufficient scope, severity, or immediacy that their populations are likely to continue to decline without management or other intervention. Also, some S3 species may have been included due to their significance as indicator species within rare, high quality, or otherwise significant habitats even though they might not currently be facing severe or immediate threats.
S4 or S5 species	Some are included because of their importance as indicator or umbrella species of significant or high quality habitats, or because of known gradual, long-term population declines or shifting distribution even though they are still considered relatively common within Maryland.
SH (historical)	Some are included because of their potential for rediscovery, albeit sometimes rather low. Most of these species have had insufficient survey work and additional surveys are needed to confirm their loss from Maryland. Some may be candidates for reintroduction efforts, as identified.
SX (extirpated)	A few are included if they have some reasonable potential for successful reintroduction efforts.
SU (uncertain)	Some are included if they have restricted distributions within Maryland and/or live in rare, declining, high quality, or otherwise significant habitats, even though insufficient information currently exists related to threats, statewide population size, or other primary factors that are needed to determine an accurate conservation status rank. These species are often good candidates for additional research into biological attributes that would enable more accurate priority ranks to be assigned.

SNA	Because these are migrants or transitory species within Maryland, such that they could occur over a widespread area for relatively short periods during migration or the winter, the species are included primarily when there is regional or federal concern regarding their status.

Conservation Status Groups

As the factors and methods for determining species and natural community conservation status ranks have evolved over decades, the complexity of the ranking system has grown and the level of information contained within the ranks has increased. This is useful for conservation practitioners who understand the system's complexities, scientific rationale, and intended applications. However, for the more general public, a simplified system in the form of a small matrix is provided in Figure 3.1.

SGCN Categorization Matrix[1]

		STATE STATUS						
		S1	S2	S3	S4	S5	SNR / SU / SNA	SH / SX
GLOBAL STATUS	G1	A					D	E
	G2	A	A				D	E
	G3	A	A	B			D	E
	G4	A	B	C	C		D	E
	G5	A	B	C	C	C	D	E
	GNR / GU	A	B				D	E

Figure 3.1 Matrix used to categorize species into five conservation status categories. Global and state ranks are defined in Table 3.5. Conservation status categories are defined in Table 3.7.

[1] To apply the matrix, “range" status ranks were rounded upward in priority (e.g., S2S3 = S2); "range" ranks spanning 3 ranks were considered as the middle rank (e.g., S1S3 = S2); global status ranks for subspecies with T-ranks are treated as the "T" status (e.g., G5T3 = G3). Most "non-numeric" state status ranks are classified in Group D (e.g., SU, SNR, SP, SR), except for SH and SX.

Table 3.7 Definitions of the five conservation status categories from Figure 3.1 based on grouping global and state conservation status ranks.

Category	Definition
A	Highest conservation status
B	High conservation status
C	Moderate conservation status
D	Conservation status uncertain; insufficient data to assign a state conservation status rank.
E	Historical status; ranked as “SH” or “SX” and may no longer occur in Maryland, but with some potential for rediscovery in the foreseeable future.

In this matrix, the assignment of conservation status groups to SGCN provides an overarching and less technical view of the state of Maryland's wildlife species. Taking into account state and global ranks, this system especially highlights those species and taxonomic groups most in need of conservation (i.e., species in the A status group) and also those which are in danger due to lack of knowledge and research on these species (i.e., D status group). A number of species in the D status group remain on the SGCN list as opposed to the SAPS list. These are species for which—despite their relative data deficiency—specific threats, actions, and habitat associations could be articulated. If all three of these associations could not be made, a species was moved to the SAPS list. Each SGCN's conservation status group is included in Appendix 3a; species on the SAPS list do not have conservation status groups because they are all assumed to be data deficient.

Regional Context for Species of Greatest Conservation Need:
An Additional Factor for SGCN Selection

The *Northeast Regional Conservation Synthesis for 2025 State Wildlife Action Plans* (TCI & NEFWDTC 2023) summarizes the status of Regional Species of Greatest Conservation Need, or RSGCN. These 806 species are indicative of the diversity and overall health of wildlife in the Northeast region. The RSGCN list, organized into 20 taxonomic groups, is updated every five years to include new information on the status of select species and taxonomic groups in the region. Certain portions of the 2023 synthesis have been included below in order to summarize how these RSGCN were selected and how the Northeast RSGCN list impacted the revision of Maryland's own SGCN and SAPS lists.

The states of the Northeast region and the District of Columbia have collaborated to prioritize Regional Species of Greatest Conservation Need (RSGCN) for shared conservation and management since 1999. This regional effort aims to maintain a non-regulatory list of RSGCN to provide focus, resources, and collaboration to conserve these species of mutual conservation concern (and their habitats) for current and future generations in the Northeast.

Northeast RSGCN are species for which the region has stewardship responsibility due to high conservation concerns or populations centralized within the Northeast Region. The list includes 20 vertebrate and invertebrate taxa groups of SGCN from SWAPs in the Northeast Association of Fish and Wildlife Agencies (NEAFWA) planning geography (Maine to Virginia, including the District of Columbia). The list promotes focused action on high-priority Northeast species by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) in developing SWAPs and conservation planning and implementation by state fish and wildlife agencies and their partners. NEFWDTC updates the RSGCN list every five years according to regional stewardship responsibility (i.e., proportion of the species range in the Northeast region) and conservation concern status.

The RSGCN list provides an effective, collaborative conservation focus, which facilitates regional watershed and landscape approaches for fish and wildlife diversity conservation in the Northeast. The current RSGCN list and supportive information on status updates demonstrate how the Northeast continues to lead the RSGCN concept nationally by implementing NEAFWA's conservation planning model through its Regional Conservation Needs (RCN) program and committee charges. This effort informs all Northeast state fish and

wildlife agencies, their SWAPs, and partners about these priority species, habitats, threats, and actions. NEFWDTC then develops and implements research, surveys, and monitoring, as well as conservation on the ground through the RCN program to fund conservation at the regional scale.

The goal of the RSGCN list is to secure and restore RSGCN and their habitats across the region's lands and waters through strategic, collaborative action. It creates a recognizable regional stewardship responsibility, implements proactive measures to prevent further declines of common species with conservation concerns, and prioritizes imperiled species. The RCN program spotlights species with population or habitat declines or emerging issues for collective conservation actions, fills data gaps, and enhances knowledge of a species' range-wide distribution, imperilment status, threats, and needed actions.

The newest version of the RSGCN list includes subcategories of RSGCN that allow for more accuracy regarding each species' needs and current status. These categories are RSGCN, Proposed RSGCN, Watchlist [Assessment Priority], Watchlist [Interdependent Species], Watchlist [Defer], and Proposed Watchlist [Assessment Priority]. The four Watchlist categories are essentially the regional version of the SAPS list. Between all these categories, 806 species were listed as RSGCN in some capacity (Table 3.8).

Table 3.8 RSGCN by major taxonomic group

Taxonomic Group[1]	Number of RSGCN Species
Mammals	49
Birds	70
Reptiles	25
Amphibians	30
Fish	152
Insects	337
Other Invertebrates	143
Total	806

[1]As NEAFWA uses different invertebrate categories for RSGCN than Maryland does for its SGCN, the 'Insects' and 'Other Invertebrates' categories have been combined in the above table.

It is important to note that, being at the southern end of the Northeast region, many Northeast RSCGN are not actually found in Maryland, and therefore were not included on Maryland's SGCN or SAPS list. The RSGCN list also does not include plants. Because of this, while the RSGCN list was certainly a factor in determining whether some species were included in Maryland's SWAP, they account for a comparatively small portion of the total species. 222 of Maryland's 975 SGCN (23%) are on the RSGCN list; 73 of 821 of Maryland's SAPS (9%) are on the RSGCN list. The full list of Northeast RSGCN can be found at the online database. For a list of which Maryland SGCN and SAPS are also RSGCN, please refer to Appendices 3a and 3b.

Mammals of Maryland

A total of 97 native mammal species have been documented in the state, including 29 marine mammals. The 68 land mammals are represented by 12 shrews and moles, 12 bats, 3 rabbits and hares, 21 rodents, 16 carnivores, 3 ungulates, and one marsupial, the Virginia opossum. Most of Maryland's native extant mammals have a statewide distribution. However, the Appalachian Plateau physiographic region supports the highest diversity and the majority of the state's most imperiled mammals, followed by the Ridge and Valley. Eight non-native mammal species have also been introduced in Maryland and are now established, including Norway rat, black rat, house mouse, sika deer, fallow deer, nutria, domestic horse, and domestic cat. Though nutria has been considered eradicated from Maryland since 2022 (Eisenhauer 2022), recolonization of the Delmarva Peninsula remains a possibility due to its continued presence in Virginia.

Twenty-one mammals in Maryland are game species with regulated hunting or trapping seasons. MD DNR's WHS maintains several programs that monitor the status of game mammal species, including the deer, bear, small game, and furbearer projects. The white-tailed deer management program monitors abundance and distribution in the state and regulates deer hunting seasons to maintain healthy deer populations within biological and cultural carrying capacities. A deer management plan (MD DNR 2020) was first developed by DNR in 1998 and is revised on a roughly 10-year basis, with the current plan guiding management through 2034. Before implementation of this plan, which included creating one of the first ever urban/suburban deer management programs in the U.S., deer populations had dramatically rebounded from historic lows. Populations doubled or more in most counties, increasing as much as five to seven times (MD DNR 2020). Deer populations have been on a declining trend since the deer population peaked in 2002 at nearly 295,000 deer. The 2020–2021 white-tailed deer population was estimated at 232,000 (MD DNR 2021).

Having reached historical lows in the mid-twentieth century, Maryland's black bear population has increased dramatically in western Maryland over the past few decades. The first black bear management plan went into effect in 1992 and was followed by another 10-year management plan in 2004; at the time of writing, the plan is being updated once more and will be available to the public once completed. The bear population in western Maryland has continued to expand, with breeding now documented in Garrett, Allegany, Washington, and Frederick counties, and occasional sightings in neighboring counties. The population has likely grown to around 2,000 individuals; exact numbers will soon be available due to ongoing research efforts at the University of Maryland.

The furbearer management program monitors and collects biological information on 14 mammal species that are legally harvested for their fur, either currently or historically. These species include gray fox *(Urocyon cinereoargenteus)*, red fox, muskrat, beaver, and raccoon. Additionally, three carnivore species that had been extirpated from either portions of their historic range or all of Maryland prior to 1970 are now present due to natural range expansion or translocation efforts. Fishers were translocated to West Virginia in 1969 and rapidly expanded their range into Maryland, while river otter were reintroduced into the upper Potomac and Youghiogheny watersheds beginning in 1989. Eastern coyotes naturally expanded their range in the Mid-Atlantic and arrived in Maryland in 1972; they are now ubiquitous throughout the state and considered to be a naturalized species.

Exotic species of mammals have become established in Maryland either through intentional or unintentional introductions. The house mouse and Norway rat arrived in Maryland with the earliest waves of Europeans to the Americas. Native to East Asia, sika deer were released in Maryland on James Island in 1916 and on Assateague Island around 1930. They have expanded their range in Maryland, now occupying five counties on Maryland's Eastern Shore (MD DNR 2021). Nutria, a rodent species of South American origin, displaced the smaller native muskrat in many coastal marsh regions and degraded the marshes themselves through their destructive feeding habits. Their ability to breed throughout the year enabled their rapid expansion. An aggressive nutria eradication program achieved success in 2022, when they were declared to be eradicated from Maryland (Eisenhauer 2022). Current efforts to limit nutria expansion in Virginia are underway and are needed to prevent recolonization of the Delmarva peninsula.

Mammal SGCN of Maryland

Thirty-four of the state's 97 native mammal species were identified as SGCN in the 2025 SWAP revision (Table 3.10). Eighteen of these are state-listed, of which eight are also federally listed. The group also comprises 27 species of regional conservation concern in the northeastern U.S. (TCI & NEFWDTC 2023) and 14 globally rare species. In addition to these SGCN, 16 mammal species are listed as SAPS. While species on the SAPS list are not listed in this section, a full list of mammal SAPS can be found in Appendix 3b.

Delmarva fox squirrel (Sciurus niger cinereus) (John White)

The vast majority of mammal SGCN are represented by three broad groups: bats, marine mammals, and species that are restricted—or mostly so—to montane habitats in western Maryland. These groups are described below. In addition, several small mammals occur in a wider variety of forested and open habitats, such as American mink *(Neogale vison)* and least weasel *(Mustela nivalis)*. On Maryland's Eastern Shore, the Delmarva fox squirrel *(Sciurus niger cinereus)* depends on forested habitats with at least some larger mast-producing trees, and least shrew *(Cryptotis parva)* can be found in coastal marshes and other habitats.

Montane Mammal SGCN

The state's greatest mammal diversity lies in the mountainous western region, which encompasses the Blue Ridge, Ridge and Valley, and Appalachian Plateau physiographic provinces. Roughly 57 mammal species have been documented there, although seven are either extirpated from the state (snowshoe hare, gray wolf, American marten, elk, American bison), extinct (eastern cougar), or their current presence remains in question (eastern spotted skunk *[Spilogale putorius]*). Of those still extant, approximately half are SGCN, including eight bat species (see subsequent section on SGCN bats) and nearly all of the state's most critically imperiled mammals. Eight of these species occur only or nearly only in the western region, with Garrett County supporting the greatest number of land mammal SGCN.

Many of western Maryland's mammal SGCN are associated with rare or uncommon montane habitats within large forested landscapes. Among the most specialized mammals is the eastern water shrew *(Sorex albibarbis),* a globally rare species listed as Endangered in Maryland. Feeding primarily on aquatic insect larvae (e.g., mayflies, caddisflies, stoneflies), this small (~15 cm), uniquely adapted, semi-aquatic mammal is restricted to pristine, high-elevation headwater streams in the central and southern Appalachians. The streams are typically bordered by bog wetlands and mature cool, moist forests dominated by northern hardwoods, hemlock, and/or red spruce, often with dense rhododendron thickets. In Maryland, small populations remain along just six or seven streams, all in Garrett County. Another globally rare species, the southern rock vole (*Microtus chrotorrhinus carolinensis*), is endemic to the Appalachian Mountains, with stringent habitat requirements. Known from just three Maryland sites, this state-Endangered mammal occurs in mesic, mature-to-old-growth northern hardwood-hemlock forest with extensive, moss-covered boulderfields that often lay over springs.

Including bats, at least 14 mammal SGCN are associated with rock outcroppings and talus in western Maryland. These unique montane habitats are used seasonally or year-round as den sites, young-rearing areas, refuges, escape cover, and for foraging or hunting. Mammal SGCN that use or have historically used one or both of these habitats include eastern spotted skunk, bobcat *(Lynx rufus),* and eastern small-footed bat *(Myotis leibii).* Perhaps best exemplifying this habitat association is the state-Endangered Allegheny woodrat *(Neotoma magister).* An agile climber, it occurs almost exclusively in extensive rock outcroppings and talus slopes (and occasionally caves) surrounded by mast-bearing, mature-to-old-growth forest (Thompson 1984; Ford et al. 2006; Mengak et al. 2008). Although historically occurring as far east as the western edge of Washington, DC, today its Maryland range is limited to a handful of widely scattered sites in the three westernmost counties, mostly along or near mountain ridge crests. Like many SGCN, the Allegheny woodrat is sensitive to forest fragmentation, and maintaining adequate connectivity between sites to allow for dispersal and gene flow is key to the species' survival.

Another species that requires montane talus habitat is the long-tailed shrew *(Sorex dispar).* It is limited to mesic forest containing large areas of loose talus where it preys primarily on small invertebrates such as spiders, beetles, and centipedes. Although found throughout the Appalachians, it occurs in highly localized, widely scattered locations and is rare to uncommon in parts of its range—including Maryland, where it is state-listed as In Need of Conservation. Yet another montane habitat specialist is the Appalachian cottontail *(Sylvilagus obscurus).* It is partially restricted to heavily forested, high-elevation areas with extensive dense ericaceous vegetation (i.e., plants of the heather family, including mountain laurel [*Kalmia latifolia*] and great rhododendron [*Rhododendron maximum*]), especially along mountain ridgetops and slopes with extensive outcroppings and talus that provide thermal refugia and escape cover. It also occurs in natural shrubland and semi-open woodland habitats, such as shale barrens and sandstone glades. Appalachian cottontail is state-listed as In Need of Conservation and is a species of regional concern because of known and potential declines due to habitat loss, fragmentation, and competition with the ubiquitous eastern cottontail.

Bat SGCN

Of the 12 species of bats known to occur and three others potentially occurring in Maryland, eight are considered to be SGCN and six are SAPS. Unlike other mammals such as rabbits and mice, bats have a low reproduction rate. They make up for this low reproduction rate by living long lives, provided they survive the many stressors and hazards in their environment. As a result of these stressors and hazards, the Indiana bat *(Myotis sodalist)* and northern long-eared bat *(Myotis septentrionalis)* are federally listed as Endangered, The tricolored bat (*Perimyotis subflavus*) is proposed to be listed as federally Endangered and the little brown bat (*Myotis lucifugus*) is under review for federal listing. Additionally, the eastern small-footed bat is state-listed as Endangered. Two more bat species are under review for possible state listing because of white-nose syndrome, a fungus that has killed millions of bats in the eastern United States (USGS 2015).

Indiana bat (Myotis sodalist)
(Adam Mann, USFWS)

All bats in Maryland are insectivorous and use a highly sophisticated system of echolocation to find and catch insects in mid-air or glean from foliage. Bats are the primary predators of night-flying insects and can almost eat their own weight in insects every night. Many of the insects eaten by bats are pests of gardens and farm crops (Webster et al. 1985).

Although bats in Maryland can be divided into groups based on life history strategies, in general they tend to select roosts near permanent water such as streams, rivers, ponds, and lakes. Since insects are generally not active during winter, some of Maryland's bats migrate south and others fly to overwinter in hibernacula such as caves and abandoned sub-surface mines. Recent research (Johnson et al. 2024) and acoustic data indicates that some bats also hibernate in less "traditional" hibernacula such as cliffs, talus, and rock outcrops.

Migratory bats include eastern red bats *(Lasiurus borealis),* hoary bats *(Lasiurus cinereus),* and silver-haired bats *(Lasionycteris noctivagans).* Eastern red bats have been documented as occurring year-round in Maryland, although it is unknown if the bats that are present in the summer are the same as the individuals that overwinter. Red bats prefer mature deciduous trees to roost in during the summer (Limpert et al. 2010) and will overwinter under leaf litter in the fall and winter, while hoary bats prefer evergreen trees as summer roosts. Hoary bats are the largest bats in Maryland and occur throughout the state with a similar pattern to red bats. They prefer to roost in coniferous trees in clumps of foliage (Webster et al. 1985). Silver-haired bats have not yet been documented as breeding in Maryland, although they have been documented during spring and fall migration periods. Silver-haired bats like to roost under bark crevices and in woodpecker holes, and occasionally are found in wood piles, open sheds, and rock crevices. Biologists think that silver-haired and hoary bats migrate south in the fall to areas where insects

are active all year; however, much is still unknown about these species because they tend to roost singly or in family groups, are small in size, and are secretive in nature (Webster et al. 1985).

The remaining bat SGCN hibernate during the winter months when food is not available (little brown bat, northern long-eared bat, tricolored bat, eastern small-footed bat, and Indiana bat). These species winter in caves, mines, and abandoned railroad tunnels in Maryland, although recent research indicates that coastal bat populations may not fully hibernate; instead, they undergo short bouts of torpor during periods of colder weather when insects are not flying (Jordan 2020; De la Cruz et al. 2024). Very little is currently understood about these coastal populations and whether Maryland's bats undertake a similar strategy. Tricolored bats were once the most abundant wintering species in Maryland's caves, mines, and tunnels, but populations of this species—as well as little brown and northern long-eared bats—have been decimated by white-nose syndrome in addition to suffering other threats and stressors (M. Zagorski, unpublished data; MD DNR 2026a). During the summer breeding season, most of these species form loose colonies of females and pups (i.e., maternity colonies) in snags and hollow trees, under loose bark, in buildings, and in bat roosting boxes. Eastern small-footed bats differ in that they select rock outcrops for maternity sites. Males of these species tend to roost alone or in small bachelor colonies in similar habitats during the summer months.

Marine Mammal SGCN

Marine mammals encountered to date or likely to occur in Maryland waters (including the Atlantic Ocean) include 29 species: 24 cetaceans (whales, dolphins, porpoises), four pinnipeds (seals), and the West Indian manatee *(Trichechus manatus)* (MBP 2026). Of these 29 species, 10 have been selected as SGCN and four as SAPS.

Cetaceans are divided into two groups: the baleen whales and the toothed whales. Baleen whales have large strips of whalebone or baleen instead of teeth that are used to filter water and food. Baleen whales do not echolocate, though they do use sound to communicate. Baleen whale SGCN include the sei *(Balaenoptera borealis)*, blue *(Balaenoptera musculus),* fin *(Balaenoptera physalus),* minke *(Balaenoptera acutorostrata),* humpback *(Megaptera novaeangliae),* and North Atlantic right *(Eubalaena glacialis)* whales. All of these species (with the exception of minke and humpback whales) are federally listed as Endangered and population stocks are classified as depleted by the Marine Mammal Protection Act (MMPA). The federal status of the humpback whale was under review for delisting in April 2015, which resulted in subdividing the global population into 14 distinct population segments. The population segment that encompasses Maryland was downlisted to "not at risk" status (NOAA 2026a). Most baleen whales are state-listed as Endangered.

Baleen whales in general spend the summer much further north of Maryland waters and migrate through to calving grounds much further south. Most sightings of baleen whales off the coast of Maryland occur in the fall, winter, and spring. The primary diet of these species includes krill, copepods, small schooling fish, and squid, which they can consume in vast quantities. Sei whales can be found in subtropical to subpolar oceans on the continental shelf edge and slope, often singly or in small groups of two to five individuals. Blue whales tend to be further offshore than other baleen whales (NOAA 2026b) and in general their movements are correlated with krill concentrations. Fin whales form social groups of two to seven individuals, though they may also

feed with humpback whales, minke whales, and Atlantic white-sided dolphins (NOAA 2026c). Humpbacks engage in hunting techniques involving the creation of air bubbles to herd and trap fish. This technique, called bubble netting, is unique to humpbacks and is a hunting strategy where individuals cooperate together to trap fish (NOAA 2026a). Right whales got their name because they have a layer of fat that floats them to the surface when dead; early whalers therefore referred to them as the "right" whales to hunt. Right whales are the rarest of baleen whales and among the rarest of marine mammals overall, with only 380 individuals estimated in the North Atlantic, of which as few as 70 are reproductively active females (NOAA 2026d). Their diet is primarily zooplankton but, unlike other baleen whales, they skim the water through a concentration of zooplankton with their mouths open. North Atlantic right whales occur in coastal or shelf waters.

Species of toothed whales on Maryland's SGCN list include the sperm whale *(Physeter macrocephalus)*, bottlenose dolphin *(Tursiops truncatus),* and harbor porpoise *(Phocoena phocoena).* The sperm whale is the only species federally and/or state-listed as Endangered, with stocks listed as depleted by the MMPA. Sperm whales can dive to 3,000 feet for an hour to feed on prey including large squid, sharks, skates, and fishes. Females form social bonds with other females and their young and tend to stay in the same unit all their lives in tropical waters, whereas young males form bachelor groups. As the young males age, they move polewards and become more solitary over time (NOAA 2026e).

Bottlenose dolphin (Tursiops truncatus)

Bottlenose dolphins in the Mid-Atlantic are of two types: a coastal type (Tamanend's bottlenose dolphin), which is the one designated as "depleted" by the MMPA, and the offshore type (common bottlenose dolphin). The coastal type is the one most likely to be found along the coast of Maryland and in the Chesapeake Bay. Similarly, Williams et al. (2015) found the coastal type most prevalent in the nearshore part of the study area in summer and remaining until fall, returning in the spring. Bottlenose dolphins were also the most abundant delphinid observed in that study. Their diet consists of invertebrates, squids, and fish, and they use echolocation to find food. Sometimes these dolphins employ a strategy known as "fish whacking" where they use their flukes to smack fish out of the water (NOAA 2026f). Harbor porpoises, while not as abundant in Maryland as bottlenose dolphins, are found along the coast and in Chesapeake Bay (MBP 2026). They usually occur in small groups of two or three individuals, although groups of up to 200 have been reported. They feed on schooling fish and squid and often move seasonally inshore–offshore depending on prey availability. Population estimates and trends for the species in the Mid-Atlantic are unknown (NOAA 2026g); however, passive acoustic monitoring detected harbor porpoises regularly during the period January–May offshore of Maryland (Wingfield et al. 2017).

Threats to Mammal SGCN

Threats to mammal SGCN are varied, reflecting the unique life histories and habitat requirements of this diverse group of species. Extensive forested, mountain ridgetop areas containing rock outcrops, talus slopes, and mature-to-old-growth forest are among the most important habitats in Maryland for mammal SGCN. These areas are threatened by energy development (e.g., wind power development, coal strip mining, and powerline projects) as well as other forms of human disturbances, including residential development and incompatible timber harvest practices. They provide critical habitat for Allegheny woodrats, long-tailed shrews, southern rock voles, and eastern small-footed bats and can provide important habitat for other mammals such as Appalachian cottontails, bobcats, and smoky shrews *(Sorex fumeus).*

The loss of high-elevation red spruce and hemlock forest contributed to the extirpation of snowshoe hare and the decline of other mammals, including southern rock voles. This unique forest habitat and associated mammal fauna are likely to continue to be impacted by climate change, introduced species (e.g., hemlock wooly adelgid), and conversion to non-forested land uses. The eastern water shrew, which requires high-quality montane streams surrounded by old forest and high-elevation wetlands, is vulnerable to a variety of land uses that could eliminate or degrade its requisite habitat. Mammal SGCN in other parts of the state are similarly threatened by habitat loss and degradation. For example, urbanization has increased the level of competition and disease transmission between some SGCN and other species (e.g., raccoons) that adapt well to human-altered landscapes. Gray fox have been elevated to SGCN status due to wide-ranging population declines that may implicate canine distemper virus, a disease carried by other mammal species (Indiana DNR 2025).

Gray fox (Urocyon cinereoargenteus)
(Tammy Mealman, USFWS)

Bats face particular threats to their insect food source through pesticide use and pollution. They are also sensitive to disturbance during hibernation and while in maternity colonies located in tree cavities, rock outcrops (eastern small-footed bats), and human structures. The removal of large tree snags and forest cover affects species such as the Indiana bat, northern long-eared bat, and eastern red bat. At present, the greatest threat faced by a number of bat species is white-nose syndrome (WNS). Caused by a fungus (*Pseudogymnoascus destructans*), WNS was first detected in New York in the winter of 2006–2007 and has rapidly spread throughout the Eastern U.S., decimating bat populations in most states east of the Mississippi River (Turner et al. 2011). The eastern small-footed bat is already an uncommon cave bat in the Northeast and is vulnerable to extirpation by chance events. Maryland's other cave hibernating bats (e.g., the northern long-eared bat) used to be more common but have declined >90%, putting their population(s) at risk for chance stochastic events such as WNS to affect isolated colonies concentrated in hibernacula.

One of the biggest threats to migratory bat species is direct mortality from interactions with industrial wind turbines, estimated to kill as many as 888,000 migratory bats in North America per year (Smallwood 2013). Wind turbines can pose a threat to non-migratory bats as well. In an effort to track the effects of wind turbines on Endangered species, the U.S. Fish and Wildlife Service (USFWS) documents Indiana (n=28) and northern long-eared (n=35) bat fatalities at wind energy facilities (Pruitt & Reed 2022; USFWS 2024).

Marine mammals face threats from pollutants and toxins dumped in the ocean as well as entanglement and capture in fishing gear, incidental take, and injuries/mortality from ship strikes. The coastal type of bottlenose dolphin (Tamanend's bottlenose dolphin) has suffered viral outbreaks, especially around 2013–2015, resulting in deaths and strandings. There is also growing concern about the effects of anthropogenic noise pollution on deep-diving marine mammals. The possible effects of offshore wind turbine development on marine mammals and other marine taxa have been flagged for further study.

Conservation Actions and Information Needs for Mammal SGCN

Some of the conservation actions needed to address threats to specific SGCN are presented in recovery plans for federally listed species (e.g., Indiana bat, certain whale species) (Table 3.9). For many mammal SGCN, the protection of critical forest, wetland, and rock outcrop habitat represents the most urgent and important conservation need. The best—and in some cases, only—remaining habitat for some species is confined to MD DNR lands. For this reason, incorporating species and habitat conservation needs into public land management planning takes on an even greater importance. Landscape habitat models may help provide more effective conservation strategies for species with large home ranges (e.g., bobcat) or that occur as metapopulations and require large forested landscapes with minimal fragmentation (e.g., Allegheny woodrat). The restoration of high-elevation red spruce-hemlock forest, along with efforts to minimize impacts from hemlock wooly adelgid, would provide important habitat for several mammal SGCN as well as other SGCN taxa, and may even provide opportunities for population reintroductions. Public education and working with mining, wind energy, and other industries that commonly cause disturbance in bat habitat could help to minimize mortality and deter the presence of invasive or pest species, such as domestic cats, near SGCN habitat.

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

Concerning marine mammals, the aforementioned MMPA of 1972 was monumental in that it provided ecosystem-level protection to all marine mammals in U.S. waters. Before the MMPA, marine mammals were protected by species on an as-needed basis to prevent total depletion of at-risk species, but the MMPA reaches across all marine mammal categories in its prohibition of

take or harassment of marine mammals. The MMPA is carried out by the Secretary of the Interior through USFWS and by the Department of Commerce through the National Oceanic and Atmospheric Administration (NOAA). NOAA oversees the management of most marine mammals in Maryland, including cetaceans, such as whales and dolphins, and pinnipeds, such as seals. The only marine mammal SGCN not managed by NOAA is the West Indian manatee, for which USFWS is responsible.

Marine mammals are particularly vulnerable to shoreline strandings. A wide variety of factors both natural and anthropogenic can cause these animals to strand, including injuries from boat collisions, entanglement in fishing gear, and disease or other injury. The National Aquarium in Baltimore is responsible for live stranded marine animals in Maryland. The Aquarium's goal is to capture, rehabilitate, and eventually release all captured animals, as possible. Upon request, the Marine Mammal and Sea Turtle Stranding (MMSTS) Program may assist with such stranding events, though they typically respond to dead strandings. It is the goal of MMSTS to recover and collect data from as many scientifically viable animals as possible, which may include a necropsy examination to investigate the cause of death. This in turn contributes to the body of research regarding these animals and assists in our understanding of their relative locations, population sizes, and causes of death.

To research the potential impacts of offshore wind development on these animals, acoustic monitoring sensors (hydrophones) have collected marine mammal sounds and gathered much-needed data on the presence, habitat use, and migration patterns of these species. These data will inform various protection measures, including the implementation of "slow zones" to reduce ship strikes when northern right whales are detected. Phone apps like Whale Alert and Ocean Alert help mariners know when and where marine species have been spotted to help reduce vessel strikes. Coordinated by NOAA, Take Reduction Teams develop recommendations to reduce serious injury and incidental mortality of cetaceans from commercial fishing (NOAA 2026h).

Table 3.9 Existing federal recovery plans for mammal SGCN

Mammal Species	Federal Recovery Plan	Recent Action
Delmarva fox squirrel	USFWS 1993	2014: Draft post-delisting monitoring plan
Indiana bat	USFWS 2007	2024: Initiation of 5-year review
Northern long-eared bat	Forthcoming	2022: Changed from Threatened to Endangered
Blue whale	NOAA Fisheries 2020	2020: 5-year review
Fin whale	NOAA Fisheries 2010	2023: 5-year review, summary, & evaluation
Humpback whale	NOAA Fisheries 1991	2023: Initiation of 5-year review for some distinct populations
North Atlantic right whale	NOAA Fisheries 2004	2022: 5-year review
Sei whale	NOAA Fisheries 2011	2021: 5-year review, summary, & evaluation
Sperm whale	NOAA Fisheries 2010	2021: Initiation of 5-year review

Table 3.10 Mammal SGCN in Maryland

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Allegheny woodrat	*Neotoma magister*	G3	S1		E	A
American mink	*Neogale vison*	G5	S4			C
Appalachian cottontail	*Sylvilagus obscurus*	G4	S1		I	A
Blue whale	*Balaenoptera musculus*	G3G4	S1	E	E	A
Bobcat	*Lynx rufus*	G5	S3		I	C
Bottlenose dolphin	*Tursiops truncatus*	G5	S4			C
Delmarva fox squirrel	*Sciurus niger cinereus*	G5T3	S1		I	A
Eastern red bat	*Lasiurus borealis*	G3G4	S3S4			B
Eastern small-footed bat	*Myotis leibii*	G4	S1		E	A
Eastern spotted skunk	*Spilogale putorius*	G4	S1			A
Eastern water shrew	*Sorex albibarbis*	G5	S1		E	A
Fin whale	*Balaenoptera physalus*	G3G4	S1S2	E	E	A
Gray fox	*Urocyon cinereoargenteus*	G5	S5			C
Harbor porpoise	*Phocoena phocoena*	G4G5	S4			C
Hoary bat	*Lasiurus cinereus*	G3G4	S3S4			B
Humpback whale	*Megaptera novaeangliae*	G4	S1S2		E	A
Indiana bat	*Myotis sodalis*	G2	S1	E	E	A
Least shrew	*Cryptotis parva*	G5	S3S5			C
Least weasel	*Mustela nivalis*	G5	S2S3		I	B
Little brown bat	*Myotis lucifugus*	G3G4	S1			A
Long-tailed shrew	*Sorex dispar*	G4	S2		I	B
Minke whale	*Balaenoptera acutorostrata*	G5	S1			A
North Atlantic right whale	*Eubalaena glacialis*	G1	S1	E	E	A
Northern long-eared bat	*Myotis septentrionalis*	G2G3	S1	E	E	A
Sei whale	*Balaenoptera borealis*	G5?	S1	E	E	A
Silver-haired bat	*Lasionycteris noctivagans*	G4	SU			D
Smoky shrew	*Sorex fumeus*	G5	S2S3		I	B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Southeastern shrew	*Sorex longirostris*	G5	S3S4			C
Southern bog lemming	*Synaptomys cooperi*	G5	S3			C
Southern pygmy shrew	*Sorex hoyi winnemana*	G5T4	S2			B
Southern rock vole	*Microtus chrotorrhinus carolinensis*	G5T3	S1		E	A
Sperm whale	*Physeter macrocephalus*	G3G4	S1	E	E	A
Tricolored bat	*Perimyotis subflavus*	G3G4	S1	PE		A
West Indian manatee	*Trichechus manatus*	G2G3	S1N	T		A

[1] = See Table 3.5 for S-rank and G-rank definitions
[2] = T (Threatened); E (Endangered); I (In Need of Conservation); PE (Proposed Endangered)
[3] = See Table 3.7 for Conservation Status definitions

Birds of Maryland

Birds are the most familiar and widely enjoyed wildlife in North America. As of 2024, 463 species of birds have been documented at least once in the state as represented in the "Official List of the Birds of Maryland" (MOS 2024). This list includes one species that has been extirpated from the state (greater prairie chicken), two extinct species (passenger pigeon and Carolina parakeet), five introduced species that have become naturalized, and a large number of species that have made their way into Maryland only once or a few times since records were first kept in 1804.

Northern bobwhite (Colinus virginianus) (John White)

Most Maryland birds are migratory and do not spend the entire year in the state, although some, such as the pileated woodpecker and northern bobwhite *(Colinus virginianus)*, are non-migratory and permanent year-round residents. Many species that breed in the state migrate to other areas outside of the breeding season. Some more northerly breeding species migrate south to Maryland and spend the winter here, while other species simply pass through the state during spring and fall migration periods. Less common are species like golden-crowned kinglet *(Regulus satrapa)* and dark-eyed junco *(Junco hyemalis)* that breed in western Maryland, but whose numbers increase when wintering individuals from the north occupy the entire state. Marine birds occur in the waters offshore with seasonally based abundance and distribution patterns, but their specific presence largely depends

on the location of concentrations of their fish prey. Two hundred and nine species were documented as possibly, probably, or confirmed breeding in the state during data collection for the Third Breeding Bird Atlas from 2020 to 2024 (G. Foley, unpublished data). Although a number of other species only migrate through or overwinter in Maryland, their success while they are in the state can be critical to their continued survival.

Maryland's importance to birds has been recognized by several organizations that have designated specific areas as particularly valuable to seabirds, wading birds, waterfowl, shorebirds, and others. The Atlantic Coast Joint Venture (ACJV) designated much of Maryland's coastal regions as Waterfowl Focus Areas in their 2005 ACJV Waterfowl Implementation Plan. Focus Areas include the Atlantic Coastal Bays, the Blackwater–Nanticoke River region on the Delmarva Peninsula, the Chester River and Kent County Bayshore region, the Choptank River region, the Eastern Shore's Eastern Bay region, the Patuxent River region, the Tangier Sound and Bay islands, and the Tidal Potomac region (ACJV 2005).

The Mid-Atlantic/New England Maritime Regional Working Group for Waterbirds (MANEM), a regional partnership working to conserve waterbirds in the Northeast, identified Important Waterbird Areas for breeding seabirds, wading birds, and marshbirds for 11 states and four provinces in the Northeast. MANEM maps for each of the mentioned groups of waterbirds are available for each state, including Maryland. Key areas for shorebird and marine bird conservation were developed by working groups for shorebirds (Atlantic Flyway Shorebird Business Strategy group) and marine birds (Northwest Atlantic Marine Bird Cooperative). Information from these and other efforts led to the creation of focal area maps for coastal areas in Maryland for shorebirds, waterbirds, landbirds, and waterfowl.

In Maryland, concentrations of high priority landbirds, waterbirds, and/or shorebirds have led to the designation of 43 areas as Important Bird Areas (IBAs) by the National Audubon Society. Of the 43, six IBAs are of global significance, meaning that the IBA contains bird species of global conservation concern or the site meets other criteria based on the species limited range and high density in the IBA. IBAs are found in every region of Maryland, with the majority of higher ranked IBAs in coastal regions (National Audubon Society 2013). At regional and local scales, target areas in Maryland have been or are being identified for particular species (e.g., cerulean warbler *[Setophaga cerulea]*, golden-winged warbler *[Vermivora chrysoptera]*, rusty blackbird *[Euphagus carolinus]*, and American woodcock *[Scolopax minor]*) or groups of species (e.g., forest interior breeding birds, nightjars) based on habitat needs and known concentrations.

Maryland's landscape encompasses six physiographic regions, as described in Chapter 2: Lower Coastal Plain, Upper Coastal Plain, Piedmont, Ridge and Valley, Blue Ridge, and Appalachian Plateau. The diversity of habitats within these regions directly accounts for the diversity of birds found in the state. Because of this physiographic diversity, three Bird Conservation Regions (BCRs) occur in Maryland: New England/Mid-Atlantic Coast, Piedmont, and Appalachian Mountains. The Regions were designated by the North American Bird Conservation Initiative (NABCI) to represent ecologically distinct regions with similar bird communities, habitats, and resource management issues. Each BCR addresses different suites of species and issues, and some have designated priority areas for focal species. Additionally, numerous conservation plans

address the unique guilds or groups of bird species that occur within BCRs and across the entire Atlantic Coast region.

Bird SGCN of Maryland

One hundred and forty-six species of birds have been listed by the 2025 SWAP revision process as SGCN in Maryland (Table 3.12). This number includes two subspecies, for which the full species are also included; it does not include the five bird species on the new SAPS list. Of these 146 species and subspecies, 34 are state-listed, 18 of which are listed as Threatened or Endangered. 60 species are also of conservation concern across the Northeastern U.S. region (TCI & NEFWDTC 2023). The remaining species were included because they are of national or international concern (IUCN 2026), the best available current scientific information indicates that their populations are in decline, and/or they require more specialized habitat types that are likely to be degraded. For example, regional rusty blackbird populations have declined steeply in recent years, and Maryland has joined efforts to identify key wintering and migration wetland areas. Coordinated regional surveys are also underway for nightjars (eastern whip-poor-will *[Antrostomus vociferus]*, common nighthawk *[Chordeiles minor],* chuck-will's-widow *[Antrostomus carolinensis]*) based on suspected declines and the difficulty of surveying nocturnal species.

Birds federally listed as Endangered that formerly bred in Maryland include roseate tern *(Sterna dougallii)* and red-cockaded woodpecker *(Leuconotopicus borealis)*. The bald eagle *(Haliaeetus leucocephalus)* was removed from the federal list of Threatened and Endangered species in 2007, but the Atlantic coast breeding population of piping plovers *(Charadrius melodus)* is still federally listed as Threatened; both bird species are listed as SGCN in Maryland. Fourteen species are considered by the MD DNR to be Endangered in the state: Wilson's plover *(Anarhynchus wilsonia),* piping plover, upland sandpiper *(Bartramia longicauda)*, black rail *(Laterallus jamaicensis),* common tern *(Sterna hirundo),* gull-billed tern *(Gelochelidon nilotica),* royal tern *(Thalasseus maximus)*, black skimmer *(Rynchops niger),* short-eared owl *(Asio flammeus)*, sedge wren *(Cistothorus stellaris),* loggerhead shrike *(Lanius ludovicianus),* Swainson's warbler *(Limnothlypis swainsonii),* mourning warbler *(Geothlypis philadelphia)*, and American goshawk *(Astur atricapillus).* Species listed as Threatened in the state are American bittern *(Botaurus lentiginosus),* Rufa red knot *(Calidris canutus rufa),* least tern *(Sternula antillarum),* and Nashville warbler *(Leiothlypis ruficapilla).* For additional ranks, see Appendices 3a and 3b.

Montane Bird SGCN

Forests dominate the Blue Ridge, Ridge and Valley, and Appalachian Plateau provinces more than any other part of the state. They include mostly a mix of mature and younger sapling and pole stage forests with just scattered small remnants of old growth forest. Although most forests are dominated by hardwoods, more northern forest types with a conifer component are also present. Where they occur, old growth forests in this region tend to support higher densities of several forest bird SGCN. In addition, bog and fen wetland complexes, cliff and rock outcrops, beaver-created wetlands, and large managed grasslands provide habitats for a great diversity of bird SGCN. Because some of these habitats occur nowhere else in the state, a number of bird species breed exclusively, or nearly so, in these regions, especially in the Appalachian Plateau. Some of these species are at or near the southern extent of their breeding ranges, such as

Nashville warbler, mourning warbler, northern saw-whet owl *(Aegolius acadicus),* Canada warbler, and alder flycatcher *(Empidonax alnorum)*. Eight state-listed species and an additional 11 bird SGCN breed only in western Maryland's montane region, including American goshawk, pine siskin *(Spinus pinus),* winter wren *(Troglodytes hiemalis),* red-breasted nuthatch *(Sitta canadensis),* and golden-winged warbler.

Northern saw-whet owl (Aegolius acadicus) (George Jett)

Although historically a predominantly forested landscape, the Appalachian Plateau region includes some areas of anthropogenic grasslands resulting from strip mine reclamation and agricultural practices (e.g., hayfields, pasture). These habitats provide some of the few remaining areas in Maryland where area-sensitive grassland nesting birds such as northern harrier *(Circus hudsonius)* and upland sandpiper *(Bartramia longicauda)* still breed.

The mountain ridges of Maryland feature concentrations of migrating raptors by day and songbirds by night, where migrants also stop to feed and rest on their journeys. Satellite tracking studies of golden eagles *(Aquila chrysaetos)* have reinforced hawk watch data showing that the regional population concentrates along just a few mountain ridges as birds pass over Maryland (Katzner et al. 2012). In addition, ongoing studies at higher elevations in forested areas have shown they are regularly used as wintering grounds by golden eagles.

Bird SGCN of the Piedmont

The forests, riparian corridors, wetland habitats, and open areas of the Piedmont Bird Conservation Region support roughly 140 breeding bird species (Carter et al. 2000). Six bird species have a disproportionately large share of their global populations breeding within this area, which extends from southern Virginia to northern New Jersey (Kearney 2003; Watson 2014). These include four SGCN deciduous forest nesting species—wood thrush *(Hylocichla mustelina)*, Acadian flycatcher *(Empidonax virescens)*, scarlet tanager *(Piranga olivacea),* and Louisiana waterthrush *(Parkesia motacilla)*—and one SGCN associated with early successional habitats, the prairie warbler *(Setophaga discolor)*. Willow flycatcher *(Empidonax traillii)* and American kestrel *(Falco sparverius)* also breed more commonly in the Piedmont section of the state.

Prairie warbler (Setophaga discolor) (George Jett)

The Piedmont is in the heart of these species' geographic ranges and, therefore, forest conservation in this region could especially benefit and sustain their populations over the long term. Regional planning efforts have also identified the importance of the Piedmont for protected habitat corridors for forest and grassland species, maximizing opportunities to preserve habitats for breeding and migratory priority species in rapidly increasing urban and suburban areas (Watson 2014).

Due to the concentration of human population growth, changes in farming practices, and alteration of natural fire frequencies, the Maryland Piedmont now forms a particularly fragmented mosaic of forest and mostly anthropogenic grassland, which limits the success of birds that depend on large blocks of these habitats for successful nesting. For example, broad-winged hawk *(Buteo platypterus),* brown creeper *(Certhia americana),* Kentucky warbler *(Geothlypis formosa)*, and cerulean warbler have shown declines in the Piedmont, likely due to forest loss and fragmentation. In addition to forest-dependent species, Maryland's Piedmont habitats traditionally supported grassland species such as the vesper sparrow *(Pooecetes gramineus),* grasshopper sparrow *(Ammodramus savannarum),* and eastern meadowlark *(Sturnella magna)* (Kearney 2003), the populations of which have greatly declined due in part to habitat loss. Bobolink *(Dolichonyx oryzivorus),* American barn owl *(Tyto furcata),* American kestrel, and upland sandpiper were also once more common in the grassland habitats of this region of Maryland. Birds of shrublands and early successional habitats—such as the northern bobwhite, American woodcock, and yellow-breasted chat *(Icteria virens)*—have also seen large population declines as farming practices have changed and urbanization has increased in the Piedmont. Loss of habitat to development, changes in farming practices (e.g., lack of hedgerows), and other factors have also led to the loss of loggerhead shrike as a breeding bird in recent years in Maryland and surrounding states. The continued expansion of development in this area of the state as well as in the region represents a particular challenge regarding bird conservation for SGCN that occur in Maryland's Piedmont.

Bird SGCN of the Coastal Plain

The avifauna of the Upper and Lower Coastal Plain is transitional and contains a mix of species mostly centered in southeastern North America, with some additional species coming into the area from more inland regions. Of the Coastal Plain breeders, many SGCN are associated with wetland habitats, although some are associated with upland forests, shrublands, and grasslands. As would be expected, waterfowl, marshbirds, shorebirds, and colonial nesting waterbirds, are important components of this region's avifauna (Kushlan et al. 2002). Of the perching birds, Coastal Plain specialists include marsh wren *(Cistothorus palustris),* Swainson's warbler, saltmarsh sparrow *(Ammospiza caudacuta),* seaside sparrow *(Ammospiza maritima),* Coastal Plain swamp sparrow *(Melospiza georgiana*

Saltmarsh sparrow (Ammospiza caudacuta)
(Bri Benvenuti, USFWS)

nigrescens), Ipswich sparrow *(Passerculus sandwichensis princeps),* and boat-tailed grackle *(Quiscalus major).*

The Chesapeake Bay is a major wintering area for waterfowl in the Atlantic Flyway, including brant *(Branta bernicla),* redhead *(Aythya americana),* canvasback *(Aythya valisineria),* and long-tailed duck *(Clangula hyemalis)*. Several SGCN also breed in the Chesapeake Bay region, including American black duck *(Anas rubripes),* blue-winged teal *(Spatula discors)*, and gadwall *(Mareca strepera)*, all of which have declined in the state (Costanzo & Hindman 2007; G. Foley, unpublished data). The Bay is also very important for wintering and migrating red-throated loons *(Gavia stellata)* and horned grebes *(Podiceps auritus)*; migrating northern gannets *(Morus bassanus)* and saltmarsh sparrows; and breeding rails and sparrows, according to an analysis of the Chesapeake Bay's importance to avian populations during different parts of their life cycle (Watts 2013). Overall, the Chesapeake Bay supports 67 breeding species, 87 wintering species, and 138 migrants that are dependent on this estuary (Watts 2013), many of which are SGCN.

Marshbirds are species that breed and sometimes live exclusively in marshes, including species such as rails, gallinules, pied-billed grebe *(Podilymbus podiceps)*, marsh wren, and a few sparrows. Efforts to assess Maryland's marshbird populations began in the early 1990s (Brinker et al. 2001). Compared to most other groups of birds, many aspects of marshbird biology remain poorly understood. Information is lacking or incomplete, for example, with regard to breeding and winter distribution, migration patterns, threats, and limiting factors (Watts 2013). Many breeding marshbirds are included on the SGCN list due to documented declines in Maryland and the wider region. Of great concern is the disappearance of Endangered black rails from many of their former locations; they were located in only two atlas blocks during the recent Breeding Bird Atlas (G. Foley, unpublished data). This reflects the region-wide decline estimated to be as high as 90% according to the Eastern Black Rail Conservation and Management Working Group (ACJV 2020). Marshes and wetlands of the Coastal Plain also provide important breeding habitat for other rails, ducks, shorebirds, raptors, wrens, and sparrows. A region-wide collaboration, the Saltmarsh Habitat and Avian Research Program, provides data on trends and productivity of a suite of marshbird SGCN that are critical for effective conservation of these species.

Colonial nesting waterbirds are particularly vulnerable to disturbance or loss of breeding areas, as they concentrate into very limited areas during the nesting season. Since 1989, MD DNR has had an active colonial waterbird management program to assess and monitor these vulnerable populations. Regional management coordinated through MANEM and the Atlantic Flyway Council Technical Section's Colonial Waterbird and Shorebird Working Groups provides regional assessments of waterbird population status and trends. More recently, the Integrated Waterbird Management and Monitoring Program, coordinated by USFWS, has worked to provide breeding, wintering, and migration habitat for shorebirds, waterfowl, and wading birds as they occupy different areas throughout the year along the Atlantic Coast. Twenty-four species of colonial waterbirds nest currently, or nested historically, in Maryland. This group includes terns, gulls, herons, egrets, and ibises, along with black skimmer and brown pelican *(Pelecanus occidentalis).*

In Maryland, nesting black skimmers, common terns, royal terns, and Forster's terns *(Sterna forsteri)* continue to experience significant declines, while double-crested cormorants nesting on

man-made structures like bridges have increased at a dramatic rate (Brinker et al. 2007; G. Foley, unpublished data). Numerous islands important to colonial waterbirds have eroded away and those that remain continue to shrink due to erosion and sea-level rise. Nests are increasingly vulnerable to overwash during high tides and storm events. Although the number of Chesapeake Bay colonies has increased for great blue heron, decreases have been documented for other species (e.g., snowy egret [*Egretta thula*], glossy ibis [*Plegadis falcinellus*], and black-crowned night heron [Nycticorax nycticorax]) due to the loss of foraging and nesting habitats (Watts et al. 2007; G. Foley, unpublished data).

Case Study: Maryland's Artificial Tern Raft

To stabilize the declining numbers of common terns in Maryland, the Tern Raft project was launched in 2021. The project, a joint effort between MD DNR, the Maryland Coastal Bays Program (MCBP), and Audubon Mid-Atlantic, proved the viability of such artificial habitats during the 2021 pilot season, during which common terns began nesting. At the time, relatively few common terns remained nesting in the Coastal Bays due to the loss of nearly all small islands with breeding beaches in these waterways. The raft, hosting 23 nests in its pilot year, immediately became the largest nesting colony in the Coastal Bays area.

The constructed raft (Archer Larned, MCBP)

The Tern Raft is a 48-foot-by-48-foot wood-framed artificial island that serves as breeding habitat for common terns, whose natural nesting areas are under threat from sea-level rise. The raft floats in the Chincoteague Bay in Worcester County and is deployed each spring by combining 18 8-foot by 16-foot platform sections latched together. In the interest of providing habitat as close to natural conditions as possible, the surface is covered with broken clam shells, with wooden chick houses and artificial grasses providing the necessary shelter nesting terns would otherwise have available to them in dune environments. The raft is disassembled in the fall when the birds move on for their yearly migrations and reassembled the following spring ahead of nesting season.

Common terns (Sterna hirundo) using the raft (Kim Abplanalp, MCBP)

Since the inception of the project, the successful Tern Raft has become the most productive breeding site for common terns in Maryland. Over 1,100 common tern chicks have fledged from the site, and it boasts an 80% return rate for breeding pairs. American oystercatchers (*Haematopus palliatus*), a state

watchlist breeder, also regularly use the site. Royal terns began using the site in 2025. Like common terns, royal terns are endangered in Maryland and considered highly rare state breeders. Royal terns built 29 nests on the raft in 2025, from which eight chicks fledged.

The Tern Raft is intended to be used as a temporary measure to retain nesting common terns in the Coastal Bays while breeding habitat is restored by creating small islands suitable for nesting sites, allowing colonial nesting birds to easily move to appropriate, non-floating habitats as they become available. See the Small Coastal Plain Islands KWH description in Chapter 4 for more details on these habitats.

Maryland's Chesapeake Bay and Atlantic Coastal Bays provide the primary habitats where migrating shorebirds stop to feed and rest, where shorebirds spend the winter, and where rare piping plovers and nighthawks breed. Although a number of shorebird populations in North America have stabilized after large declines during the early 1980s and mid-1990s, several species that pass through (e.g., whimbrel *[Numenius phaeopus],* Rufa red knot, semipalmated sandpiper *[Calidris pusilla]*) or winter in Maryland (e.g., ruddy turnstone *[Arenaria interpres],* lesser yellowlegs *[Tringa flavipes],* sanderling *[Calidris alba]*) continued to show significant population declines in the early 2000s (Andres et al. 2012). Shorebird populations are regularly monitored in Maryland by the National Park Service (NPS) at Assateague Island National Seashore, as well as occasional Atlantic coast regional coordinated efforts (Clark & Niles 2000; Hunter 2003). Conservation actions in North America are provided in the U.S. Shorebird Conservation Plan (Brown et al. 2001), and the U.S. Shorebird Conservation Partnership Council oversees the implementation of the regional, national, and international goals of the Plan.

Left: *Piping plover ((Charadrius melodus)* (Don Freiday, USFWS); **Right:** ***P****rotected sand dunes of Assateague Island, where the piping plover, endangered in Maryland, nests* (Stephen Badger, MD DNR).

The piping plover, federally listed as Threatened and state-listed as Endangered, is a tiny dune-nesting shorebird that nests on Maryland's Assateague Island and on other Atlantic coastal beaches (USFWS 1996). The species is slowly recovering due to education of beach users, aided by signs and light fencing, the latter sometimes also being predator resistant. The Atlantic Flyway Shorebird Business Plan (NFWF 2018) presents a coordinated approach to shorebird conservation. As a business strategy instead of a conservation plan, this strategy identifies the

needs of species at greatest risk; examines necessary actions, including funding; and presents those individuals and groups which are instrumental in the recovery process, along with analysis of possible outcomes. The goal of this conservation business strategy is to create a long-term platform for stability and recovery of the focal species identified.

Remaining forested areas in the Upper and Lower Coastal Plain, especially those dominated by hardwoods, provide places for migrating songbirds to rest and refuel on their long journeys to regions north or south of Maryland. Forested corridors along rivers—particularly the Pocomoke River—have been shown to be particularly important to these migrants. Coastal Plain river corridors and Chesapeake Bay shorelines support the recovered bald eagle population at all times of the year (Watts et al. 2007). In larger forest blocks, breeding birds whose optimal habitat is forest interior form a diverse, species-rich community that can include as many as 10 species of warblers and another 11 species that depend on this habitat. In Lower Coastal Plain uplands, a mosaic of anthropogenic grasslands (e.g., hayfields, wildlife habitat plantings), shrubs, and young forest provides a landscape that supports species such as grasshopper sparrow, vesper sparrow, eastern meadowlark, yellow-breasted chat, and prairie warbler. This mosaic landscape is critical to maintain remaining northern bobwhite populations, whose range in Maryland has been largely reduced to the Lower Eastern Shore.

Marine Bird SGCN

American oystercatcher (Haematopus palliatus) (George Jett)

The birds of Maryland's oceanic waters are the least understood and least studied group of birds in the state and in the region. To try to address information gaps, the Atlantic Marine Bird Cooperative is working to support surveys and research for marine birds. This group has also identified conservation target species for the region, most of which at least pass through offshore Maryland on a regular basis. Studies from the 1970s (Rowlett 1980) and 1980s (Powers 1983), compilations of data (O'Connell et al. 2009), as well as observations from pelagic boat trips for birdwatching have provided basic information on the presence and timing of the occurrence of over 20 marine bird species in the waters off Maryland's shore, not including gulls and terns. Although more recent studies in advance of offshore wind development have provided additional information on deepwater marine birds, the distribution, seasonal movements, population status, and specific habitat preferences throughout the year remain poorly understood for many species. More information is available for birds using nearshore areas due to the ease of observation from shore compared to areas that must be reached by boat or flown over with aircraft to document species' presence and activity. Spring and fall migration periods bring the majority of marine birds to the state, although several species (loons, scoters, gannets) winter here in large numbers and some species (shearwaters, storm-petrels) can increase in abundance in the summer.

Marine birds in Maryland use pelagic habitats on the continental shelf that vary from shallow areas close to shore, to open waters beyond the three-mile state boundary, to areas above deep canyons on the ocean floor miles from the coast. The presence and location of marine birds is very much influenced by the presence of their prey, which depends on temperature and salinity as dictated by oceanic currents and weather conditions, and which can also be influenced by ocean depth and underlying physical features of the ocean floor. Concentrations of shellfish and other food sources around shoals and artificial reefs provide nearshore feeding grounds for wintering loons, grebes, and scoters. Migrating gannets move along the coast by the thousands, plunge diving on schooling fish, with a number of birds remaining over winter in Maryland waters. Further offshore, concentrations of pelagic birds can be found where fish and cephalopod prey are abundant, including near upwellings from deep canyons in the ocean floor at the outer edge of the continental shelf, where *Sargassum* mats are brought in by the Gulf Stream and where fishing trawlers and processing vessels are dumping offal. In these situations, mixed groups of shearwaters and petrels, which can number in the hundreds, are often found where food is concentrated. Several terns, jaegers, alcids (puffins, murres, razorbills), storm-petrels, black-legged kittiwake *(Rissa tridactyla)*, and two species of phalarope round out the diversity of marine birds occurring regularly offshore of Maryland. These species, especially storm-petrels and phalaropes, tend to aggregate where zooplankton, planktonic crustaceans, and small fish are concentrated at the surface. Although data to assess population trends for marine birds are limited, it has been estimated that loons, scoters, phalaropes, Sargasso shearwater *(Puffinus lherminieri)*, black-legged kittiwake, and Leach's storm-petrel *(Hydrobates leucorhous)* are declining. Changes in food availability and challenges in breeding areas, such as habitat loss and contamination, are likely contributing to these declines.

Threats to Bird SGCN

Although bird SGCN are a diverse group, many of them (> 40 species) are highly area-sensitive and negatively affected by the loss and fragmentation of their respective habitats. For example, forest nesting species—such as worm-eating warbler *(Helmitheros vermivorum),* cerulean warbler, and broad-winged hawk—typically only breed in large contiguous forest tracts and nest success tends to decline in increasingly fragmented areas. Area-sensitive grassland nesting birds such as Henslow's sparrow *(Centronyx henslowii)* and short-eared owl, as well as some wetland species like sedge wren and saltmarsh sparrow, show similar patterns.

Broad-winged hawk (Buteo platypterus) with a snake
(Courtney Celley, USFWS)

In addition to area sensitivity, some species require a mosaic of habitats at the landscape level to persist, such as northern bobwhite. Most loss and fragmentation has resulted from residential and commercial development, but agriculture and infra structure such as roads and powerlines are also a major source. Of more recent concern is forest loss and fragmentation from wind power developments on ridgetops and the potential for further

fragmentation from hydrofracking. Conversion of native forest communities to commercial pine plantations further alters the suitability of the habitat for most forest-dwelling SGCN, and some bird species, such as northern saw-whet owl, are dependent on high-elevation red spruce-hemlock habitats that have been greatly reduced in size by this conversion and even further impacted by climate change.

Changes in composition and structure of forests and shrublands from altered fire regimes, invasive insect pests like hemlock wooly adelgid, overbrowsing by deer, and invasive plant species can all have serious impacts on critical habitat for nesting birds. Forest fragmentation increases edge habitat, making it easier for nest parasites like cowbirds—which tend to prefer more open areas—to parasitize nests, reducing nest success for forest-dwelling bird SGCN. Grassland birds such as dickcissel and bobolink are further threatened by modern agricultural practices such as earlier and more frequent mowing. Wetland birds are impacted by changes to their environment from threats such as invasive plant species (especially *Phragmites*), plastic pollution and other contaminants, and lack of beaver-created wetlands.

Beach-nesting, migrating, and wintering shorebirds and colonial waterbirds face special challenges as they are concentrated in areas with increased recreational use, expanding gull populations, shoreline development, and alteration of natural shoreline processes. In addition, sea-level rise has seriously reduced suitable nesting habitat for terns as islands in the Chesapeake and Coastal Bays have continued to disappear. Disturbance of colonial waterbird colonies is of special concern given the potential to negatively affect the breeding success of a large group of birds by impacting just one or a few areas. These colonies and beach-nesting shorebirds can also be seriously impacted by increased predator populations.

The vast saltmarsh habitats of Maryland support the regional stronghold of rails and sparrows, including black rail, saltmarsh sparrow, and Coastal Plain swamp sparrow. Contamination and drainage of these and other marsh habitats through development and mosquito control efforts can be a serious problem for marsh-nesting species. Climate change has also severely impacted coastal marsh habitats through sea-level rise, combined with an increase in frequency and severity of storms and tidal surges in coastal areas during the nesting season. This is of particular concern due in part to the outsized role that Maryland's saltmarshes play in these species' conservation. For example, in the case of the saltmarsh sparrow, it is estimated that Maryland's marshes contain approximately 25% of the global population (ACJV 2024).

Marine birds are impacted by overfishing, entanglement in fishing gear, contamination, and climate alterations that impact the presence and abundance of their food sources. The development of offshore wind energy facilities has the potential to impact marine birds and other birds that migrate offshore, although the degree and severity of impacts can be difficult to predict.

Not including marine birds, 24 bird SGCN do not breed in Maryland, but only overwinter or stop in Maryland during migration. Migratory stopover or wintering habitat is critical for these species, most of which are shorebirds or waterfowl. Disturbance of beach habitats, the reduction of horseshoe crab eggs for shorebirds (especially Rufa red knot), and degradation of aquatic habitats for waterfowl threaten these species groups during winter and migration periods.

Many migrant songbirds travel at night and stop along the way to rest, forage, and acquire energy for the next flight (Moore 2018). These periods of stopover are critically important for successful completion of the migratory journey for long- to medium-distance passerine and near-passerine species, such as warblers, vireos, thrushes, flycatchers, and sparrows (Newton 2007). Recent studies using weather surveillance radar (C. E. Nemes & E. B. Cohen, unpublished data) show that migrating songbirds regularly concentrate in certain areas of the state, with some variation depending on time of year (i.e., fall or spring migration). Regional maps show where stopover "hotspots" occur: high and medium stopover density areas, as compared to all locations within that region, for spring (Figure 3.2) and autumn (Figure 3.3) migration. Protection of migratory corridors and stopover habitat in these areas is critical to support regional populations

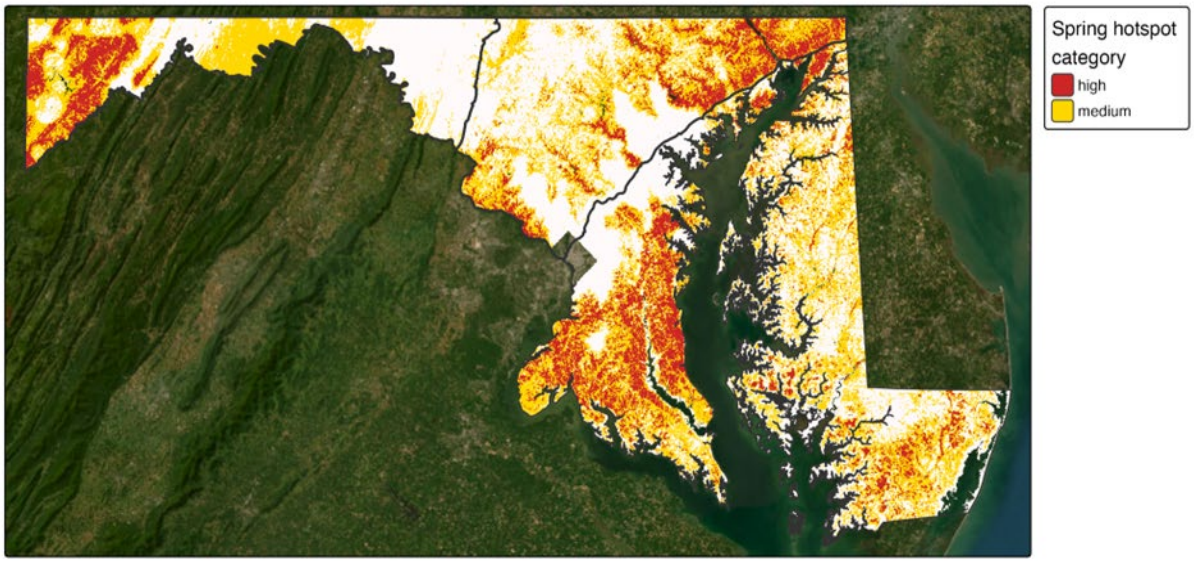


Figure 3.2 Importance of spring stopover hotspots within each bird conservation region of Maryland (Montane, Piedmont, and Coastal Plain).

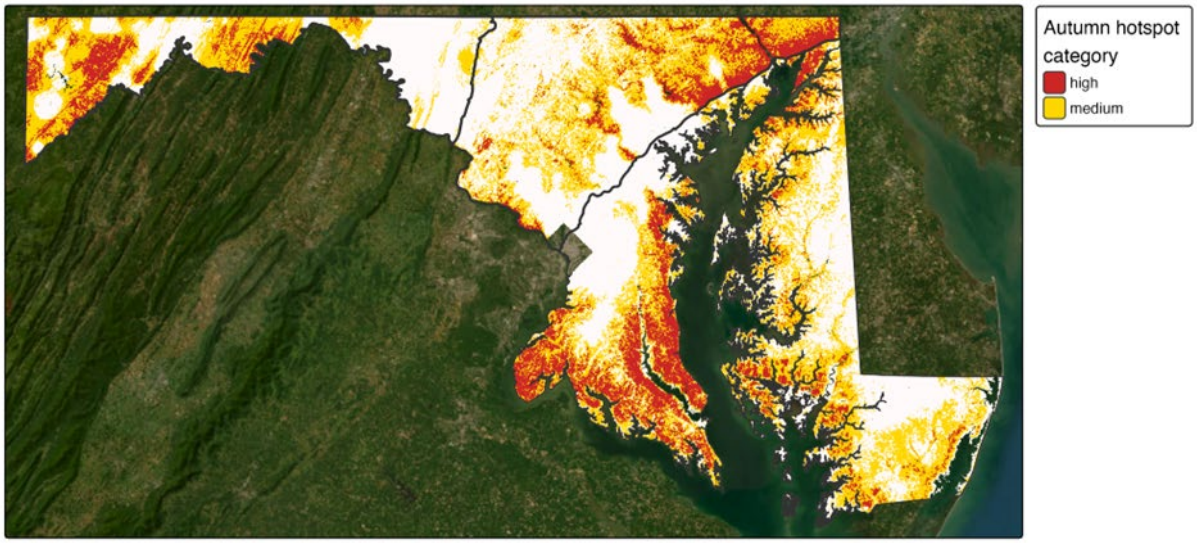


Figure 3.3 Importance of autumn stopover hotspots within each bird conservation region of Maryland (Montane, Piedmont, and Coastal Plain).

Several general threats to birds also affect SGCN to differing degrees. Collisions with wind turbines, cell towers, building windows, and other human structures kill many thousands of birds each year. During migration, landbirds are especially vulnerable to these collisions. The Threatscape threat index (Cabrera-Cruz et al., in preparation) (Figure 3.4) is a measure of the potential collision mortality risk from six sources: aircraft, buildings, communication towers, power lines, roads, and wind turbines. The spatial distribution of collision risk varies across Maryland and is highest in densely urbanized areas where multiple threat sources are present, but birds are vulnerable to collision wherever structures occur. Risk from at least one collision source occurs across most of the state, even in suburban and rural locations.

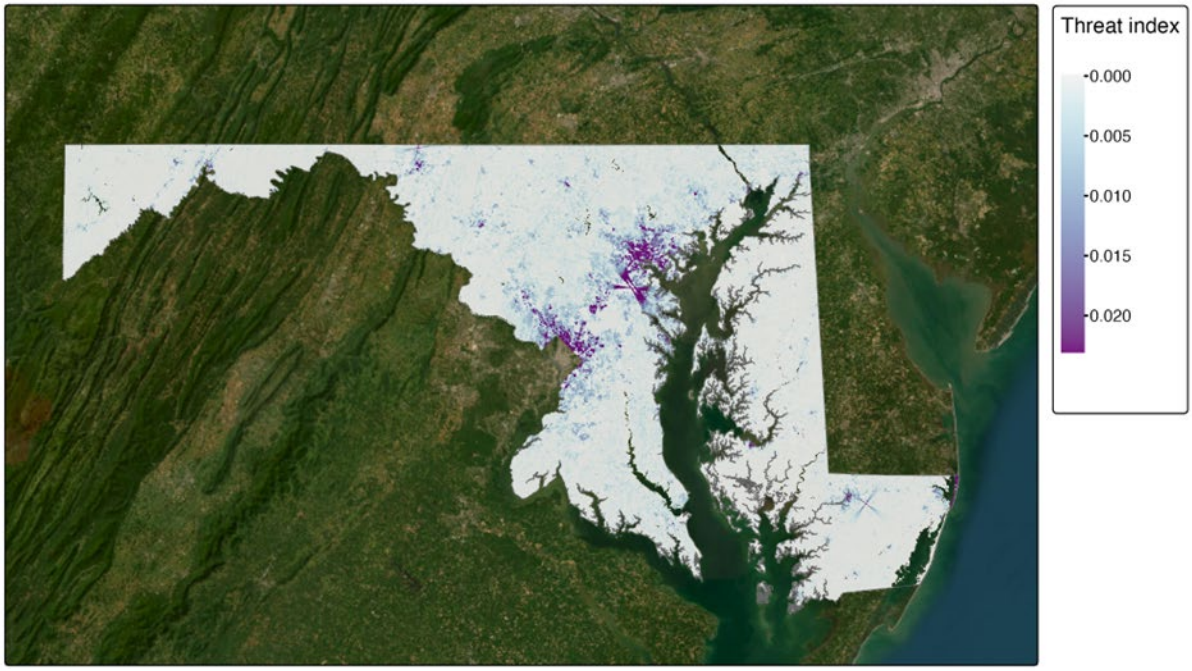


Figure 3.4 Potential risk of mortality from collisions with anthropogenic structures ("Threatscape" threat index; Cabrera-Cruz et al., in preparation).

Timbering activities in certain habitats during the breeding season may impact nesting forest birds. West Nile virus and other diseases may have significantly reduced populations of some species such as ruffed grouse *(Bonasa umbellus)* and American goshawk. SGCN face competition for nest sites with introduced bird species, and free-ranging domestic cats are estimated to kill billions of birds annually in the U.S. (Loss et al. 2013). Finally, aside from more direct threats such as sea-level rise, climate change has led to phenological mismatches for a number of bird species, aerial insectivores in particular. This is because aerial insectivores tend to be neotropical migrants, rely on insects being available when they migrate, and have few alternative food sources. Climate change has altered the timeframes of both insect and bird ecological functions, leading to less overlap and therefore a reduced food source during the migratory season.

Conservation Actions and Information Needs for Bird SGCN

State and regional efforts to identify conservation actions and information needs for birds has been extensive, more so than for any other SGCN taxonomic group. For example, Partners in Flight has produced conservation plans that include Maryland SGCN, and Bird Conservation Region plans have been completed, or species of concern have otherwise been identified, for all the regions in Maryland designated by the North American Bird Conservation Initiative. Recommendations for waterbird, seabird, shorebird, and waterfowl SGCN are included in other regional plans. These plans help to provide population targets and landscape-level habitat information that can be used to identify priority areas for conservation through acquisition and easement programs, as well as habitat restoration.

Particularly needed are habitats for area-sensitive and northern habitat species, as well as those species requiring a mosaic landscape of particular habitats. The designation of Important Bird Areas (IBA) by Audubon Maryland-DC assists with this effort by identifying habitats supporting suites of SGCN and working to protect them. In addition, information needs and conservation actions for breeding federally-listed species (e.g., piping plover, red-cockaded woodpecker) can be found in their respective recovery plans. Support for the recovery plans for federally listed Endangered and Threatened species is included in the implementation of the SWAP (Table 3.11). Partnerships like the Maryland Bird Conservation Partnership are key to networking and coordinating the efforts of local and regional groups for the most effective and efficient conservation of Maryland's bird SGCN and their habitats.

Given the mobility of birds, planning at the landscape level and the consideration of species' needs during their full life cycle is particularly important. Coordination of monitoring for birds and the use of standardized protocols are likewise important to assess population status and trends across broad landscapes (Lambert et al. 2009). To address the special needs of bird SGCN, more information continues to be needed on significant migratory corridors, stopover areas, and overwintering requirements; area sensitivity (forest, grassland, shrubland, and marsh species); and nocturnal species and marine birds. Even for some more well-studied SCGN species, details of their habitat requirements and impacts of threats throughout their life cycle are not understood well enough for effective conservation. Building on information collected during the most recent Breeding Bird Atlas (2020–2024) could help to fill information gaps for select species and indicate where improvements in habitat conservation and restoration could be most beneficial for bird SGCN. Maps of migration stopover hotspots (Figure 3.5) can help direct land easement and acquisition efforts as well as management for critical food resources, which change with the migration season.

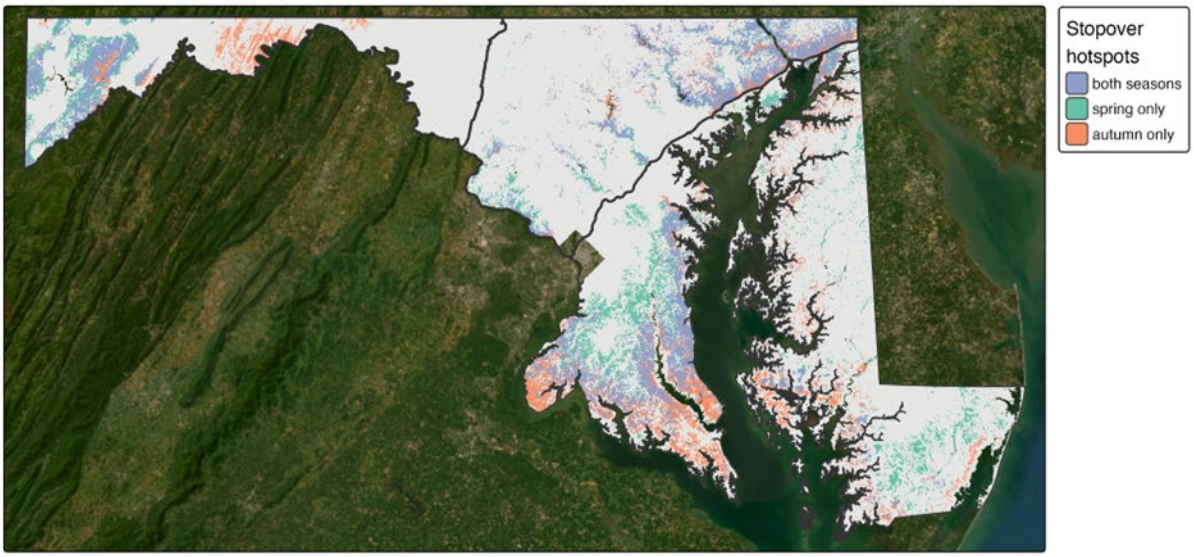


Figure 3.5 Seasonal importance of stopover hotspots within each bird conservation region of Maryland.

Fragmentation and habitat destruction for forest interior as well as area-sensitive grassland species can be limited by protecting the remaining large blocks of unfragmented forests and grasslands, controlling urban sprawl through implementation of the state's smart growth initiatives, smart siting of energy developments and transportation corridors, improving plans for timber harvests, appropriate siting of trails and recreation areas, and limiting the conversion of forests to monotypic pine plantations. Work with the public can encourage the protection of SGCN at migratory stopover sites, beach-nesting sites, and waterbird nesting colonies, and it can also help control the threat of predation by free-ranging cats. Programs that encourage private landowners to create or preserve habitat are key for several SGCN.

Control of introduced and invasive species, predators, and deer populations continues to be needed to conserve some nesting bird species. Food resources of bird SGCN can be protected by limiting the use of certain pesticides and the overharvest of horseshoe crabs and forage fish. Encouraging farming practices, utility right-of-way management, and reclaimed strip mine practices that favor grassland and shrub-scrub nesting species—practices such as late mowing, hedgerow establishment, and reduced pesticide use—can benefit a number of grassland and early successional forest bird SGCN. Best Management Practices (BMPs), such as those created for Virginia Piedmont birds (Wolter et al. 2008) and golden-winged warbler habitats in the Appalachian region (Golden-winged Warbler Working Group 2013), can be good sources for conservation practices for bird SGCN. Creation of additional BMPs would be beneficial in many instances, especially for work with private and public land managers.

Collaboration is vital in the realm of bird conservation work. In order to minimize and monitor mortality due to collisions with structures, for example, it will be vital to work with a variety of partners to develop, encourage, and implement practices that minimize the use of inappropriate lighting at night. Continued research is needed to better understand the impacts of diseases like West Nile virus and highly pathogenic avian influenza (HPAI) as well. An increase in research

and better synthesis of data between invertebrate and bird monitoring efforts would help to conserve insectivorous bird populations.

Finally, in the absence of once-available natural resources and/or cycles, human intervention can act as a stand-in when necessary. Restoration of natural fire frequencies, shoreline processes, and beaver populations can create breeding habitat for certain SGCN. The temporary deployment of tern nesting rafts (i.e., artificial islands) and the creation of small coastal islands to replace those that have been lost contribute greatly to the persistence of breeding colonial waterbirds. Retention and improvement of aquatic and wetland habitats for bird SGCN can be achieved by controlling *Phragmites*, restoring marshes, enforcing wetland protection laws, limiting excess nutrient and pollutant inputs, and reducing bycatch by commercial fisheries.

Table 3.11 Existing federal recovery plans for bird SGCN

Bird Species	Federal Recovery Plan	Recent Action
Black rail	USFWS 2025 Draft	2025: Draft recovery plan
Piping plover	USFWS 1996	2024: Initiation of 5-year review
Red-cockaded woodpecker	USFWS 2003	2018: 5-year review, summary, & evaluation
Roseate tern	USFWS 1998	2025: Initiation of 5-year review
Rufa red knot	USFWS 2023	2023: Finalized recovery plan

Table 3.12 Bird SGCN in Maryland

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Acadian flycatcher	*Empidonax virescens*	G5	S5B			C
Alder flycatcher	*Empidonax alnorum*	G5	S2B		I	B
American barn owl	*Tyto furcata*	G5	S2B		I	B
American bittern	*Botaurus lentiginosus*	G5	S1B		T	A
American black duck	*Anas rubripes*	G5	S3S4B			C
American goshawk	*Astur atricapillus*	G5	SHB		E*	E
American kestrel	*Falco sparverius*	G5	S3S4B			C
American oystercatcher	*Haematopus palliatus*	G5	S3B			C
American peregrine falcon	*Falco peregrinus anatum*	G4T4	S2S3		I	B
American redstart	*Setophaga ruticilla*	G5	S3S4B			C
American woodcock	*Scolopax minor*	G5	S3S4B			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Bald eagle	*Haliaeetus leucocephalus*	G5	S3S4			C
Baltimore oriole	*Icterus galbula*	G5	S4B			C
Bank swallow	*Riparia riparia*	G5	S3B			C
Bicknell's thrush	*Catharus bicknelli*	G4	S2M			B
Black rail	*Laterallus jamaicensis*	G3	S1	T	E	A
Black scoter	*Melanitta americana*	G5	S3N			C
Black skimmer	*Rynchops niger*	G5	S1B		E	A
Black-and-white warbler	*Mniotilta varia*	G5	S4B			C
Black-bellied plover	*Pluvialis squatarola*	G5	S3N			C
Black-billed cuckoo	*Coccyzus erythropthalmus*	G5	S3B			C
Black-crowned night heron	*Nycticorax nycticorax*	G5	S2S3B			B
Black-legged kittiwake	*Rissa tridactyla*	G5	S3N			C
Black-throated blue warbler	*Setophaga caerulescens*	G5	S3S4B			C
Black-throated green warbler	*Setophaga virens*	G5	S4B			C
Blackburnian warbler	*Setophaga fusca*	G5	S3B			C
Blue-winged teal	*Spatula discors*	G5	S1B			A
Blue-winged warbler	*Vermivora cyanoptera*	G5	S3B			C
Boat-tailed grackle	*Quiscalus major*	G5	S3B			C
Bobolink	*Dolichonyx oryzivorus*	G5	S3B			C
Brant	*Branta bernicla*	G5	S3N			C
Broad-winged hawk	*Buteo platypterus*	G5	S3B			C
Brown creeper	*Certhia americana*	G5	S3B			C
Brown pelican	*Pelecanus occidentalis*	G4	S1B			A
Canada warbler	*Cardellina canadensis*	G5	S2B			B
Canvasback	*Aythya valisineria*	G5	S3S4N			C
Cerulean warbler	*Setophaga cerulea*	G4	S3B			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Chimney swift	*Chaetura pelagica*	G4G5	S5B			C
Chuck-will's-widow	*Antrostomus carolinensis*	G5	S3S4B			C
Coastal Plain swamp sparrow	*Melospiza georgiana nigrescens*	G5T3	S2B		I	A
Common gallinule	*Gallinula galeata*	G5	S2S3B		I	B
Common goldeneye	*Bucephala clangula*	G5	S2N			B
Common loon	*Gavia immer*	G5	S3S4N			C
Common nighthawk	*Chordeiles minor*	G5	S1B			A
Common tern	*Sterna hirundo*	G5	S1B		E	A
Cory's shearwater	*Calonectris borealis*	GNR	S3N			C
Dark-eyed junco	*Junco hyemalis*	G5	S3B			C
Dickcissel	*Spiza americana*	G5	S3B			C
Dunlin	*Calidris alpina*	G5	S3N			C
Eastern meadowlark	*Sturnella magna*	G5	S4B			C
Eastern whip-poor-will	*Antrostomus vociferus*	G5	S3S4B			C
Forster's tern	*Sterna forsteri*	G5	S2B		I	B
Gadwall	*Mareca strepera*	G5	S1S2B			A
Glossy ibis	*Plegadis falcinellus*	G5	S1B			A
Golden eagle	*Aquila chrysaetos*	G5	S1N			A
Golden-crowned kinglet	*Regulus satrapa*	G5	S3B			C
Golden-winged warbler	*Vermivora chrysoptera*	G3	S1B		I	A
Grasshopper sparrow	*Ammodramus savannarum*	G5	S4B			C
Great blue heron	*Ardea herodias*	G5	S4B			C
Great egret	*Ardea alba*	G5	S3B			C
Greater scaup	*Aythya marila*	G5	S4N			C
Greater yellowlegs	*Tringa melanoleuca*	G5	S3M			C
Gull-billed tern	*Gelochelidon nilotica*	G5	SHB		E	E
Henslow's sparrow	*Centronyx henslowii*	G4	S1S2B		I	A
Hooded warbler	*Setophaga citrina*	G5	S3S4B			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Horned grebe	*Podiceps auritus*	G5	S4N			C
Ipswich sparrow	*Passerculus sandwichensis princeps*	G5T1	S1N			A
Kentucky warbler	*Geothlypis formosa*	G5	S3S4B			C
King rail	*Rallus elegans*	G4	S2B			B
Laughing gull	*Leucophaeus atricilla*	G5	S1B			A
Leach's storm-petrel	*Hydrobates leucorhous*	G5	S2N			B
Least bittern	*Botaurus exilis*	G4	S3B		I	C
Least flycatcher	*Empidonax minimus*	G5	S3B			C
Least tern	*Sternula antillarum*	G4	S2B		T	B
Lesser scaup	*Aythya affinis*	G5	S4N			C
Lesser yellowlegs	*Tringa flavipes*	G5	S2S3N			B
Little blue heron	*Egretta caerulea*	G5	S1B			A
Loggerhead shrike	*Lanius ludovicianus*	G4	SHB		E	E
Long-eared owl	*Asio otus*	G5	S1B			A
Long-tailed duck	*Clangula hyemalis*	G5	S3N			C
Louisiana waterthrush	*Parkesia motacilla*	G5	S4S5B			C
Magnolia warbler	*Setophaga magnolia*	G5	S3S4B			C
Marsh wren	*Cistothorus palustris*	G5	S3S4B			C
Mourning warbler	*Geothlypis philadelphia*	G5	S1B		E	A
Nashville warbler	*Leiothlypis ruficapilla*	G5	S1B		T	A
Nelson's sparrow	*Ammospiza nelsoni*	G5	S1N			A
Northern bobwhite	*Colinus virginianus*	G4G5	S3S4			C
Northern gannet	*Morus bassanus*	G5	S3N			C
Northern harrier	*Circus hudsonius*	G5	S2B		I	B
Northern parula	*Setophaga americana*	G5	S4S5B			C
Northern saw-whet owl	*Aegolius acadicus*	G5	S1B			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Northern waterthrush	*Parkesia noveboracensis*	G5	S2B		I	B
Olive-sided flycatcher	*Contopus cooperi*	G4	SHB		X	E
Ovenbird	*Seiurus aurocapilla*	G5	S4S5B			C
Pied-billed grebe	*Podilymbus podiceps*	G5	S2S3B			B
Pine siskin	*Spinus pinus*	G5	S1B			A
Piping plover	*Charadrius melodus*	G3	S1B	T	E	A
Prairie warbler	*Setophaga discolor*	G5	S4B			C
Prothonotary warbler	*Protonotaria citrea*	G5	S4B			C
Red phalarope	*Phalaropus fulicarius*	G5	S3N			C
Red-breasted nuthatch	*Sitta canadensis*	G5	S3B			C
Red-cockaded woodpecker	*Leuconotopicus borealis*	G3	SHB	T	X	E
Red-necked phalarope	*Phalaropus lobatus*	G4G5	S3M			C
Red-throated loon	*Gavia stellata*	G5	S3S4N			C
Redhead	*Aythya americana*	G5	S2N			B
Roseate tern	*Sterna dougallii*	G4	SXB	E	X	E
Royal tern	*Thalasseus maximus*	G5	S1B		E	A
Ruddy turnstone	*Arenaria interpres*	G5	S1N			A
Rufa red knot	*Calidris canutus rufa*	G4T2	S1M	T	T	A
Ruffed grouse	*Bonasa umbellus*	G5	S3			C
Rusty blackbird	*Euphagus carolinus*	G4	S2S3N			B
Saltmarsh sparrow	*Ammospiza caudacuta*	G2	S2B		I	A
Sanderling	*Calidris alba*	G5	S3N			C
Sandwich tern	*Thalasseus sandvicensis*	G5	S1B			A
Sargasso shearwater	*Puffinus lherminieri*	G4G5	S3N			C
Savannah sparrow	*Passerculus sandwichensis*	G5	S3B			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Scarlet tanager	*Piranga olivacea*	G5	S4S5B			C
Seaside sparrow	*Ammospiza maritima*	G4	S3S4B			C
Sedge wren	*Cistothorus stellaris*	G5	S1B		E	A
Semipalmated sandpiper	*Calidris pusilla*	G5	S3M			C
Sharp-shinned hawk	*Accipiter striatus*	G5	S2B			B
Short-billed dowitcher	*Limnodromus griseus*	G3	S3M			B
Short-eared owl	*Asio flammeus*	G5	S1B		E	A
Snowy egret	*Egretta thula*	G5	S2B			B
Sora	*Porzana carolina*	G5	S1B,S3M			B
Spotted sandpiper	*Actitis macularius*	G5	S3B			C
Surf scoter	*Melanitta perspicillata*	G5	S4N			C
Swainson's thrush	*Catharus ustulatus*	G5	SHB		X	E
Swainson's warbler	*Limnothlypis swainsonii*	G4	S1B		E	A
Swamp sparrow	*Melospiza georgiana*	G5	S3B			C
Tricolored heron	*Egretta tricolor*	G5	S1B			A
Upland sandpiper	*Bartramia longicauda*	G5	S1B		E	A
Veery	*Catharus fuscescens*	G5	S3S4B			C
Vesper sparrow	*Pooecetes gramineus*	G5	S3B			C
Whimbrel	*Numenius phaeopus*	G5	S2M			B
White-winged scoter	*Melanitta deglandi*	G5	S2N			B
Willet	*Tringa semipalmata*	G5	S3B			C
Willow flycatcher	*Empidonax traillii*	G5	S3S4B			C
Wilson's plover	*Anarhynchus wilsonia*	G5	SHB		E	E
Winter wren	*Troglodytes hiemalis*	G5	S2B			B
Wood thrush	*Hylocichla mustelina*	G4	S5B			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Worm-eating warbler	*Helmitheros vermivorum*	G4G5	S4B			C
Yellow warbler	*Setophaga petechia*	G5	S4B			C
Yellow-breasted chat	*Icteria virens*	G5	S4B			C
Yellow-crowned night heron	*Nyctanassa violacea*	G5	S3B			C
Yellow-throated vireo	*Vireo flavifrons*	G5	S4B			C

[1] = See Table 3.5 for S-rank and G-rank definitions
[2] = T (Threatened); E (Endangered); I (In Need of Conservation); X (Endangered Extirpated)
[3] = See Table 3.7 for Conservation Status definitions
* = a qualifier denoting the species is listed in a limited geographic area only

Reptiles and Amphibians of Maryland

Maryland herpetofauna, also known as "herps," includes 42 amphibian and 47 reptile species that are native inhabitants of the state. Of these 89 species, more than half (48) are considered SGCN in Maryland, with an additional five listed as SAPS. The first few subsections of this section are dedicated to describing the general state and requirements of all herpetofauna in the state, whereas the latter subsections are dedicated solely to these 48 SGCN.

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

MD DNR and the Natural History Society of Maryland concluded a five-year-long Maryland Amphibian and Reptile Atlas (MARA) survey project in 2015. This effort updated the previously published complete account of Maryland herps (Harris 1975), which had become out of date. Johns Hopkins University Press published *The Maryland Amphibian and Reptile Atlas* (Cunningham & Nazdrowicz 2018), which documents species accounts with life history information and distribution results of Maryland's herpetofauna (see *Case Study* below for additional information on MARA).

Reptiles

Native reptile species in Maryland include 18 turtles, 6 lizards, and 23 snakes. Maryland's 18 turtles range from the highly aquatic eastern spiny softshell *(Apalone spinifera)* and the terrestrial eastern box turtle *(Terrapene carolina)* to the five sea turtles that visit offshore ocean waters, the Chesapeake Bay, and Maryland's coastal estuaries during the warmer months. Although most other turtles cannot tolerate brackish water, the diamond-backed terrapin *(Malaclemys terrapin)* lives primarily in this habitat, and a few primarily freshwater species,

such as snapping turtle and eastern mud turtle *(Kinosternon subrubrum)*, sometimes venture into brackish habitats. Most of the other species are stream and pond inhabitants, such as the widespread painted turtle and northern red-bellied cooter. Most species have a varied diet, though the state-Endangered northern map turtle *(Graptemys geographica)* feeds primarily on mollusks, including native mussels and snails as well as invasive species like zebra mussels or mystery snails (Gacheny et al. 2021).

Maryland's six lizards are small, four-legged, slender, and long-tailed reptiles. The common five-lined skink and the eastern fence lizard are widespread and, by inference, tolerate a wide range of habitats. The little brown skink, however, is restricted to the eastern half of the state; lizard SGCN also have restricted ranges, as discussed in later subsections. Lizards are frequently found in more open, sunnier, and drier habitats, including light gaps in forests or barren areas.

Timber rattlesnake (Scott Smith, MD DNR)

The 23 documented native snake species in Maryland range from the tiny, earthworm-like eastern wormsnake to the thick-bodied, heavy, and venomous timber rattlesnake *(Crotalus horridus).* About half of Maryland snakes lay eggs and the rest give live birth, with females retaining eggs during development. Maryland's snakes are carnivorous, eating a range of foods from invertebrates to small mammals. Some have specialized diets, such as the Endangered rainbow snake *(Farancia erytrogramma)* that feeds primarily on eels; the rarely seen queensnake *(Regina septemvittata),* which feeds on recently molted (i.e., soft) crayfish; and the eastern hog-nosed snake*,* which focuses on toads. Most snakes are terrestrial or even arboreal, and a few, such as the watersnakes, are semiaquatic. Only two species in Maryland are venomous, the aforementioned timber rattlesnake and copperhead *(Agkistrodon contortrix).*

Amphibians

Maryland's list of documented native amphibians includes 22 salamanders and 20 frogs and toads. Additionally, a single siren population (species currently undetermined) occurs in a lake near College Park. This population was likely introduced.

Many amphibians require vernal or other fish-free ponds, slow-moving streams, springs, or non-tidal wetlands for breeding. Nearly all of the 22 species of salamanders found in Maryland are associated with these freshwater aquatic environments, with a few notable exceptions, such as the widespread and completely terrestrial eastern red-backed salamander. Many salamanders spend the winter hibernating underground and beneath rocks and logs and then travel to seek aquatic breeding sites shortly after emergence from hibernation in late winter or early spring. When habitats are fragmented, it often becomes difficult or impossible for these salamanders to reach breeding sites—desiccation occurs when formerly shaded forests dry out, predation increases when cover is lost, and mortality results when adults try to cross roads. If their wetland breeding sites and surrounding upland buffers are altered or destroyed, then breeding may become impossible, unless alternative sites can be found (Semlitsch & Bodie 2003).

Longtail salamander (Eurycea longicauda) (Mark Tegges)

Although all Maryland frog and toad species lay eggs in water, toads and some frogs are terrestrial as adults, the latter living in cool, damp habitats where their moist skin does not readily desiccate. Each species of frog and toad has a distinctive mating call, usually made at night in spring and summer when most breeding activity occurs. After breeding, most frogs and toads go silent, and then their presence is much harder to detect.

Reptile and Amphibian SGCN of Maryland

Forty-eight species of amphibians and reptiles have been identified by the SWAP process as SGCN in Maryland (Table 3.14), with an additional five on the SAPS list not covered in this chapter. Of these 48 SGCN, 19 are amphibians and 29 are reptiles. Five reptile SGCN are listed as federally Endangered or federally Threatened: bog turtle *(Glyptemys muhlenbergii),* green sea turtle *(Chelonia mydas),* and loggerhead sea turtle *(Caretta caretta)* are listed as Threatened, and the Kemp's ridley *(Lepidochelys kempii)* and leatherback *(Dermochelys coriacea)* sea turtles are listed as Endangered. Eight amphibian SGCN and 10 reptile SGCN are state-listed, including 6 amphibians and 9 reptiles listed as Threatened or Endangered; 1 amphibian and 1 reptile listed as In Need of Conservation; and 1 amphibian listed as Endangered Extirpated. Furthermore, 2 amphibian and 9 reptile SGCN are of international concern (IUCN 2026), and 8 amphibian and 17 reptile SGCN are of conservation concern in the Northeastern U.S. region (TCI & NEFWDTC 2023). For more explanation and additional ranks, see Appendices 3a and 3b.

Freshwater Reptile and Amphibian SGCN

Most of Maryland's freshwater aquatic and wetland SGCN herpetofauna are amphibians, although many turtles and a few snakes also have aquatic affinities. The 19 amphibian SGCN exhibit a wide range of dependency on watery habitats during their lifetime. At one extreme is the eastern hellbender *(Cryptobranchus alleganiensis),* which is wholly aquatic and spends its entire life submerged in boulder-strewn rivers in western Maryland. At the other extreme, species like Wehrle's salamander *(Plethodon wehrlei)* and green salamander *(Aneides aeneus)* can live on mountain tops and in other drier habitats by finding cool, moist crevices in boulders and caves and moist soils under rocks and logs, as well as by foraging at night. The majority of the 14 salamanders and five frogs and toads on the SGCN list require vernal pools, ponds, springs, or streamside wetlands for reproduction. After mating and laying eggs, the adults may remain nearby while the eggs develop into larval forms (i.e., tadpoles) before transforming into adults and leaving their watery habitats. Species particularly dependent on vernal pools and Delmarva Bay habitats include barking treefrog *(Dryophytes gratiosus),* carpenter frog *(Lithobates virgatipes),* eastern tiger salamander *(Ambystoma tigrinum),* Jefferson salamander *(Ambystoma jeffersonianum),* and upland chorus frog *(Pseudacris feriarum).*

Eastern hellbender (Cryptobranchus alleganiensis)
(Lori Pruitt, USFWS)

Four of Maryland's amphibian species belong to *Ambystomatidae,* the mole salamanders, a family in which the rate of population decline is greater than the average for all other amphibians (Stuart et al. 2004). One of these four species, the eastern tiger salamander, is state-listed as Endangered in Maryland.

Three new native species have also been identified in Maryland in recent years. All three are included in the SWAP in some capacity: striped mud turtle *(Kinosternon baurii)* on the SGCN list, Atlantic coast leopard frog and southern two-lined salamander on the SAPS list. The striped mud turtle was first documented in southern Maryland after the release of the 2015 SWAP revision and has since been observed on the Eastern Shore as well. The Atlantic Coast leopard frog was first identified in 2012 and described in 2014 (Newman et al 2012; Feinberg et al 2014). The southern two-lined salamander was discovered as occurring on the state's southern Eastern Shore in 2008. These species were previously overlooked due to their similarity to other native species. Our knowledge of the Maryland distribution and life history of these species is still limited and in need of additional research—though we know enough about the striped mud turtle to have some understanding of its needs, hence its 2025 addition to the SGCN list.

Reptile SGCN that regularly live in or near freshwater habitats include eight turtles and four snake species. Of the turtles, the eastern spiny softshell (state-listed as In Need of Conservation) and northern map turtle (state-listed as Endangered) spend much of their time submerged in larger rivers or basking on river structures, rarely leaving the water except to nest. Wood turtles *(Glyptemys insculpta*) are more terrestrial than the other riverine turtles, dividing their time between the associated floodplains and upland habitats during the active season and brumating (i.e., overwintering) in coldwater streams during the winter. The spotted turtle *(Clemmys guttata)* and especially the bog turtle inhabit freshwater wetlands, only occasionally making movements away from the water. Wetland-dependent snake SGCN include eastern ribbonsnake *(Thamnophis sauritus)* and plain-bellied watersnake *(Nerodia erythrogaster),* formerly known as red-bellied watersnake. Queensnakes occur in freshwater streams with abundant crayfish populations. The state-Endangered rainbow snake is limited to southern sections of the Potomac River and lives in tributary streams, marshes, and swamps as it hunts eels and other aquatic prey at night.

Reptile SGCN of Upland Habitats

Most of the remaining reptile SGCN are primarily associated with upland forests, rock outcrops, open fields, grassy glades, and other terrestrial habitats. The well-known eastern box turtle lives in moist and dry forests throughout much of Maryland, though habitat loss and diseases are negatively impacting many of these populations. A new population of the state-Endangered northern coal skink *(Plestiodon anthracinus)* was discovered in western Maryland in 2013; however, the shale barren habitat where it was found is scarce and considered a rare habitat in

the state. A number of snakes associated with upland habitats are secretive, living underground or otherwise hidden, and are difficult to survey, such as the northern mole kingsnake *(Lampropeltis rhombomaculata)*. This species, along with smooth greensnake *(Opheodrys vernalis),* is found in meadows and open woods, with the latter species restricted to western Maryland. The mountain earthsnake *(Virginia valeriae pulchra)* and timber rattlesnake are also restricted to western Maryland today, although the timber rattlesnake historically occurred further east into the Piedmont.

Marine and Estuarine Reptile SGCN

Maryland's marine turtles are large to massive, have their forefeet modified as flippers, and have specialized salt glands to maintain proper water balance while living in the marine environment. Most observations of these turtles come from documentation of sea turtle strandings along Maryland's coastline and in the Chesapeake Bay, or capture in fishing nets and fish traps. However, the loggerhead sea turtle has been documented successfully nesting on the beaches of Assateague Island. Most sea turtles observed in the Chesapeake and Coastal Bays are juveniles and non-breeding subadults, which use these estuaries to feed on various crabs, mollusks, and other invertebrates during the warmer summer months.

The two most common species in Maryland are the loggerhead and Kemp's ridley sea turtles; the MARA project documented 51 sightings in 40 atlas blocks for the former and 13 blocks for the latter (Cunningham & Nazdrowicz 2018). Leatherback and green sea turtles are reported less widely, with 7 and 2 atlas blocks, respectively. The Atlantic hawksbill has only been documented in the ocean well off Maryland's coast; in fact, it has been relegated to the SAPS list for the 2025 SWAP revision due to this lack of data and documentation, leaving four remaining sea turtle SGCN.

Leatherback sea turtle (Dermochelys coriacea)
(George Jett)

The only truly estuarine reptile in Maryland, the diamond-backed terrapin, is designated as Maryland's state reptile and is one of the Chesapeake's most iconic creatures. It lives in brackish waters and coastal marshes and lays its eggs on sandy beaches and bay islands from late May to early July. Historically, this turtle was a food source for Native Americans and early European colonists. Many thousands of pounds of terrapins were harvested and sold annually into the early 1900s. The market for this species was greatly reduced over the next half-century, but the high demand in Asian markets beginning in the 1990s added significant pressure on the population (Kennedy 2018). Terrapins were commercially harvested until 2007, when the Maryland legislature enacted a ban on commercial take and limited possession (Maryland Natural Resources Code §4-902).

Threats to Reptile and Amphibian SGCN

Globally, amphibian and reptile populations are in decline (IUCN 2026). This is the result of a combination of threats of varying severity, including habitat loss, pollution, climate change, disease, invasive species, and over-exploitation (Cox et al. 2022; Leudtke et al. 2023). According to the IUCN, amphibians are the most threatened vertebrate group, with 40.7% of amphibians globally threatened (Leudtke et al. 2023). Reptiles are third, behind mammals, with 21.1% of species globally threatened (Cox et al. 2022). Besides direct threats to populations, amphibian and reptile SGCN also rely on many Key Wildlife Habitats (Chapter 4), from the Delmarva Bays and sandy dunes of the Eastern Shore to the hardwood forests and coldwater streams of the Piedmont and Appalachian Plateau. All these habitats are impacted by one or more threats.

Almost all amphibian SGCN rely on freshwater streams, vernal pools, ponds, or other freshwater wetlands for all or some of their life stages. The 22 species of salamanders found in Maryland may be negatively impacted by urbanization and associated alterations of stream habitat (Price et al. 2011). Threats such as pollution, acid mine drainage, and sedimentation due to erosion and run-off from impervious surfaces may seriously impact populations of these species by making water conditions unsuitable (Barrett & Price 2014). Per- and polyfluoroalkyl substances (PFAS), which have been used in products for decades, pose another threat to aquatic reptiles and amphibians (Gonkowski & Ochoa-Herrera 2024). Exposure in the aquatic environment, as well as through diet, may impact populations directly and the food web more broadly through bioaccumulation and biomagnification (Flynn et al. 2021, 2022). As long-lived animals, turtles may be particularly vulnerable to these "forever chemicals," which have the potential to accumulate in tissues over time (Beale et al. 2022a,b).

The impacts of deforestation include changes in water temperature, soil temperature, sedimentation, and a decrease in organic inputs that maintain a food base for amphibian SGCN. These threats are especially of concern in western Maryland, where nine of the 13 salamander SGCN are found. Wehrle's and green salamanders, for example, rely on moist rock crevices and associated arboreal habitat, making them especially vulnerable to the destruction of rock outcrops and the removal of surrounding forest canopy that alters substrate moisture (Corser 2001; Waldron & Humphries 2005; Brand et al. 2014). Forest reptiles such as mountain earthsnake and eastern box turtle are also threatened by deforestation and fragmentation due to timber harvests, habitat conversion, and road construction. Furthermore, the natural process of forest succession can negatively impact species that have restricted ranges due to habitat loss. Timber rattlesnakes and copperheads, which also rely on rock outcrops for multiple biological processes (e.g., hunting, basking, and hibernation), are threatened by encroachment on these limited sites (Ernst & Ernst 2012). Eastern tiger salamanders reproduce in Delmarva Bays on the Eastern Shore, where forest succession limits their habitat as well.

In some areas of the state, hydrological changes and groundwater withdrawal threaten the continued presence of critical water bodies for aquatic species. The loss of beaver impoundments, overgrazing, and ditching and draining of marshes and wetlands have further impacted populations of some amphibians and reptiles through the loss of habitat, including the federally listed bog turtle (Zappalorti 2023). The bog turtle has been on the Turtle Conservation Coalition's list of the world's most endangered tortoises and freshwater turtles since 2003 and is considered critically threatened (TCC 2018, 2025). Aquatic snakes (e.g., rainbow snake and

plain-bellied watersnake) and turtles that rely on riverine and pool habitats (e.g., wood turtle, eastern spiny softshell, and northern map turtle) face threats similar to amphibian SGCN. Runoff from impervious surfaces and open upland after heavy rain events can cause catastrophic flooding that displaces or kills vulnerable individuals (Norden 1999; Nickerson et al. 2007; Jones & Sievert 2009; Unger et al. 2021; Goncalves et al. 2024). Hibernating turtles can be especially susceptible to these events (Jones & Sievert 2009; Hillman & Waling 2025). Alterations to natural stream flow for hydroelectric power may also change hydrology in ways that negatively impact species. High flow rates from dam releases for electric generation as well as recreational activities alter habitat and impact biological processes of state-Endangered species like the eastern hellbender and the northern map turtle (Gacheny et al. 2021; Bárcenas-García et al. 2022).

Bog turtle (Glyptemys muhlenbergii) (USFWS)

Species' use of different habitats at different times of the year for breeding, overwintering, and development further increases the vulnerability to landscape-level fragmentation and the loss of travel corridors (Jackson et al. 2015). Movements between these habitats frequently result in road mortalities negatively impacting populations of frogs and toads, salamanders, turtles, and snakes (Marsh & Jaeger 2015; Howell & Seigel 2019). In the marine environment, sea turtles and terrapins are subject to boat collisions. and propeller strikes, entanglement and incidental take in fishing nets, predation of nests, human disturbance along nesting beaches, and ingestion of trash. The diamond-backed terrapin is also threatened as a non-target capture (i.e., bycatch) in commercial and recreational crab traps (Chambers & Maerz 2018). In addition, shoreline development and structural stabilization often cut off access to or altogether eliminate nesting areas for the terrapin and northern map turtle (Winters et al. 2015; Levasseur et al. 2023). Projects that include living shorelines with habitat or attenuating structures that reduce erosion but allow movement between water and land are currently being implemented and may benefit species like diamondback terrapins while also protecting homes (Grothues et al. 2025).

A significant cause of decline for reptiles and amphibians is overcollection and illegal trade. These groups are increasingly threatened by collection for food, medicinal purposes, and the pet trade (Stuart et al. 2004; Rosen & Smith 2010; Luiselli et al. 2016; Easter et al. 2023). The life history characteristics of turtles in particular make them at risk of population declines, as they are slow to reach reproductive maturity and have incredibly low egg and juvenile survival. Tackling this issue of illegal and unsustainable trade is made more difficult by barriers that include insufficient funding, capacity shortages, and lack of data (Sevin et al. 2022; Wixted & Christman 2022; Wixted 2024; Christman et al. 2025). Snakes in general and venomous snakes in particular are harassed and often killed when perceived to be a threat. The hibernacula of timber rattlesnakes are particularly vulnerable to harassment, destruction, and illegal collecting activities. Human activity in sensitive habitats—even those that seem innocuous—could do

harm. For example, moving rocks in streams to create rock cairns not only destroys essential habitat for stream dwelling species like the eastern hellbender, but has also resulted in killing individuals (Unger et al. 2017).

Reptiles and amphibians are threatened by several established pathogens, such as *Ophidiomyces ophiodiicola* (Oo), Ranaviruses (e.g., FV3), *Batrachochytrium dendrobatidis* (Bd), and *B. salamandrivorans* (Bsal), as well as some potentially emerging pathogens such as *Emydomyces testavorans* (Emte). Snake fungal disease, caused by the fungus *Ophidiomyces ophiodiicola*, was first documented in timber rattlesnakes in the northeastern U.S. in 2006 and has since been documented in wild snake populations throughout the eastern U.S. (Allender et. al. 2011; Clark et al. 2011; Lorch et. al. 2016). Ranaviruses are now known to affect over 200 reptile and amphibian species (Marschang et al. 2025), up from the estimated 100 when the previous SWAP revision was published in 2016. The virus can live for weeks outside the host in aquatic conditions and is usually fatal to juvenile individuals, although adults can also be susceptible to or transmit Ranavirus to other individuals (Brunner et al. 2025). The disease spreads quickly through populations that tend to congregate in large groups, with some infected populations suffering 90% mortality (NE PARC 2014). Bd and Bsal are chytrid fungi that cause the disease chytridiomycosis (Berger et al. 2015). Bd has been detected throughout North America, although the response to infection is variable and complex, with limited evidence of declines attributed to infection in the eastern United States (Lips 2016). However, infection combined with environmental stress could lead to high mortality and extirpation for vulnerable species like the eastern hellbender (Lips et al. 2006; Novotny et al. 2024).

Bsal has not yet been documented in North America, but the probability of its introduction is high and could lead to high biodiversity loss in the Appalachian region due to its high salamander diversity. Lab studies have shown that four of the 22 salamanders (eastern newt, green salamander, red salamander, and northern two-lined salamander) that inhabit Maryland are susceptible and considered moderate to very high conservation risk (Gray et al. 2023). Coinfection of Bd and Bsal may be even more lethal, as demonstrated in the eastern newt (Longo et al. 2019). While many salamander species have been listed as injurious wildlife and cannot be imported, there is still the potential for other popular pet-trade species that may be carriers to make it into the U.S. (AFWA 2024a). Finally, Emte—a recently described fungus that causes shell lesions—poses a serious risk to freshwater turtle populations, having been detected only recently in wild populations (Woodburn et al. 2019; Lambert et al. 2021; Fredrickson et al. 2024; White et al. 2025). Adding complexity to this disease threat, individuals may be infected with a pathogen (or more than one), and even show signs of disease, but no positive detection may be made (Daleo et al. 2025).

Conservation Actions and Information Needs for Reptile and Amphibian SGCN

In order to better conserve reptile and amphibian SGCN, the seasonal movements and needs of all life stages should be investigated for a number of species. Understanding the impacts of roads, development, and forest harvest practices on SGCN would also assist in their conservation. Direct inputs of contaminants to aquatic environments can be reduced through improved stormwater management practices, minimizing and mitigating acid mine drainage, controlling illegal dumping and wastewater inputs, minimizing the use of pesticides, and establishing adequate buffers of upland habitat. State and local wetland laws should be amended with larger buffers (i.e., life zones) as needed to protect significant habitats for amphibian and

reptile SGCN. Compatible management of the landscape to conserve aquatic habitats needs to include the reduction of impervious surfaces, groundwater withdrawal, stream bank erosion, and watershed deforestation through better design and placement of developments, and improved timber harvest and agricultural practices. Restoration of key wetland habitats (e.g., beaver impoundments) and the plugging of ditches can help to address wetland losses.

Road mortality may be minimized or mitigated through improved road design and placement, as well as the installation of wildlife tunnels and causeways for safe passage corridors in key locations. For marine and estuarine turtles, collision injuries and impacts from recreational and commercial harvest activities may be reduced by working with the fishing industry, recreational boaters, and crab harvesters on various strategies. Increased education may help reduce nest disturbances of beach-nesting species. Enforcement of existing state regulations on possession and trade of amphibians and reptiles and revision of those regulations for further protection are critical (AFWA 2024b). In addition, education and outreach are needed to reduce illegal collecting and killing of reptiles and amphibians.

Other inventory needs, research needs, and actions for conservation are included in sea turtle recovery plans; the bog turtle recovery plan; and the regional plans for the box turtle, spotted turtle, wood turtle, and diamond-backed terrapin. To improve population status regionally, the USFWS, National Marine Fisheries Service (NMFS), and other partners coordinate the actions identified by the Federal Recovery Plans for some species (Table 3.13). In addition to these recovery plans, Partners for Amphibian and Reptile Conservation has used the Important Bird Areas program as a model for herpetofauna habitat conservation. The resulting 2012 Priority Amphibian and Reptile Conservation Areas Report identifies valuable habitat for priority amphibians and reptiles based on designations of species rarity and richness, local and regional implementation responsibility, and landscape integrity (PARC 2012). Most recently, the IUCN Amphibian Conservation Action Plan, which was released in 2024, includes guidance on threats, informed decision-making, and species management (Wren et al. 2024). There is also a recognized national and regional need for advocacy focused on conservation and the use of an ecosystem approach to incorporate protection of amphibian and reptilian species into existing management plans (SE PARC 2004; NE PARC 2010)

More locally, a Virginia Sea Turtle Conservation Plan provides updated research on the distribution and abundance of sea turtles in the Chesapeake and Atlantic waters of Virginia. The plan discusses threats and conservation strategies for loggerhead, Kemp's ridley, green, leatherback, and hawksbill sea turtles (Virginia DNR 2025). It addresses a wide range of issues, from more direct, anthropogenic impacts (e.g., fishing practices and gear, vessel strikes, water contaminants) to natural phenomena that are worsened by humans (e.g., cold-stunning exacerbated by climate change). A recovery plan (USFWS 2001) and conservation plan (Erb 2019) for the federally listed bog turtle are being implemented in Maryland. Recent conservation plans for wood turtle (Jones et al. 2018), spotted turtle (Wiley et al. 2022), and box turtle (Roberts & Erb 2023) have also been developed with cooperation from other states in the region. These plans contain detailed status assessments, distribution information, and prioritized conservation actions based on surveys and other research results.

Case Study: Maryland Amphibian and Reptile Atlas (MARA)

Grid-based atlas projects began over 50 years ago with the Atlas of the British Flora (Perring & Walters 1962), in which 1,500 botanists mapped the distribution of 2,000 plant species to a 10-km (6.2 mi) grid. Since then, hundreds of similar atlases, many of which mapped bird distributions, have been conducted in numerous countries. Maryland has been fortunate to have completed three statewide breeding bird atlas projects: the first in 1983–1987 (Robbins & Blom 1996), the second about 20 years later in 2002–2006 (Ellison 2010), and the most recent in 2020–2024 (G. Foley, unpublished). Conclusions about changes in species distributions over those years are able to be documented throughout Maryland because of the relatively standard data gathering methods used for these atlases and the volume of data collected. This information is an essential part of assessing and documenting the conservation status of our biodiversity.

The abundance and distribution of a number of Maryland's amphibians and reptiles were thought to be in decline for many years. The increasing challenges that amphibians and reptiles face—primarily resulting from human-induced causes such as habitat loss, pollution, introduced diseases, and over-harvesting or collecting—raise concerns for their continued success and even survival. Unfortunately, sufficient data were lacking to have a good handle on the status of many herps in Maryland. Observed declines based on anecdotal evidence highlighted the need for more rigorous and complete documentation of current amphibian and reptile populations.

In the 1930s and 1940s, the Natural History Society of Maryland (NHSM) published distributional surveys of Maryland's reptile species, including *The Reptiles of Maryland and the District of Columbia* (McCauley 1945). Fifteen years later, the curator of the Department of Herpetology at the NHSM, John E. Cooper, published a paper on the distribution of amphibians and reptiles for the state (Cooper 1960). In 1969, Herbert S. Harris, Jr. published the first distributional survey of every amphibian and reptile known to occur in Maryland, and he updated the publication in 1975. No updated, complete survey of reptile and amphibian distributions had been published since then. Although distributional data have been collected dating back to the 1930s, no systematic and replicable survey of all herpetofauna had ever been conducted in Maryland.

To fill this need, the NHSM and MD DNR completed the Maryland Amphibian and Reptile Atlas (MARA) community science project, using State Wildlife Grant funding and thousands of hours of volunteer effort. The project's goal was to map the current distribution of all 89 native species of amphibians and reptiles in a repeatable manner, thus establishing a baseline and aiding current and future species conservation status assessments. Understanding these patterns of change is necessary for land managers, regulators, and citizens to make better decisions to conserve the herpetofauna of Maryland.

MARA began in 2009 with a one-year pilot project to iron out logistics. However, the bulk of the fieldwork was conducted in a five-year window beginning in January 2010. With the help of social media outlets, including Facebook and Meetup, MARA also became an important

educational tool, as hundreds of people across Maryland spent roughly 30,000 hours searching for herps and reported nearly 35,000 herp sightings. The data were collected and visualized in real time, both in map and tabular formats, through MD DNR's online database website. Similar to the breeding bird atlas projects, a book with species accounts, life history information, and distribution results was written by various people involved with MARA and was published in 2018 (Cunningham & Nazdrowicz 2018). While the linked database still exists, the book is currently the best way to view the collected data. Figure 3.6 shows a comparison of a MARA distribution map and a Harris distribution map.

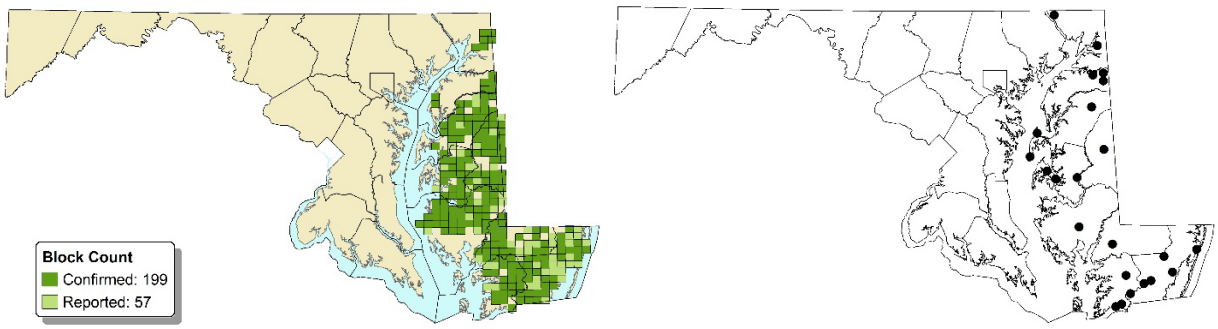


Figure 3.6 New Jersey chorus frog distribution map comparison: MARA 2018 (left) and Harris 1975 (right). Sources: Cunningham & Nazdrowicz 2018; Harris 1975.

MARA provided valuable data for the 2015 SWAP revision to inform the development of the updated SGCN list. Some species, such as upland chorus frog, six-lined racerunner *(Aspidoscelis sexlineata),* northern mole kingsnake, and Coastal Plain milksnake (though it has since been replaced with eastern milksnake *[Lampropeltis Triangulum]* due to taxonomic uncertainty) were added because their ranges have been reduced since Harris's 1975 publication. On the other hand, a number of species were removed from the SGCN list because they did not appear to have undergone range restrictions since Harris's publication, and more active volunteers agreed that these species did not seem to be in decline. These removed species included the New Jersey chorus frog, northern red-bellied cooter, and eastern hognose snake.

An undetermined species of siren was discovered also in Maryland during the MARA project, and around 25 introduced, non-native species were documented during the process as well. Some of these include Florida softshell turtle, Mississippi map turtle, yellow-bellied slider, savannah monitor, green anole, American alligator, red-tailed boa, Burmese python, Cuban treefrog, and northwestern salamander, which was found hitchhiking on a Christmas tree from the Pacific Northwest.

During the 2025 SWAP period, MARA data were used in Status Assessments and state listing decisions for Maryland's rare and declining species. More specifically, the distribution identified during MARA is a critical piece of information for identifying the total area of occupancy in the state. Additionally, MD DNR staff have identified a need for targeted surveys to fill in distribution gaps for a suite of species including mole kingsnake, scarletsnake (*Cemophora coccinea),* and mud salamander *(Pseudotriton montanus).*

Table 3.13 Existing federal recovery plans for reptile SGCN

Reptile Species	Federal Recovery Plan	Recent Action
Bog turtle	USFWS 2001	2022: Interim Species Status Assessment/Biological Report for the Northern Population of the Bog Turtle published; 2018: Initiation of 5-year review
Green sea turtle	NOAA Fisheries and USFWS 1991	2023: Designation of critical habitat; 2016: Final Rule to list eleven Distinct Population Segments of the Green Sea Turtle as Endangered or Threatened and revision of current listings under the ESA
Kemp's Ridley sea turtle	NOAA Fisheries and USFWS 2011	2021: Initiation of 5-year review
Leatherback sea turtle	NOAA Fisheries and USFWS 1992	2025: 90-Day finding on petition to revise critical habitat; 2020: 12-Month finding on a petition to identify the NW Atlantic Leatherback Turtle as a Distinct Population Segment and list it as Threatened under ESA
Loggerhead sea turtle	NOAA Fisheries and USFWS 2008	2019: Initiation of 5-year review; 2014: Designation of critical habitat

Table 3.14 Reptile and amphibian SGCN in Maryland

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Reptiles						
Bog turtle	*Glyptemys muhlenbergii*	G2G3	S2	T	T	A
Copperhead	*Agkistrodon contortrix*	G5	S5			C
Eastern box turtle	*Terrapene carolina*	G5	S5			C
Eastern kingsnake	*Lampropeltis getula*	G5	S4			C
Eastern milksnake	*Lampropeltis triangulum*	G5	S4			C
Eastern mud turtle	*Kinosternon subrubrum*	G5	S5			C
Eastern musk turtle	*Sternotherus odoratus*	G5	S4			C
Eastern ribbonsnake	*Thamnophis sauritus*	G5	S4			C
Eastern spiny softshell	*Apalone spinifera*	G5	S1		I	A
Green sea turtle	*Chelonia mydas*	G4	S1N	T	T	A
Kemp's ridley sea turtle	*Lepidochelys kempii*	G2	S1N	E	E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Leatherback sea turtle	*Dermochelys coriacea*	G2G3	S1N	E	E	A
Loggerhead sea turtle	*Caretta caretta*	G2G4	S1B, S1S2N	T	T	A
Mountain earthsnake	*Virginia valeriae pulchra*	G5T3T4	S1S2		E	A
Northern coal skink	*Plestiodon anthracinus*	G5	S1		E	A
Diamond-backed terrapin	*Malaclemys terrapin*	G4	S4			C
Northern map turtle	*Graptemys geographica*	G4G5	S1		E*	A
Northern mole kingsnake	*Lampropeltis rhombomaculata*	G4	S1			A
Plain-bellied watersnake	*Nerodia erythrogaster*	G5	S2S3			B
Queensnake	*Regina septemvittata*	G5	S4			C
Rainbow snake	*Farancia erytrogramma*	G4	S1		E	A
Red cornsnake	*Pantherophis guttatus*	G5	S2			B
Scarletsnake	*Cemophora coccinea*	G5	S1			A
Six-lined racerunner	*Aspidoscelis sexlineata*	G5	S3			C
Smooth greensnake	*Opheodrys vernalis*	G5	S3S4			C
Spotted turtle	*Clemmys guttata*	G5	S3S4			C
Striped mud turtle	*Kinosternon baurii*	G4G5	SU			D
Timber rattlesnake	*Crotalus horridus*	G4	S3			C
Wood turtle	*Glyptemys insculpta*	G2G3	S2S3			A
Amphibians						
Barking treefrog	*Dryophytes gratiosus*	G5	S1		E	A
Carpenter frog	*Lithobates virgatipes*	G4	S3			C
Common mudpuppy	*Necturus maculosus*	G5	SX		X	E
Eastern hellbender	*Cryptobranchus alleganiensis*	G3	S1		E	A
Eastern narrow-mouthed toad	*Gastrophryne carolinensis*	G5	S2S3		E	B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Eastern spadefoot	*Scaphiopus holbrookii*	G5	S5			C
Eastern tiger salamander	*Ambystoma tigrinum*	G5	S1		E	A
Green salamander	*Aneides aeneus*	G3G4	S1		E	A
Jefferson salamander	*Ambystoma jeffersonianum*	G4	S3			C
Longtail salamander	*Eurycea longicauda*	G5	S5			C
Mountain chorus frog	*Pseudacris brachyphona*	G5	SH		E	E
Mountain dusky salamander	*Desmognathus ochrophaeus*	G5	S5			C
Mud salamander	*Pseudotriton montanus*	G5	S2?			B
Red salamander	*Pseudotriton ruber*	G5	S5			C
Seal salamander	*Desmognathus monticola*	G5	S4			C
Spring salamander	*Gyrinophilus porphyriticus*	G5	S4			C
Upland chorus frog	*Pseudacris feriarum*	G5	S4			C
Valley and Ridge salamander	*Plethodon hoffmani*	G5	S4			C
Wehrle's salamander	*Plethodon wehrlei*	G4	S2		I	B

[1] = See Table 3.5 for S-rank and G-rank definitions
[2] = T (Threatened); E (Endangered); I (In Need of Conservation); X (Endangered Extirpated)
[3] = See Table 3.7 for Conservation Status definitions
* = a qualifier denoting the species is listed in a limited geographic area only

Fishes of Maryland

It is estimated that some several hundred species of fishes reside in Maryland's waters. This includes the Chesapeake Bay, Coastal Bays, Atlantic Ocean, and rivers, streams, lakes, and ponds, whether natural or artificial. Of this number, 34 are considered SGCN in Maryland, with an additional 15 on the SAPS list. The first few subsections of this section are spent describing the general state and requirements of all fishes in the state, whereas the latter subsections are dedicated to these 34 SGCN.

Various species of fishes reside in estuarine, marine, and/or freshwater environments, depending on their needs. Some fishes are residents of bays and estuaries, including hogchoker and northern pipefish. Anadromous fishes—those that utilize Maryland's freshwater for spawning but spend the rest of their life in saline or brackish waters—include striped bass, shad, and river herring. Other species (e.g., red drum, tautog, Atlantic croaker) spawn in marine waters but rely upon

Brook trout (Salvelinus fontinalis) (Kerry Wixted, MD DNR)

bays and estuaries for juvenile development. Purely marine species of fishes, such as bluefin tuna and marlin, tend to be highly migratory, traveling long distances during their life spans. Finally, some of the state's fish species are freshwater residents, such as brook trout *(Salvelinus fontinalis)* and mud sunfish *(Acantharchus pomotis).*

In addition to native species, numerous fishes have also been stocked in Maryland's streams for more than 170 years, including largemouth bass, brown and rainbow trout, and common carp (Boward et al. 1999). MD DNR Fishing and Boating Services (FABS) currently stocks a number of ponds, lakes, and streams with warm water species and stocks approximately 240,000 coldwater trout annually (MD DNR 2025a).

The Fishery Management Plan (FMP) Workgroup of the Chesapeake Bay Program (CBP) led the development of some of the first Chesapeake Bay-specific fish management plans guiding conservation of the major commercial, recreational and ecologically valuable fish species in the Bay, including shad and river herring (CBP 1989a), striped bass (CBP 1989b), and summer flounder (CBP 1991a). The latest full Fishery Management Plan includes updates for 27 FMPs encompassing 30 species (MD DNR 2025b). Fisheries management expanded to the ecosystem level when representatives from a number of organizations focused on the health of the Chesapeake Bay came together to develop a Fisheries Ecosystem Plan (Chesapeake Bay Fisheries Ecosystem Advisory Panel 2006). This Ecosystem Plan describes the structure and function of the Chesapeake Bay ecosystem, focusing on the interactions between key fisheries species in an effort to move beyond traditional fisheries management tools like controlling harvest limits. Based on this foundational plan, detailed ecosystem-based reports were developed for fisheries species and species groups including *Alosines* (i.e, shad) (MDSG 2011), striped bass (MDSG 2009a), and menhaden (MDSG 2009b).

The Atlantic States Marine Fisheries Commission (ASMFC), Mid-Atlantic Fishery Management Council (MAFMC), and National Marine Fisheries Service (NMFS) have also developed FMPs for numerous fishes that are found in the state's Atlantic Ocean, Coastal Bays, and Chesapeake Bay. These plans, addendums, amendments, and framework changes promote species conservation and habitat needs to achieve interstate management goals.

Marine and Estuarine Fishes

Maryland's marine and estuarine waters host a diverse array of fishes, with the Chesapeake Bay hosting 350 species of fishes, the Coastal Bays more than 140, and the Atlantic Ocean being home to hundreds more (MD DNR 2004b; Pyzik et al. 2004). Many marine species have existing FMPs that are used to guide their conservation (e.g., striped bass, spiny dogfish, and scup). Many questions on the status of forage species, trophic interactions, and the loss of critical spawning and nursery habitat also remain unanswered. Sharks, marlin, and tuna are highly migratory

species that move over large areas of the ocean and are not permanent residents of the state's marine waters. As a result, their management requires regional, national, and international (e.g., IUCN, CITES) partnerships. NMFS monitors the status of highly migratory species and has a fishery management plan (MD DNR 2025b) outlining conservation efforts for billfishes, sharks, tuna, and swordfish. This plan is amended regularly for management, conservation, and habitat needs.

Blackbanded sunfish (Enneacanthus chaetodon) (Tino Strauss)

Freshwater Fishes

MD DNR's Maryland Biological Stream Survey (MBSS) has sampled thousands of sites since 1995, compiling a robust inventory of the status and distribution of the nearly 100 freshwater fish species found in the state (MD DNR 2026b). The survey samples streams representing the four ecological stream types: Highlands Warmwater, Highlands Coldwater, Eastern Piedmont, and Coastal Plain. Eighteen species of freshwater fish were found to occur in all geographic regions. Coastal Plain streams had the most fish species (86), followed by Eastern Piedmont streams (72 species). The combined highlands had a total of 70 species. The most common fishes in Maryland's streams include the blacknose dace, blue ridge sculpin, mudminnow, creek chub, and tessellated darter. Rare species—many of which are SGCN, as discussed below—include blackbanded sunfish *(Enneacanthus chaetodon)*, ironcolor shiner *(Alburnops chalybaeus),* stonecat *(Noturus flavus),* and stripeback darter *(Percina notogramma).* MBSS continues to maintain the best available scientific information regarding population status, abundance, and distribution of nongame freshwater fishes in the state.

Non-native fishes have been widely introduced in Maryland dating as far back as 1854 (Smith & Bean 1899). Many introductions were made to establish and maintain recreational fisheries, while others resulted from the illegal release of unused bait, unwanted aquarium pets, or of fishes purchased from live seafood markets. At least 20–25 introduced fishes now inhabit Maryland's waters. In recent years, mimic shiner and bluehead chub, likely introduced as bait, have expanded in many tributaries to the Potomac River. Chesapeake channa (formerly known as northern snakehead) and blue catfish in particular have expanded widely throughout tributaries of the Chesapeake Bay. In response, as part of the Whole Watershed Program, MD DNR has implemented commercial and recreational harvest incentives to reduce numbers of these invasive species (MD DNR 2026c).

Fish SGCN of Maryland

Thirty-four fishes have been identified by the SWAP process as SGCN in Maryland (Table 3.16). Of these, for the sake of categorization, 21 are considered freshwater and 13 are considered marine or estuarine—though, as previously mentioned, a number of fishes in fact travel between fresh, saline, and/or brackish waters over the course of their life cycles. Two of these SGCN, the Atlantic *(Acipenser oxyrinchus)* and shortnose *(Acipenser brevirostrum)* sturgeons, are federally listed as Endangered. Fourteen fish SGCN are state-listed, 6 of which are

listed as Endangered, 3 as Threatened, 3 as In Need of Conservation, and 2 as Endangered Extirpated. Additionally, 11 are of national or international concern (IUCN 2026) and 28 are of conservation concern in the Northeastern U.S. region (Terwilliger & NFWDTC 2023). Any species that does not fall into one or more of these categories was designated as an SGCN due to concerns about declining populations, habitat loss, and/or other reasons. For additional ranks, see Appendices 3a and 3b.

In Maryland, sharks are found in the Atlantic Ocean, Coastal Bays, the Chesapeake Bay, and its larger tributaries. They use these areas for pupping, nurseries, and foraging. Sharks are slow growing, long lived, late maturing, and have long reproductive cycles which makes cooperative management of these migratory species important for conservation and responsible harvest.

Shark management tools (e.g., seasons, possession limits) are found in several FMPs. As a member of the Atlantic States Marine Fisheries Commission (ASMFC), the State of Maryland implements management measures found in the Interstate Fishery Management Plan for Coastal Sharks and the associated addendums in state waters (0–3 nautical miles). For the most part, that fishery management plan is complementary to federal management covering the exclusive economic zone (3–200 nautical miles) by the National Oceanic and Atmospheric Administration's (NOAA) Consolidated Atlantic Highly Migratory Species Management Plan. For some sharks, such as blue sharks, shortfin mako, and porbeagle, NOAA is the authority for managing binding Recommendations and non-binding Resolutions from the International Commission for the Conservation of Atlantic Tunas.

Sandbar shark (Carcharhinus plumbeus) (G.P. Schmahl, NOAA)

Shark SGCN that use Maryland waters are included in ASMFC and NOAA fishery management plans, which prohibit both commercial and recreational harvest. The Coastal Bays, particularly Chincoteague Bay, and lower Chesapeake Bay are known nursery areas for sandbar sharks (*Carcharhinus plumbeus*) (Wesche 1997). Atlantic angel (*Squatina dumeril*), dusky (*Carcharhinus obscurus*), sandbar, longfin mako (*Isurus paucus*), sand tiger (*Carcharias taurus*), whale (*Rhincodon typus*), and white (*Carcharodon carcharias*) sharks are found in the ocean. Longfin mako sharks are rare and reports of the filter feeding whale sharks are also rare but occasionally filter in from offshore anglers.

Though not technically fish, horseshoe crabs are treated as such in the SWAP due to their management needs; horseshoe crabs even have an FMP in Maryland, which is typically reserved for fish. Horseshoe crabs (*Limulus polyphemus*) move from the ocean into Chesapeake Bay and Coastal Bays from May through July. Some horseshoe crabs overwinter inshore, especially as juveniles. They spawn on sandy beaches on the new and full moon high tides. Spawning dates

are determined based on lunar phase and temperature; a minimum water temperature of 18 ˚C initiates spawning activity. Sandy beaches are critical habitat for spawning horseshoe crabs.

Horseshoe crabs ((Limulus polyphemus) (Dick Arnold)

Horseshoe crabs also play an ecological role in that horseshoe crab eggs provide sustenance for migrating shorebirds and fish. Migrating shorebirds use the horseshoe crab eggs as fuel to migrate north to the Hudson area from South America in order to nest. The migration distance is as long as 6,000 miles and the shorebirds can increase their weight to complete their migration in as little as two weeks.

Horseshoe crabs are managed by the ASMFC and are harvested for bait and biomedical uses. Horseshoe crab populations in the Delaware Bay region (which includes Maryland) have been characterized as stable to increasing, approaching historical high abundances last reached in the late 1990s. However, studies continue to show local declining populations in nearby areas and therefore continued need for concern (Crosby 2025).

Coastal waters serve as important habitat to Atlantic sturgeon and shortnose sturgeon. These fishes also frequent the Chesapeake Bay estuary and its tidal tributaries. These tidal waters are an important habitat for these species, utilized as adult spawning grounds and as juvenile nurseries. Atlantic sturgeon populations can spawn during spring and fall with a fall-spawning population of Atlantic sturgeon inhabiting Marshyhope Creek in the Nanticoke River basin. This fall-spawning life history strategy was previously unrecognized.

Hickory shad (*Alosa mediocris*) and American shad (*Alosa sapidissima*) congregate in large schools during the early months of spring. Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), which are collectively known as river, herring migrate long distances from the sea to spawn in freshwater. Together, these anadromous species utilize spawning habitats in both Coastal Plain and Piedmont streams of Maryland. Populations of these species remain depleted from historical levels due to a combination of habitat loss, stream blockages, overfishing, ocean bycatch, exposure to invasive predators, and pollution. Extensive restoration efforts including hatchery propagation and the removal of stream blockages, such as the removal of the Patapso River's Bloede Dam in 2018, have been largely successful at increasing their abundance in bay tributaries, especially that of hickory shad.

Congregating in large schools during the early months of spring, hickory shad (*Alosa mediocris*); American shad (*Alosa sapidissima*); and river herring, collectively alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), migrate long distances from the sea to spawn in freshwater. These anadromous species utilize spawning habitats in both Coastal Plain and Piedmont streams of Maryland. Populations of these species remain depleted from historical levels due to a combination of habitat loss, stream blockages, overfishing, ocean bycatch, exposure to invasive predators, and pollution (ASMFC 2020, 2024). Extensive restoration efforts

including hatchery propagation and the removal of stream blockages, such as the removal of the Patapsco River's Bloede Dam in 2018, have been largely successful at increasing their abundance in bay tributaries, especially that of hickory shad.

Coastal Plain streams and rivers support a variety of fish SGCN. In smaller Coastal Plain streams, the solitary and secretive mud sunfish lurks in slow water, hidden among soft substrate and submerged vegetation. Two additional SGCN fishes, blackbanded sunfish and banded sunfish *(Enneacanthus obesus)*, are perfectly adapted to the naturally low-oxygen, acidic blackwater swamps that characterize forested lowlands of the Eastern Shore. Ironcolor shiner and swamp darter *(Etheostoma fusiforme)* can also be found in these dystrophic habitats.

The Chesapeake logperch *(Percina bimaculata)*, a species described in 2008 (Near 2008), is a resident of the Susquehanna River and its larger tributaries, including Deer Creek. This species is a habitat generalist, and is equally at home in fast-flowing, cobble-strewn riffles in Piedmont streams as it is in slow, vegetated habitats common within the Coastal Plain. Although once known from the Potomac River, the distribution of the Chesapeake logperch now includes only the waters of the Upper Chesapeake Bay and the Lower Susquehanna River in Maryland and southeastern Pennsylvania.

From the Piedmont province and west, Maryland's fish SGCN are associated with higher-gradient streams with an abundance of cobble, gravel, and other coarse substrates. For example, the stonecat is a small, nocturnal catfish that seeks shelter during daylight hours under large submerged boulders. It is a species that was eliminated from a large portion of its historical range in western Maryland as a result of poor coal mining practices. Several more SGCN in this region are restricted to clean, coldwater habitats. For example, the mottled sculpin *(Cottus bairdii)* is a small, bottom-dwelling insectivorous fish found in high-gradient, coldwater streams of the Youghiogheny River basin. As a species that requires clean coarse substrate to spawn, the mottled sculpin tends to be especially susceptible to sedimentation. The longnose sucker *(Catostomus catostomus)*, a species that may be extirpated from the state, was once (and may still be) a coldwater Youghiogheny River dweller. Brook trout, a coldwater specialist that ranges from the Appalachian Plateau to the eastern Piedmont, prefers stream temperatures below 20ºC year-round to survive. SGCN of western Maryland also include checkered sculpin *(Cottus sp. 7)* and Allegheny pearl dace *(Margariscus margarita)*, two limestone stream specialists restricted to spring-fed streams flowing through the karst terrain of the Great Valley of Maryland near Hagerstown.

Threats to Fish SGCN

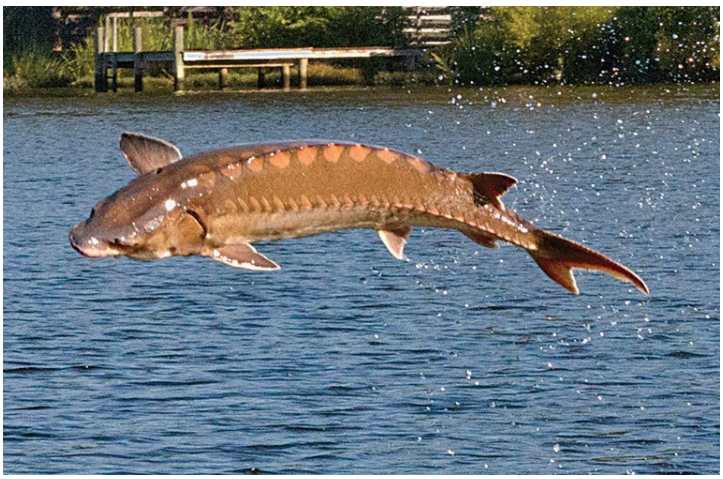
The dependence of fish SGCN on aquatic environments makes them vulnerable to negative inputs to streams, rivers, estuaries, and the Atlantic Ocean. For example, run-off from roads, impervious surfaces, and farm fields can directly contaminate SGCN habitats through inputs of road salt, oil, pesticides, herbicides, nutrients, and excessive fine sediments. All flowing water bodies are further influenced by upstream inputs, and accumulations of toxins, sediments, and nutrients can be particularly acute in large rivers and estuaries. Removal of trees from a watershed in general and especially from riparian areas can reduce the quality and quantity of fish habitat by increasing stream temperature, stream bank erosion, and decreasing instream woody debris, rootwads, and leaf litter. The influx of silt that often accompanies deforestation

can bury important spawning and feeding habitats, negatively affecting SGCN like stripeback darter and mottled sculpin.

Any changes in pH, temperature, and turbidity from acid mine drainage, livestock grazing, urbanization, and other sources can make habitats unsuitable for fish SGCN. For example, brook trout, the only trout species native to Maryland, are particularly sensitive to temperature changes that occur when forest cover is removed. This species has suffered drastic population declines, in eastern Maryland especially. As a species that thrives in cold water, their population decline is attributed to runoff from roofs, roadsides, and other impervious surfaces; loss of trees along streams; and climate change.

Human activities in or near aquatic environments can adversely affect SGCN and their habitats. Bridge construction and demolition, dredging, and vessel strikes have adversely affected SGCN of large rivers such as the shortnose and Atlantic sturgeons and can impact spawning runs of shad, river herring, and other migratory fishes (Litwiler 2001). Similarly, the practice of stream ditching and channelization, common on the Delmarva Peninsula, can adversely impact SGCN like mud sunfish. Surface and groundwater withdrawals for drinking water and irrigation are an increasing threat to stream and river habitats, especially in rapidly urbanizing areas. Dams and other barriers to fish passage (e.g., road culverts) isolate populations and disrupt the habitat connectivity that many resident and migratory fishes require to remain a viable part of Maryland's fauna. These barriers prevent the upstream and downstream movement of fishes in response to stressors and may hinder their ability to adapt to altered flow and temperature regimes expected with climate change.

Pesticide applications, such as those for mosquito control, can reduce aquatic prey species important to many fish SGCN. There are emerging contaminants such as forever chemicals (e.g., PFAS) as well as contaminants associated with the breakdown of tires (e.g., 6PPD- quinone) that are of growing concern regarding their impacts to aquatic organisms.



Atlantic sturgeon (Acipenser oxyrinchus) (Stan Belback)

Overharvest has particularly affected populations of shad, river herring, sharks, and sturgeon. For example, many sharks were overharvested when commercial fishermen were encouraged to target them in the 1980s, and some species are still considered overfished today: sandbar sharks and dusky sharks *(Carcharhinus obscurus)* remain classified as overfished in the most recent NOAA Fishery Stock Statue Update (NOAA 2025). Management rebuilding tools such as fisheries management plans, stock assessments, surveys, moratoriums, and fish passage are part of the solution, although life history and environmental factors can also affect recovery time. For example, shark populations can take a long time to recover because of

their reproduction strategies, fishing mortality (e.g., dusky shark), lack of scientific data, and lack of funding.

Additionally, species introduced for sport, mosquito control, or other means (e.g., bait bucket introductions, released pets) can impact fish SGCN through direct competition and predation. Other non-native, invasive species like the zebra mussel and blue catfish have the capacity to alter the structure and function of aquatic food webs directly and indirectly, affecting fish SGCN and their habitats. Aquatic invasive species are a major threat to fish SGCN, though progress has been made and continues to be made in this area.

Conservation Actions and Information Needs for Fish SGCN

For the effective conservation of fish SGCN, threats to aquatic habitats must be addressed at both local and landscape scales. This is true for headwaters to large rivers, the Chesapeake and Coastal Bays, and the Atlantic Ocean. Minimizing or eliminating stressors that affect aquatic habitats are possible through better land use planning, improved stormwater management, reduction of impervious surfaces, mitigation of acid mine drainage, improved wastewater treatment, improved agricultural and forestry practices, reduction of pesticide use, and maintenance and improvement of riparian buffers. Careful planning to limit the location and extent of deforestation, urbanization, and nutrient inputs is needed to conserve functioning watersheds. The ecological impacts of surface and groundwater withdrawals should be better assessed and research should be conducted to quantify the minimum flow requirements of each fish SGCN. Maps of groundwater and hydrological systems could assist with determining potential impacts and planning restoration activities. Human-made dams should continue to be removed wherever possible. When removal is not an option, fish passage should be improved with ladders or other techniques. Coordination and planning with state and county highway departments should be increased to replace undersized or faulty road culverts and encourage state-of-the-art stream crossing designs that reduce stream alterations and improve connectivity of SGCN habitats.

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

To restore Atlantic sturgeon, shad, and river herring in the Chesapeake Bay, MD DNR FABS uses a combination of closed fishery, removal of barriers to spawning grounds, and water quality improvements. MD DNR also supplements shad and river herring populations using hatchery-produced fish. Information regarding threats and conservation actions for these fishes can be found in the Fishery Management Plan for Atlantic Sturgeon by the Atlantic States Marine Fisheries Commission (ASMFC 1998) and subsequent addenda, as well as Maryland's regional American Shad Habitat Plan (Bourdon 2021). This is in addition to the original Interstate Fishery Management Plan for American Shad and River Herring and associated amendments, which

include compliance and monitoring requirements for states (ASMFC 1985, 1999, 2009, 2010). Federal recovery plans exist for Atlantic and shortnose sturgeon (Table 3.15).

Table 3.15 Existing federal recovery plans for fish SGCN

Fish Species	Federal Recovery Plan	Recent Action
Atlantic sturgeon	NOAA Fisheries 2018	2022: Finalized 5-year review
Shortnose sturgeon	NOAA Fisheries 1998	2010: Biological assessment

Table 3.16 Fish SGCN in Maryland

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Alewife	*Alosa pseudoharengus*	G5	S5			C
Allegheny pearl dace	*Margariscus margarita*	G5	S2S3		I	B
American brook lamprey	*Lethenteron appendix*	G4	S2		T	B
American shad	*Alosa sapidissima*	G5	S3			C
Atlantic angel shark	*Squatina dumeril*	GNR	SNR			D
Atlantic sturgeon	*Acipenser oxyrinchus*	G3	S1	E	E	A
Banded sunfish	*Enneacanthus obesus*	G5	S3S4			C
Blackbanded sunfish	*Enneacanthus chaetodon*	G3	S1		E	A
Blueback herring	*Alosa aestivalis*	G3G4	S5			C
Bridle shiner	*Notropis bifrenatus*	G3	SH		X	E
Brook trout	*Salvelinus fontinalis*	G5	S3S4			C
Checkered sculpin	*Cottus sp. 7*	G4Q	S2			B
Chesapeake logperch	*Percina bimaculata*	G1G2	S1S2		T	A
Comely shiner	*Notropis amoenus*	G5	S3			C
Dusky shark	*Carcharhinus obscurus*	G3	SNR			D
Flier	*Centrarchus macropterus*	G5	S2S3		I	B
Glassy darter	*Etheostoma vitreum*	G4G5	S2		T	B
Hickory shad	*Alosa mediocris*	G4	S3			C
Horseshoe crab	*Limulus polyphemus*	G5	S3			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Ironcolor shiner	*Alburnops chalybaeus*	G4	S1		E	A
Johnny darter	*Etheostoma nigrum*	G5	S3			C
Longfin mako	*Isurus paucus*	G2G3	SNR			D
Longnose sucker	*Catostomus catostomus*	G5	SX		X	E
Mottled sculpin	*Cottus bairdii*	G5	S4			C
Mud sunfish	*Acantharchus pomotis*	G4G5	S3			C
Sand tiger shark	*Carcharias taurus*	G3G4	SNR			D
Sandbar shark	*Carcharhinus plumbeus*	G4	SNR			D
Shield darter	*Percina peltata*	G4	S3S4			C
Shortnose sturgeon	*Acipenser brevirostrum*	G3	S1	E	E	A
Stonecat	*Noturus flavus*	G5	S1		E	A
Stripeback darter	*Percina notogramma*	G4	S1		E	A
Striped shiner	*Luxilus chrysocephalus*	G5	S1S2		I	A
Swamp darter	*Etheostoma fusiforme*	G5	S3			C
Whale shark	*Rhincodon typus*	G4G5	SNR			D
White shark	*Carcharodon carcharias*	G2	SNR			D

[1] = See Table 3.5 for S-rank and G-rank definitions
[2] = T (Threatened); E (Endangered); I (In Need of Conservation); X (Endangered Extirpated)
[3] = See Table 3.7 for Conservation Status definitions

Invertebrates of Maryland

Though small in size, invertebrates account for the majority of Maryland's wildlife diversity and exert an outsized influence on ecological processes. More than 10,000 named arthropod and mollusk species are known from Maryland, with additional species documented each year. Although not SGCN, the blue crab and eastern oyster are among Maryland's most recognizable invertebrates, forming the state's two most valuable commercial fisheries (NOAA 2024). That being said, the ecosystem services of invertebrates far surpass the value of any extractive industry.

Biological control of crop pests provided by invertebrates in the United States has been valued at approximately $6 billion, while the economic value of invertebrate-driven decomposition is estimated at roughly $500 million (Losey & Vaughan 2006). Pollination services of crops in Maryland alone have been estimated to be worth over $15 million (Patch et al. 2021). Furthermore, by sustaining bird populations, invertebrates can be estimated to contribute approximately $282 million annually to Maryland's economy through birdwatching activities

(Losey & Vaughan 2006; USFWS & USCB 2011). Invertebrates also play a critical role in environmental monitoring and water quality; one group, freshwater mussels, even directly improves water quality. For example, in the Susquehanna River watershed, it has been found that mussels denitrify approximately 10,000 pounds of nitrogen annually (Wood et al. 2021).

Despite their economic and ecological value, invertebrates in Maryland are not nearly as well-studied as vertebrates. This is due to the overwhelming number of invertebrate species, limited number of taxonomic specialists, and the complexities of the ecological communities of which they are an integral part. However, since the last SWAP revision in 2015, there have been significant advances in invertebrate conservation, including improved understanding of species distributions and conservation needs. This increased attention is partly driven by growing concern over widespread insect abundance declines—around 1% population loss per year—often referred to as the "insect apocalypse" (Wagner et al. 2021).

More optimistically, increased attention to invertebrate conservation has also been driven by growing public interest. Unlike many threatened species, invertebrates are readily observed even in highly urbanized environments and comprise a substantial proportion of community science records. The Maryland Biodiversity Project (MBP) was established as a nonprofit in 2012 to document Maryland's plant and wildlife diversity by combining expert-vetted iNaturalist records with additional verified observations to produce comprehensive sub county-level species lists. In recent years, a dedicated group of MBP volunteers, ranging in age from 15 to over 60, have rediscovered species absent from Maryland's records for decades, especially in more remote areas such as Garrett County. Close collaboration between the MD DNR NHP and MBP has proven essential for maintaining up-to-date assessments of invertebrate population health.

Although Maryland is a relatively small state, its wide variety of ecosystems and habitats supports some of the highest plant species densities in the country, with roughly one-third classified as rare, Threatened, or Endangered—a high proportion compared to neighboring states with much larger land areas (Maryland Botanical Heritage Work Group 2014; Kartesz & BONAP 2015). This diversity is largely due to Maryland's central latitude, where northern and southern species overlap, as well as the state's wide range of elevations and geologic regions. Because invertebrates are closely associated with plants, the state's diverse habitats also support a correspondingly high number of rare invertebrate species.

Maryland's rare invertebrates are particularly associated with wetland/riparian and barren habitats in both upland (i.e., Piedmont and Appalachian Plateau) and lowland (i.e., Coastal Plain) physiographic provinces. For example, important lowland wetland Key Wildlife Habitats (KWHs) for invertebrates include Coastal Plain Seepage Acidic Fen, Delmarva Bay, and Tidal Freshwater Marsh and Shrubland; important lowland barrens include the Coastal Plain Oak-Pine Forest, Coastal Bluff, and Maritime Dune and Grassland. For upland physiographic provinces, important wetland/riparian habitats include Montane Acidic Fen, Coldwater Stream, and Highland Stream; important upland barren habitats include Serpentine Barren, Shale Barren, and Cliff, Talus, and Rock Outcrop. Other habitats are also important, but most of Maryland's rare invertebrate species are found in upland or lowland areas and in wetlands or barrens. More information about these KWHs and their species associations can be found in Chapter 4.

Counterintuitively, one additional ecosystem category of particular importance is human-influenced habitats such as the Artificial Barren, Managed Grassland, Roadside and Utility Right-of-Way, and Urban and Suburban Greenspace KWHs. Highly disturbed areas prevent natural succession, sustaining barren and grassland habitats and preserving species that might otherwise be lost to canopy closure. However, human-influenced habitats are also particularly susceptible to anthropogenic threats, such as pesticide use and invasive species.

Left: *A monarch caterpillar on a milkweed plant* (Richard Orr); **Right**: *A monarch butterfly* (Orr)

Invertebrate SGCN of Maryland

There are 259 invertebrates listed as SGCN in the 2025 SWAP revision, making up more than one quarter of Maryland's SGCN list; not counting plants, invertebrates account for nearly half of the SGCN list. Sixty-three invertebrate SGCN in 2025 are legally listed in Maryland (COMAR 08.03.08). Regionally, 82 Maryland SGCN are also listed or proposed to be listed as Regional Species of Greatest Conservation Need (RSGCN) or Assessment Priority species by the Northeast Association of Fish and Wildlife Agencies (NEAFWA) (TCI & NEFWDTC 2023); these species are referred to as being "of regional concern" for the remainder of this section, regardless of whether their statuses are confirmed or merely proposed. Globally, 68 SGCN are ranked G3 (globally vulnerable) or rarer by NatureServe; these species are referred to as being "globally rare" for the remainder of this section.

Seven invertebrate SGCN are federally protected or proposed to be protected. The rusty-patch bumble bee (*Bombus affinis*) and dwarf wedgemussel (*Prolasmidonta heterodon*) are federally listed as Endangered. The Puritan tiger beetle (*Ellipsoptera puritana*), yellow lance (*Elliptio lanceolata*), and eastern beach tiger beetle (*Habroscelimorpha dorsalis dorsalis*) are federally listed as Threatened. The Bethany Beach firefly (*Photuris bethaniensis*) and green floater (*Lasmigona subviridis*) are currently Proposed Threatened by the U.S. Fish and Wildlife Service (USFWS). The monarch butterfly is also proposed to be listed as Threatened by USFWS. However, while the monarch occurs in Maryland and faces a number of threats, it is still a fairly widespread migrant and breeder in the state, leading to its removal from the SGCN list and placement on the State Assessment Priority Species (SAPS) list for additional research and inventory.

In 2015, there were 350 invertebrate species listed as SGCN. This apparent reduction in SGCN to 259 species is due to a new category, the aforementioned SAPS list, introduced in the 2025

SWAP revision. There are 780 invertebrate SAPS in 2025, bringing the total assessed number of invertebrate species in the Maryland SWAP to 1,039. The process for assigning SGCN versus SAPS differed slightly for invertebrates due to the large number of species assessed. To be designated as an SGCN, sufficient information was required on a species' distribution, habitat, and specific actionable threats. Species known to be rare but lacking information in one or more of these areas were instead assigned to the SAPS list instead.

Broad threats affecting an entire taxonomic group were not sufficient on their own for listing a species as an SGCN. For example, a rare moth was not designated as an SGCN solely because moths are generally affected by light pollution. However, when a species' distribution and habitat were well understood and the species was documented near a light pollution source, the species could be listed as an SGCN with a targeted conservation action of reducing light pollution in that specific area. Application of this protocol resulted in 118 species being moved from the 2015 SGCN list to the 2025 SAPS list, including some species with existing state legal protection. Placement on the SAPS list does not impact a species' legal status. Rather, it allows survey and conservation efforts to be better prioritized. This approach ensures that species designated as SGCN are accompanied by clearly defined conservation actions. Because of this taxonomic group's outsized presence on the SAPS list, depending on the subgroup in question, SAPS are therefore addressed in this section in more detail than in other sections of this chapter.

Fifty-one invertebrate species were removed in the 2025 SWAP revision compared to the 2015 SWAP revision. Eleven species were removed because of no historical records of occurrence in the state. Twenty-five were removed due to extirpation. Twelve were removed due to being more common and widespread across their range than previously known. Three other species were removed for being vagrants or because of changes in taxonomy.

All species known to occur in Maryland within 13 invertebrate taxonomic groups were evaluated for listing in the 2025 revision. These groups were: dragonflies, damselflies, stoneflies, caddisflies, freshwater mussels, cave and groundwater invertebrates, butterflies, macro-moths, bees, hoverflies, fireflies, and tiger beetles. These groups were able to be fully assessed due to extensive surveys, high detectability, substantial prior research, and/or available expertise. These taxa comprise the majority of listed species, although select species from other groups were included based on expert review and existing information.

Aquatic Invertebrate SGCN: Dragonflies and Damselflies (Odonates)

Considerable progress has been made over the past few decades in determining the status, distribution, and habitat association of odonates (i.e., insects in the order *Odonata*). This is due in large part to recent publications of excellent field guides and a surge in interest among amateur naturalists. Alongside the efforts of MBP, an odonate expert and a group of dedicated naturalists track and update odonate county records each year. Additionally, the recent publication of "Status of Odonata on the

Little blue dragonlet (Erythrodiplax minuscula) (Judy Gallagher)

Delmarva Peninsula" (White et al. 2024) has provided a comprehensive assessment of damselflies and dragonflies on Maryland's Eastern Shore.

Today, at least 186 odonate species have been recorded in Maryland and almost half are listed as either SGCN (47 species) or SAPS (37 species). Many odonates have highly restricted ranges and stringent habitat requirements, and some are associated with rare, unique, and/or high-quality aquatic habitats, such as pristine headwater streams, forested seepage wetlands, montane rivers, and Delmarva Bays. Among the state's odonate SGCN are 6 globally rare species, 8 species with state legal protection, and 20 species are of regional concern. As a group, few other animal taxa have such a high proportion of species warranting conservation attention, perhaps reflecting, in part, the degraded condition of their freshwater habitats.

Aquatic Invertebrate SGCN: Mayflies, Stoneflies, and Caddisflies (EPT: Ephemeroptera, Plecoptera, Trichoptera)

Mayflies (order Ephemeroptera), stoneflies (order Plecoptera), and caddisflies (order Trichoptera), often referred to as "EPT," are very sensitive to pollution, sedimentation, and other forms of habitat degradation, so they are important biological indicators for water quality. Through the Maryland Biological Stream Survey (MBSS), the state's stratified random stream sampling program, we have a relatively robust understanding of EPT communities in first- through fourth-order streams. Still, EPT identification, especially to species level, requires specialized taxonomic training which can pose formidable challenges to documenting species distribution, habitat, threats, and conservation needs. Fortunately, a recent study incorporating new survey work (Hogan & Grubbs 2022) has provided an extensive assessment of stoneflies in Maryland, including seven new state records. Additionally, Andy Rasmussen of Florida A&M University maintains a distributional checklist of Nearctic Trichoptera (Rasmussen & Morse 2023), which was recently expanded upon with additional records (Hogan et al. 2025). Unfortunately, we do not yet have a comprehensive understanding of mayfly species occurrences in Maryland and were therefore unable to fully assess this taxonomic group. However, select mayfly species were included based on expert opinion and records from the MBSS.

Maryland hosts 122 stonefly species with eight listed as SGCN and 22 listed as SAPS. Of these, 11 are of regional concern and 12 are ranked globally rare by NatureServe. One hundred seventy-two species of caddisfly are found in Maryland, of which 29 are listed as SAPS. Seven Maryland caddisflies are of regional concern and 15 are globally rare. While we do not have complete information for mayflies, Maryland hosts at least 85 species. Fifteen of these are listed as SAPS. Nine of the mayflies are of regional concern and two are globally rare. Because mayflies are difficult to reliably identify from photographs, future assessments will need to rely on collected specimens rather than citizen science projects like MBP.

Aquatic Invertebrate SGCN: Freshwater Mussels

Freshwater mussels belong to the order *Unionoida*, a group of bivalves comprising 998 species worldwide (Graf & Cummings 2021). They are distinguished from other orders of bivalves by a pearly nacre on the inside of the shells, a lack of byssal threads used to permanently attach themselves to hard substrate, and a parasitic larval stage that requires a host fish to complete their reproductive cycle. North America supports the second highest diversity of freshwater mussels with 307 species. Most of this diversity lies in the southeastern United States. Maryland

is positioned near the northeastern edge of this region, in a transition area between the South and North Atlantic faunal regions, with 16 native and at least two non-native species of freshwater mussels (Haag 2010).

In addition to having unique reproductive cycles, freshwater mussels have evolved a variety of morphological and behavioral adaptations, such as shell sculpturing and mantle lures. They also play a critical role in aquatic ecosystems by serving as prey for numerous aquatic and terrestrial species; performing particle filtration, nutrient sequestration, and recycling; and modifying habitats, especially when found in dense aggregations known as mussel beds (Vaughn 2018). Empty mussel shells also provide physical habitat for other aquatic organisms as well as long-term storage and release of nutrients and minerals.

Studies and status assessments have revealed alarming declines in freshwater mussels. In the United States, over 70% of the approximately 300 species are declining, threatened, endangered, or extinct (Williams et al. 1993). A similar pattern holds in Maryland, where 13 of the state's 16 native species are identified as SGCN and one species (Atlantic spike *[Elliptio producta]*) is identified as SAPS due to taxonomic uncertainty. These include eight globally rare species and seven state-listed species. At both the state and national level, freshwater mussels represent one of the most imperiled faunal groups (Strayer et al. 2004). Their decline is an indication of their sensitivity to many factors, especially pollution and habitat loss (Downing et al. 2010), along with the condition of many of our streams and rivers.

Triangle floater (Alasmidonta undulata)
(James McCann, MD DNR)

Since 1990, MD DNR NHP and MD DNR Monitoring and Non-tidal Assessment Division (MANTA) have conducted more than 1,500 freshwater mussel surveys in streams, rivers, and impoundments throughout the state (Bogan et al. 2026). These data, along with intensive population monitoring for some high priority species, have provided essential information for conducting species status assessments, identifying important mussel habitat, and prioritizing conservation actions. Presently, three species are state-listed as Endangered, including the dwarf wedgemussel, which is also federally listed as Endangered. Among the most imperiled species are brook floater *(Alasmidonta varicosa)* and green floater. Both are state-listed as Endangered and have been recently considered for federal listing. Although they were once fairly widespread in rivers of the Piedmont and Ridge and Valley physiographic regions, only a few small populations of each species remain; similar declines have been observed in surrounding states. Yellow lance is state- and federally listed as Threatened. It was not known to be extant in Maryland when the 2015 SWAP revision was written because of unresolved taxonomic relationships within the lance-shaped *Elliptio* species. The triangle floater *(Alasmidonta undulata)* was recently downlisted in Maryland from Endangered to Threatened. Although it is typically found in very low numbers, it is fairly widespread in Maryland, occurring from the Delmarva peninsula to the Ridge and Valley. Two other species, the Atlantic spike and creeper (*Strophitus undulatus),* are state-listed as In Need of Conservation. As previously mentioned, though it may be state-listed, the Atlantic

spike has been moved to the SAPS list for the 2025 SWAP revision due to recent concerns about its taxonomic validity versus the closely related northern lance *(Elliptio fisheriana).*

Case Study: Planting Trees and "Planting" Mussels

As a tree's canopy spreads over a stream and its roots anchor into the soil, humans and wildlife alike reap the benefits. These include cleaner water through erosion and runoff control, cleaner air through leaves' absorption of carbon dioxide and other particles, and food, shelter, and shade for all life forms. These living, breathing filters benefit the terrestrial habitat and the aquatic habitat. One group that benefits from tree-lined waterways are freshwater mussels.

Town Creek (Matt Ashton, MD DNR)

Due largely to loss and degradation of habitat, more than 70% of mussels in the U.S. are extinct, endangered, or in decline. The best remaining mussel populations occur in relatively intact streams in predominantly forested watersheds. Multiple studies have found diverse mussel populations and rare mussel species correlate with the presence of forested streamside, or riparian buffers.

Collaborating in the Town Creek Watershed

MD DNR's Forest Service (MFS) works with private landowners to get trees in the ground for stream restoration projects that support habitat for sensitive species, like mussels and Brook trout. MFS been planting riparian forest buffers in the Town Creek watershed since 1997 thanks to supportive landowners and funding from the U.S. Environmental Protection Service (EPA). The Town Creek Ecosystem Management Project was funded through a Special Rivers Project grant, eventually expanding to most of Allegany County. More than 100,000 linear feet and 327 acres of buffers have been planted so far by forestry staff and partners. Today, streamside forests along Allegany County waterways stabilize banks and reduce runoff, providing stable stream bottoms required by native mussel species.

Following the success of the Forest Service's riparian forest buffer project at improving stream health, staff from MD DNR's Wildlife and Heritage Service (WHS) and Resource Assessment Service (RAS) began planning for release of freshwater mussels in Town Creek in 2015 with the revision of Maryland's previous SWAP, which recognized a need for restoration.

In the summer of 2020, staff "planted" 116 individually marked, hatchery-propagated brook floater in stream bottom enclosures in portions of the creek where riparian buffers had been established. After two months, there was 99% survival among the small mussels, and they'd grown up to a tenth of an inch. Unfortunately, a major flood happened in the river valley a month later and washed away most of the enclosures and their mussels. Encouraged by the initial

Brook floater (Alasmidonta varicosa)
(Matt Ashton, MD DNR)

results, MD DNR repeated the study in 2021 with another 125 brook floater and observed the same pattern. After three months, 98% of the mussels survived and had grown about a tenth of an inch. In the following spring, only one more mussel had died, indicating they grew enough to survive through the winter when food, like phytoplankton, is scarce. From 2022 to 2023, another 373 brook floater were stocked, and 85 of these at least once during annual surveys.

Other studies to culture freshwater mussels in a MD DNR hatchery, develop a mussel restoration plan framework, and conduct a reintroduction of a common species of mussel (eastern elliptio) were all necessary before committing resources to larger restoration projects like the one in Town Creek. This work also required a range of partners to be successful, including Trout Unlimited, Pennsylvania Fish and Boat Commission, and the Virginia Fisheries and Aquatic Wildlife Conservation Center at Harrison Lake National Fish Hatchery.

Freshwater mussels play an important role in streams. One adult mussel can filter 10–15 gallons of water a day, and their presence has been linked to healthy aquatic communities. According to one study (Hoellein et al 2017), a typical mussel population of a stream could remove 56 kilograms of nitrogen per day. With some mussels able to live for decades, these ecosystem services can have enormous effects on Maryland's waters. Just as trees cool and clean runoff from the landscape, mussels can help play a role in cleaning streams. Ultimately, the goal is to restore a healthy, self-sustaining mussel community that will help overall stream health in Town Creek and bring downstream benefits to the Potomac River, and eventually the Chesapeake Bay.

Cave and Groundwater Invertebrate SGCN

This highly diverse group comprises 24 SGCN and 25 SAPS. All are obligate subterranean species that are restricted to cave habitats and/or shallow groundwater springs and seeps (i.e., hypotelminorheic habitats). Most species are aquatic, occurring in cave drip pools, phreatic (groundwater) pools, subterranean streams, shallow groundwater aquifers, and associated spring and seep emergences. Their greatest diversity lies in karst-dominated areas in western Maryland, followed by the Piedmont and the Fall Zone, where the Piedmont abruptly transitions into the Upper Coastal Plain. Most are troglomorphic, meaning they exhibit physical adaptations to subterranean life, such as reduced eyes and pigment. Caves and other subterranean habitats are extremely fragile and subject to numerous threats that could permanently alter or eliminate them.

Franz's cave amphipod (Caecidotea franzi)
(Dan Feller, MD DNR)

This group includes many of the state's rarest, most imperiled species, including at least eight Maryland endemics. The group is represented by 32 crustaceans, 10 flatworms or planarians, 5 spiders, a beetle, and a springtail. Of the 49 species, 26 are globally rare and 19 have state legal protection. Unfortunately, one species, Norden's groundwater isopod (*Caecidotea nordeni*), has been determined to be extirpated after extensive searches failed to relocate the species at the initial location or any other sites. It has therefore been removed from the SGCN list for the 2025 SWAP revision.

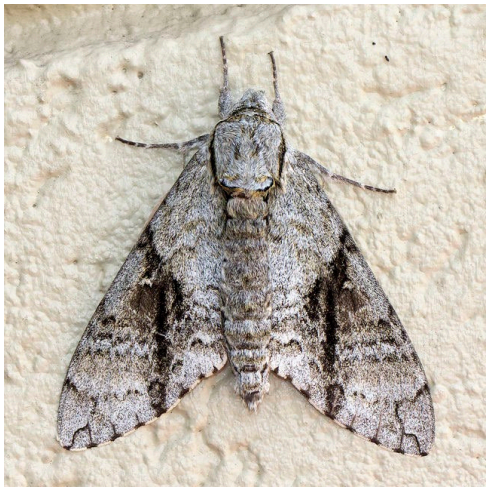
Terrestrial Invertebrate SGCN: Butterflies

Butterflies are one of the most surveyed invertebrate taxa in Maryland. As highly conspicuous pollinators, they are well represented on community science platforms such as iNaturalist. Similar to odonates, MBP and other naturalists monitor rare butterfly populations annually, providing a strong understanding of population status and trends. For example, a group of naturalists conducts butterfly counts in Green Ridge State Forest twice a year to track shale barren–associated species.

One hundred and fifty-nine species of butterfly have been found in Maryland with 27 listed as SGCN and 25 listed as SAPS. Of these, 20 are of regional concern, 8 are ranked globally rare by NatureServe, and 17 have state legal protection. Six species were removed from the 2025 SWAP revision, due to either never occurring in Maryland, being extirpated, being a vagrant or stray, or being more common than previously known.

Terrestrial Invertebrate SGCN: Moths

The most substantial invertebrate update in the 2025 SWAP revision is the comprehensive assessment of eight macro-moth families in Maryland (Noctuidae, Geometridae, Sphingidae, Saturniidae, Notodontidae, Lasiocampidae, Drepanidae, and Erebidae). This effort was made possible by the availability of extensive resources, including "Macromoths of Maryland: An Annotated List" (Glaser et al., unpublished, 2005), Bob Patterson's Moth Photographers Group (2026), data from the North Carolina Biodiversity Project moth database (Hall et al. 2026), and the continued inventorying efforts of MBP volunteers.



Ash sphinx (Manduca jasminearum)
(Mike Burchett, MBP)

To date, at least 2,704 moth species have been recorded in Maryland. Of these, 268 species are designated as SAPS due to their apparent rarity and 43 species are listed as SGCN. Twenty-two species are ranked globally rare and 19 are of regional concern. Sixteen moth species have been removed from the 2025 revision for being extirpated. Thirteen moth SGCN are considered ash-dependent and are therefore threatened by the decline of *Fraxinus* species caused by the invasive emerald ash borer (*Agrilus planipennis*).

Terrestrial Invertebrate SGCN: Bees

A comprehensive assessment of Maryland bees represents the second-most substantial invertebrate update in the 2025 revision. Maryland is fortunate to host the United States Geological Survey (USGS) Bee Lab at the Eastern Ecological Science Center within the Patuxent Wildlife Research Refuge. This lab is one of the premier bee data collection and identification centers in the country. Bees from across the United States are processed, identified, and added to the database at the USGS Bee Lab. These records are made publicly available through DiscoverLife.org (Ascher & Pickering, 2020). A key resource used for the SWAP assessment is a soon-to-be-published manuscript from the USGS Bee Lab detailing every bee species found in Maryland and associated conservation actions (Droege et al., in preparation).

Maryland is host to 409 species of bees, 46 of which are listed as SGCN and 141 as SAPS in the 2025 SWAP revision. Seven of these bee species are considered globally rare and 18 are of regional concern. One species, the rusty-patch bumble bee, is both federally and state-listed as Endangered due to its rediscovery in Garrett County in 2022 after no records for 20 years. Three species were removed from the 2025 revision due to extirpation. One additional species, the marine metallic-sweat bee, was removed due to being more common than previously known and apparently secure.

Terrestrial Invertebrate SGCN: Hoverflies (Syrphidae)

The family Syrphidae was evaluated as a taxonomic group for the first time in the 2025 SWAP revision. Commonly known as hoverflies or flower flies, syrphids provide important ecosystem services, including pollination by adults and biological control by larvae. Some species are relatively conspicuous and are frequently detected during flower surveys targeting bees, while others feed on sap or decaying vegetation and are more difficult to detect. A key resource for assessing Syrphidae in Maryland was the syrphid database housed in the Canadian National Collection of Insects, Arachnids, and Nematodes, assembled in support of the *Field Guide to the Flower Flies of Northeastern North America* (Skevington et al. 2019).

At least 184 syrphid species are known to occur in Maryland. Of these, only one species, the painted wood fly (*Blera pictipes*), is listed as an SGCN, while 74 are listed as SAPS, four of which are considered globally rare.

Terrestrial Invertebrate SGCN: Fireflies

Fireflies were also evaluated as a taxonomic group for the first time in the 2025 SWAP revision. In recent years, interest in firefly conservation has increased substantially, driven in part by public concerns over population decline. We have substantially greater understanding of firefly distribution and ecological needs in Maryland due to closer coordination between states through the Xerces Society for Insect Conservation Firefly Working group and a two-year statewide survey of Maryland parks. Identification remains

Bethany Beach firefly (Photuris bethaniensis) (Jason Davis, DNREC)

challenging without specimens and flash patterns, but ongoing development of morphology-based identification resources is expected to support future assessments.

Maryland hosts at least 30 species of fireflies, five of which are listed as SGCN and 16 of which are listed as SAPS. At least six are globally rare and nine are of regional concern. The Bethany Beach firefly was proposed for listing as Threatened under the Endangered Species Act in 2024.

Terrestrial Invertebrate SGCN: Tiger Beetles

Maryland hosts 27 species and subspecies of tiger beetles, 10 of which are SGCN and five of which are SAPS in the 2025 SWAP revision. This relatively well-known beetle group includes seven globally rare taxa, all of which also have state legal protection and are considered of regional concern. Two are also federally listed as Threatened (Puritan tiger beetle and eastern beach tiger beetle). Tiger beetles as a group occur in a variety of habitats, but each of the rare species is highly habitat-specific, requiring highly dynamic habitats whose existence depends on disturbance regimes. These habitats include naturally eroding earthen cliffs along the Chesapeake Bay, pristine coastal beaches, and fire-dependent sandy pine-oak woodlands.

Other Invertebrate SGCN of Maryland

Every species known to be in Maryland of the above taxa were assessed for the 2025 SWAP revision. Several additional taxa groups could not be fully investigated, though they were included selectively due to known conservation concerns. As noted above, the 15 mayflies designated as SAPS fall into this category.

Beyond the fully assessed groups, 11 beetle SGCN and 24 beetle SAPS were identified. Four of these beetles have state legal protection: the Seth Forest water scavenger beetle (*Hydrochus spangleri*), a vernal pool obligate known from only two sites on the Eastern Shore; the six-banded longhorn beetle (*Dryobius sexnotatus*), which may be an old growth sugar maple specialist; and two darkling beetles (family Tenebrionidae), *Helops cisteloides* and *Schoenicus puberulus*, which are restricted to inland sand ridge oak–pine woodlands on the lower Eastern Shore. Other listed beetles include ash specialists, chestnut specialists, lady beetles, and aquatic beetles.

In the insect order Hemiptera, three SGCN and two SAPS were identified, including the state-endangered and globally rare eastern sedge barrens leafhopper (*Limotettix minuendus*). For ants, one SGCN (an ash specialist) and 16 SAPS were identified. Within wasps, 67 SAPS were identified across the families Crabronidae, Vespidae, and Sphecidae. For flies, five SGCN and two SAPS were included, representing bee flies (Bombyliidae), ash gall formers, and pitcher plant specialists. Five mite species—largely pitcher plant or ash specialists—and one ash-specialist sawfly were also listed. In total, 28 ash-specialist invertebrates were listed as SGCN.

This SWAP revision also includes six land snail SGCN and seven land snail SAPS. Seven of these species are globally rare, seven are of regional concern, and four have state legal

Cherrystone drop (Hendersonia occulta)
(Timothy Pearce, Carnegie Museum of Natural History)

protection: the Appalachian springsnail (*Fontigens bottimeri*), Blue Ridge springsnail (*Fontigens orolibas*), cherrystone drop (*Hendersonia occulta*), and Maryland glyph (*Glyphyalinia raderi*). Three snail species have been removed due to extirpation or because subsequent review determined that the original specimens did not occur in Maryland. Finally, three crayfish SGCN and two crayfish SAPS are included, all of which are impacted by stream degradation and the expansion of non-native crayfish populations.

Some taxa, such as beetles, flies, and wasps, are so diverse that the relatively small number included here represent only a fraction of the species in Maryland. However, by prioritizing groups that are already known or reasonably feasible to assess, we can make more actionable conservation decisions that may also benefit less-studied taxa. One path forward to inventory those diverse groups is through targeted surveys of rare plants to identify monophagous or highly specialized species. Several taxa were not assessed at all due to limited records, a lack of taxonomic expertise, and/or low representation in community science data. Nonetheless, some groups warrant closer attention because sufficient expertise exists and their overall diversity is more manageable. These include the insect orders Mecoptera (scorpionflies), Neuroptera (lacewings), Araneae (spiders), and Orthoptera (grasshoppers/katydids). Orthopterans may be particularly vulnerable to grassland loss, and some species can be identified by their calls, providing a possible method for future survey efforts. Finally, although the horseshoe crab (*Limulus polyphemus*) was not assessed within the invertebrate taxa covered here, it is listed as a SGCN within the marine fish section of this SWAP revision.

Threats to Invertebrate SGCN

Like plants, declines in rare invertebrates often serve as early indicators of habitat degradation, preceding impacts to higher trophic levels. One of the greatest challenges facing invertebrate conservation in Maryland is the sheer number of species, which makes conservation of all rare species impossible. This challenge is compounded by the fact that invertebrates, despite representing the majority of animal diversity, receive comparatively few conservation resources. Simply, invertebrates receive less—and often more negative—attention than more charismatic fauna. Thus, there is a huge taxonomic bottleneck limiting invertebrate conservation. Funding limitations further exacerbate this issue resulting in some species declining due to insufficient resources to intervene.

Maryland is fortunate to have the ability to provide legal protection to state-listed species. However, discrepancies between the biological survey record and environmental review process can lead to a lag in those protections. For example, a population of the federally threatened Puritan tiger beetle was discovered along the Severn River, but that information did not reach the Maryland Department of the Environment (MDE) in time to prevent shoreline armoring with riprap at that site. Additionally, there is currently no automatic data-sharing mechanism between

MBP and the MD DNR NHP database. As a result, some records are not flagged during environmental review in time to prevent habitat degradation or loss.

Beyond these administrative challenges, habitat loss and degradation represent the primary threats to invertebrates in Maryland. The state is among the most densely populated in the country and lies within close proximity to multiple major population centers. As a result, development associated with low-density residential housing, solar facilities, data centers, and transmission corridors poses an ongoing threat to invertebrate habitats. Development also fragments remaining undeveloped areas. Habitat fragmentation limits the ability of populations to disperse and recolonize sites following local extirpations caused by habitat loss, extreme weather, or disease. The effects of deer browse, predation, and parasitism may also be intensified as populations become concentrated within small, isolated habitat patches. Finally, fragmentation can lead to inbreeding depression by restricting gene flow among isolated populations, increasing the likelihood of reduced fitness and the expression of deleterious traits.

Development that alters water quality or hydrology is a particularly serious threat to aquatic invertebrates. Dams, for example, can have profound impacts on freshwater mussels and have contributed to the extinction of several species in North America. In Maryland, dams have limited mussel population size and reproduction by blocking the movement of host fishes, particularly migratory species such as shad, river herring, and eels (Galbraith et al. 2018). Undersized or failing culverts can produce similar effects in smaller streams by restricting fish passage and degrading aquatic habitat. Vernal pools, which provide the sole breeding habitat for several invertebrate SGCN, may be drained or degraded through development. The loss of beaver impoundments, along with the ditching and draining of marshes and wetlands for agricultural purposes, further threatens dragonfly and damselfly SGCN, as well as other invertebrates that depend on wetlands to complete their life cycles. In addition, cave and groundwater habitats that support several SGCN are exceptionally fragile and have very limited potential for restoration once their catchment basins are polluted or otherwise disturbed.

Unfortunately, even protected lands are not immune to development pressures. A recent Maryland law change exempted certain portions of Maryland's Wildlands, such as those within Savage River State Forest, from industrial activities. In addition, the state has limited authority over land-use decisions on federal properties. Maryland hosts the Patuxent Wildlife Research Refuge, a large, undeveloped area that supports numerous rare invertebrate species, particularly bees and odonates. Development of this site would result in the extirpation of hundreds of invertebrate species from the state. Nearby, the Beltsville Agricultural Research Center contains a rare pine barren habitat. The proposed closure of this facility leaves the future of this land uncertain.

Habitat degradation is another key threat to invertebrates, though it can occur in counterintuitive ways. For example, many rare invertebrate species in the state are specialists of barrens and grasslands rather than interior forests. Canopy closure, non-native plant invasion, and forest mesophication pose significant threats to sand dunes in Coastal Plain oak–pine forests on the Eastern Shore, serpentine barrens in central Maryland, and shale barrens in western Maryland. Similarly, Coastal Plain seepage acidic fens and montane acidic fens are also increasingly threatened by canopy closure.

Whether driven by climate change, fire suppression, invasive plant species, or natural succession, these processes are causing the gradual loss and homogenization of unique barren habitats. In some cases, disturbed or developed areas now provide the most suitable remaining habitat. Certain tiger beetle species, for example, are found primarily in powerline corridors or along forestry roads, while many butterfly and bee species benefit from the floral resources available in/along roadsides, utility rights-of-way, suburban gardens, agricultural field edges, and sand or gravel mines. However, these alternative habitats carry their own risks, including frequent mowing or herbicide application, soil compaction, and elevated pollution levels.

Pollution is a major concern for both aquatic and terrestrial invertebrates. Freshwater mussels, crustaceans, odonates, aquatic macroinvertebrates, and spring amphipods are especially sensitive to contamination of water sources from acid mine drainage, sedimentation, and nutrient runoff. Light pollution is harmful to moths, fireflies, and adult EPT taxa because it interferes with orientation, leads to wasted energy, and disrupts mating behavior (Owens et al. 2020). Pesticides are among the most harmful pollutants affecting terrestrial invertebrates. Agricultural pesticide drift is particularly damaging to pollinator taxa, causing both direct mortality and sublethal effects that impair navigation, foraging, and reproduction (Desneux et al. 2007). Pesticide applications targeting forest pests, such as spongy moths or hemlock woolly adelgid, can have substantial non-target effects on rare species that share these habitats. In addition, mosquito control programs conducted by state agencies or residential pest control companies can result in significant non-target exposure when broad-spectrum adulticides are used.

Baltimore checkerspot (Euphydryas phaeton) (Scott Smith, MD DNR)

Many invertebrate taxa are specialists on particular hosts, and the decline of these hosts represents a critical threat to rare species. For some freshwater mussel SGCN, dependence on specific host fish species to complete their life cycle exacerbates vulnerability, as these fishes are themselves sensitive to the same environmental stressors affecting aquatic systems. For primary consumers in terrestrial systems, hosts are usually plants, either as larval food sources or as providers of pollen. One of the primary drivers of host plant loss in Maryland is intensive browsing by overabundant deer populations. Certain plant species are particularly vulnerable, including white turtlehead (*Chelone glabra*), the host plant of the Baltimore checkerspot (*Euphydryas phaeton*), and sundial lupine (*Lupinus perennis*), a host plant for the frosted elfin (*Callophrys irus*). Deer browsing also contributes to the widespread loss of oak regeneration. This change is significant because oaks support hundreds of invertebrate species (Tallamy 2021).

Invasive species further contribute to the decline of rare invertebrates. This occasionally manifests as direct competition or predation—such as impacts to native mussels from zebra mussels, blue catfish, and rusty crayfish—but often takes the form of indirect effects such as introduced pests and pathogens. The decline of chestnut and ash trees, for example, has led to

corresponding declines in their associated specialist invertebrates. If beech diseases continue to expand in Maryland, additional impacts are likely, including potential declines of the early hairstreak butterfly. Pathogens can also affect invertebrates directly. Recent declines in bumble bees have been partially attributed to the spread of *Nosema bombi*, a parasitic microsporidian introduced to North American bees through the importation of European bumble bees (Jacobson et al. 2018).

Climate change represents an emerging threat to invertebrates, with impacts that are often complex and difficult to predict. Sea-level rise, along with shoreline stabilization efforts intended to mitigate its effects, poses a clear threat to Maryland's beach, cliff, and tidal wetland invertebrates, as habitats may be hardened, submerged, eroded, lost to storm surges, or exposed to increased salinity. Increasing drought frequency has the potential to reduce nectar resources in harsh barren habitats, a pattern observed occasionally in shale barrens of western Maryland. Increased temperature variability can also drive population declines. For example, the Baltimore checkerspot butterfly experiences high mortality during winter heat waves (Abarca et al. 2019). In addition, many invertebrate species, particularly in Garrett County, are likely to experience range shifts that may result in their extirpation from Maryland, while other species are expected to expand into the state, a trend already observed in southern Maryland counties. Climate change also poses a growing and poorly understood threat to aquatic invertebrates such as freshwater mussels. Changes in precipitation patterns and water temperatures are expected to alter hydrology, host fish populations, and habitat availability (Hastie et al. 2003; Galbraith et al. 2010). As lower reaches of coastal streams become increasingly saline due to sea-level rise, freshwater mussel habitat is likely to contract toward the Fall Line and may eventually disappear altogether. These transitional reaches near the non-tidal–tidal boundary currently support a diverse and distinctive mussel assemblage, including the alewife floater (*Utterbackiana implicata*) and tidewater mucket (*Atlanticoncha ochracea*).

Lastly, the improper use of ecological resources poses a threat to many invertebrates. Illegal ATV use on forestry roads can place tiger beetle populations at risk. Spelunking threatens rare amphipods and isopods that depend on these habitats. The collection of rare insects for pinning or display has also historically affected some charismatic taxa, including butterflies and tiger beetles. Even activities considered ecologically beneficial can have unintended negative consequences. Captive rearing of butterflies, for example, can reduce genetic diversity and increase pathogen transmission (see the Xerces Society joint statement on captive breeding of monarchs). Similarly, the commercial breeding and sale of bees for pollination purposes can elevate disease risks in native bees, and "bee hotels" have been shown to increase rates of parasitism (MacIvor & Packer 2015).

Conservation Actions and Information Needs for Invertebrate SGCN

Over the past decade, tremendous progress has been made in understanding the conservation needs, occurrences, and distributions of Maryland's invertebrate species. While surveys to discover new records, monitor existing populations, and study life histories remain a priority, our focus is shifting toward applying this knowledge to active conservation. As a part of the 2025 SWAP revision process, we outlined specific, often location-based conservation actions for each invertebrate SGCN, with most of these actions being aimed at recovery rather than simply avoiding extirpation. Fortunately, many invertebrate conservation actions are effective at

relatively small scales, making them more practical to implement. These actions may include augmenting and/or reintroducing host plants or invertebrate populations, planting flowering resources, creating no-mow areas or time periods, removing invasive species, installing deer exclosures around host plants, conducting prescribed burns, creating buffers, plugging drainage ditches, and reducing pollution near important waterbodies. Although this list of actions has been generalized for brevity, the list of specific location-based actions generated during the development of the 2025 SWAP will be reviewed, prioritized, and used for future conservation actions.

Effective conservation also requires a broader, landscape-level perspective that considers regional species recovery rather than focusing solely on individual populations. This requires maintaining connectivity between metapopulations through habitat corridors by working with private landowners to establish "stepping stones" on agricultural or urban lands. Collaboration with partners is essential, whether partnering with the State Highway Administration to plant pollinator strips along roadsides, the Maryland Forest Service to conduct prescribed burns, or the Department of Agriculture to reduce pesticide impacts from mosquito control. Finally, public education and engagement are critical. Fact sheets, outreach materials, and social media must emphasize the diversity and ecological importance of Maryland's rare invertebrates, helping the public better understand our agency's conservation efforts.

Table 3.17 Existing federal recovery plans for invertebrate SGCN

Invertebrate Species	Federal Recovery Plan	Recent Action
Insect Species		
Eastern beach tiger beetle	USFWS 1994	2025: Initiation of 5-year review
Puritan tiger beetle	USFWS 1993b	2018: Initiation of 5-year review
Rusty-patch bumble bee	USFWS 2021	2021: Initiation of 5-year review
Other Invertebrate Species		
Dwarf wedgemussel	USFWS 1993a	2025: Initiation of 5-year review
Yellow lance	USFWS 2022	2023: Initiation of 5-year review

Table 3.18 Invertebrate SGCN in Maryland

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Dragonflies and Damselflies (Odonates)						
American emerald	*Cordulia shurtleffii*	G5	S3			C
Appalachian jewelwing	*Calopteryx angustipennis*	G4	S1S2			A
Appalachian snaketail	*Ophiogomphus incurvatus incurvatus*	G3T2T3	S1		E	A
Atlantic bluet	*Enallagma doubledayi*	G5	S1			A
Banded spiketail	*Zoraena obliqua fasciata*	G4T3Q	S1			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Beaverpond baskettail	*Epitheca canis*	G5	S3			C
Black-tipped darner	*Aeshna tuberculifera*	G5	S2			B
Blackwater bluet	*Enallagma weewa*	G5	S2			B
Burgundy bluet	*Enallagma dubium*	G5	S1			A
Canada darner	*Aeshna canadensis*	G5	S2			B
Coppery emerald	*Somatochlora georgiana*	G3G4	S1			A
Crimson-ringed whiteface	*Leucorrhinia glacialis*	G5	S1			A
Elfin skimmer	*Nannothemis bella*	G4G5	S1		E	A
Fine-lined emerald	*Somatochlora filosa*	G5	S2			B
Frosted whiteface	*Leucorrhinia frigida*	G5	S1			A
Green-faced clubtail	*Hylogomphus viridifrons*	G3G4	S1			A
Green-striped darner	*Aeshna verticalis*	G5	S2			B
Harpoon clubtail	*Phanogomphus descriptus*	G4G5	S1S2			A
Hudsonian whiteface	*Leucorrhinia hudsonica*	G5	S1			A
Laura's clubtail	*Stylurus laurae*	G4	S2S3			B
Little blue dragonlet	*Erythrodiplax minuscula*	G5	S1			A
Maine snaketail	*Ophiogomphus mainensis fastigiatus*	G4G5TU	S1			A
Midland clubtail	*Gomphurus fraternus*	G5	S2			B
Mustached clubtail	*Hylogomphus adelphus*	G5	S1			A
Northern bluet	*Enallagma annexum*	G5	S1			A
Pale bluet	*Enallagma pallidum*	G4	S1			A
Pygmy snaketail	*Ophiogomphus howei*	G3	S1			A
Rainbow bluet	*Enallagma antennatum*	G5	S1			A
Rapids clubtail	*Phanogomphus quadricolor*	G3G4	S2		I	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Royal river cruiser	*Macromia taeniolata*	G5	S3			C
Rusty snaketail	*Ophiogomphus rupinsulensis*	G5	S2			B
Seepage dancer	*Argia bipunctulata*	G4	S3			C
Selys' sundragon	*Helocordulia selysii*	G4	S2		T	B
Ski-tailed emerald	*Somatochlora elongata*	G5	S2			B
Southern pygmy clubtail	*Lanthus vernalis*	G4	S2			B
Southern sprite	*Nehalennia integricollis*	G5	S1S2			A
Sparkling jewelwing	*Calopteryx dimidiata*	G5	S2			B
Spatterdock darner	*Rhionaeschna mutata*	G4	S1		E	A
Sphagnum sprite	*Nehalennia gracilis*	G5	S2			B
Spine-crowned clubtail	*Hylogomphus abbreviatus*	G4	S1			A
Splendid clubtail	*Gomphurus lineatifrons*	G4	S1			A
St. Croix snaketail	*Ophiogomphus susbehcha*	G1	S1			A
Superb jewelwing	*Calopteryx amata*	G5	S1S2		T	A
Treetop emerald	*Somatochlora provocans*	G4	S1		E	A
Uhler's sundragon	*Helocordulia uhleri*	G5	S3			C
White corporal	*Ladona exusta*	G5	S1		E	A
Zebra clubtail	*Stylurus scudderi*	G5	S1			A
Mayflies, Stoneflies, and Caddisflies (EPT)						
Dusky sallfly	*Alloperla biserrata*	G3	SNR			D
Lash springfly	*Remenus bilobatus*	G4?	SNR			D
Lobed stone	*Acroneuria internata*	G4	SNR			D
Pocahontas sallfly	*Sweltsa pocahontas*	G2G3	S2			A
Shenandoah needlefly	*Megaleuctra flinti*	G2G3	S1			A
Shenandoah sallfly	*Sweltsa palearata*	G2G3	S2			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Variable needlefly	*Leuctra variabilis*	G3	SNR			D
Vernal springfly	*Helopicus subvarians*	G4	SNR			D
Freshwater Mussels						
Alewife floater	*Utterbackiana implicata*	G5	S3			C
Brook floater	*Alasmidonta varicosa*	G3	S1		E	A
Creeper	*Strophitus undulatus*	G5	S2S3		I	B
Dwarf wedgemussel	*Prolasmidonta heterodon*	G2?	S1	E	E	A
Eastern lampmussel	*Lampsilis radiata*	G5	SU			D
Eastern pondmussel	*Sagittunio nasutus*	G3	S1S2			A
Green floater	*Lasmigona subviridis*	G2G3	S1	PT	E	A
Northern lance	*Elliptio fisheriana*	G4	S3S4			C
Paper pondshell	*Utterbackia imbecillis*	G5	S3			C
Tidewater mucket	*Atlanticoncha ochracea*	G3G4	S1S2			A
Triangle floater	*Alasmidonta undulata*	G4	S1S2		T	A
Yellow lampmussel	*Lampsilis cariosa*	G3G4	SU			D
Yellow lance	*Elliptio lanceolata*	G2	S1	T	T	A
Cave and Groundwater Invertebrates						
A cave obligate planarian	*Sphalloplana buchanani*	G1G2	SNR			D
A planarian	*Paraplanaria dactyligera*	GNR	S2			B
A planarian	*Procotyla typhlops*	G1G2	S1		E	A
Allegheny spring isopod	*Caecidotea alleghenyensis*	G1G2	S1		E	A
Biggers' cave amphipod	*Stygobromus biggersi*	G2G4	S1		E	A
Capital Area groundwater amphipod	*Stygobromus sextarius*	G1	S1		E	A
Cecil groundwater amphipod	*Stygobromus caecilius*	G1	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Feller's groundwater amphipod	*Stygobromus felleri*	G1	S1		E	A
Franz's cave isopod	*Caecidotea franzi*	G2G4	S1		E	A
Friendly cave amphipod	*Stygobromus amicus*	G1	S1		E	A
Greenbrier cave amphipod	*Stygobromus emarginatus*	G3	S1		E	A
Hoffmaster's cave planarian	*Sphalloplana hoffmasteri*	G3G4	S1		E	A
Holsinger's cave isopod	*Pseudobaicala-sellus holsingeri*	G5	S1		E	A
Maus' cave isopod	*Pseudobaicala-sellus mausi*	G2	S1		E	A
Pennsylvania cave amphipod	*Crangonyx dearolfi*	G2	S1		E	A
Pizzini's cave amphipod	*Stygobromus pizzinii*	G3G4	S1			A
Prettyboy groundwater amphipod	*Stygobromus paxillus*	G1	S1		E	A
Price's cave isopod	*Conasellus pricei*	G5	S3			C
Rappahannock spring amphipod	*Stygobromus foliatus*	G2	S1		E	A
Refton Cave planarian	*Sphalloplana pricei*	G2G3	SNR			D
Rock Creek groundwater amphipod	*Stygobromus kenki*	G2	S1		E	A
Shenandoah Valley cave amphipod	*Stygobromus gracilipes*	G3G4	S1		E	A
Tidewater amphipod	*Stygobromus indentatus*	G3	S1			A
Vandel's cave isopod	*Pseudobaicalas ellus vandeli*	G3G4	S1		E	A
Butterflies						
Atlantis fritillary	*Argynnis atlantis*	G5	S1		T	A
Baltimore checkerspot	*Euphydryas phaeton*	G4	S2			B
Black dash	*Euphyes conspicua*	G4G5	S4			C
Bog copper	*Tharsalea epixanthe*	G4G5	S1		E	A
Bronze copper	*Lycaena hyllus*	G5	S4			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Cobweb skipper	*Hesperia metea*	G4	S3			C
Edwards' hairstreak	*Satyrium edwardsii*	G4	S1		E	A
Frosted elfin	*Callophrys irus*	G3	S1		E	A
Gray comma	*Polygonia progne*	G5	S3			C
Great purple hairstreak	*Atlides halesus*	G5	S2S3			B
Harris's checkerspot	*Chlosyne harrisii*	G4?	S2		T	B
Hoary elfin	*Callophrys polios*	G5	S1		E	A
Indian skipper	*Hesperia sassacus*	G5	S3			C
King's hairstreak	*Satyrium kingi*	G3G4	S1		E	A
Leonard's skipper	*Hesperia leonardus*	G4	S2			B
Long dash	*Limochores mystic*	G5	S3			C
Mulberry wing	*Poanes massasoit*	G4	S4			C
Northern metalmark	*Calephelis borealis*	G3	S2		T	A
Northern oak hairstreak	*Satyrium favonius ontario*	G5T4	S1S2		E	A
Olympia marble	*Euchloe olympia*	G5	S2		I	B
Palamedes swallowtail	*Pterourus palamedes*	G5	S1		E	A
Pepper and salt skipper	*Amblyscirtes hegon*	G5	S2		I	B
Rare skipper	*Atrytone bulenta*	G3	S1		T	A
Silver-bordered fritillary	*Boloria selene*	G5?	S3			C
Silvery blue	*Glaucopsyche lygdamus*	G5	S2		I	B
Two-spotted skipper	*Euphyes bimacula*	G4	S1		E	A
West Virginia white	*Pieris virginiensis*	G4	S1S2			A
Moths						
A grass miner moth	*Ethmia macelhosiella*	GNR	SNR			D
A twirler moth	*Coleotechnites variiella*	GNR	SNR			D
An owlet moth	*Meropleon titan*	G2G4	S2S4			B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Angel moth	*Olceclostera angelica*	G5	SNR			D
Ash borer moth	*Podosesia syringae*	GNR	SNR			D
Ash leaf cone roller moth	*Caloptilia fraxinella*	GNR	SNR			D
Ash sphinx	*Manduca jasminearum*	G3?	SNR			D
Ash tip borer moth	*Papaipema furcata*	G4	SNR			D
Bald cypress coneworm moth	*Dioryctria pygmaeella*	GNR	SNR			D
Banded ash clearwing moth	*Podosesia aureocincta*	GNR	SNR			D
Barred angle moth	*Macaria subcessaria*	G5	SNR			D
Bold-based zale moth	*Zale lunifera*	G3G4	SNR			D
Braun's ash bark-mining moth	*Marmara fraxinicola*	GNR	SNR			D
Brown flower moth	*Schinia saturata*	G5	SNR			D
Coastal graphic moth	*Drasteria graphica*	G4	SNR			D
Comstock's sallow moth	*Feralia comstocki*	GNR	SNR			D
Cypress emerald moth	*Nemoria elfa*	G4?	SNR			D
Cypress looper	*Iridopsis pergracilis*	G4G5	SNR			D
Cypress pinion	*Lithophane abita*	G4	SNR			D
Cypress sphinx moth	*Isoparce cupressi*	G4	S1S2			A
Distinguished cypress owlet moth	*Cutina distincta*	G4	SNR			D
Eastern cactus-boring moth	*Melitara prodenialis*	G4	SNR			D
Epauletted pitcher plant moth	*Exyra fax*	G4	SNR			D
Franck's sphinx	*Sphinx franckii*	G4G5	S1S2			A
Fringed dart moth	*Eucoptocnemis fimbriaris*	G4	SNR			D
Gray cypress looper	*Cutina albopunctella*	GNR	SNR			D

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Great ash sphinx	*Sphinx chersis*	G4	SNR			D
Grote's sallow moth	*Copivaleria grotei*	G5	SNR			D
Inkblot palpita moth	*Palpita illibalis*	GNR	SNR			D
Joyful holomelina moth	*Virbia laeta*	G5	S1?			A
Melsheimer's sack-bearer	*Cicinnus melsheimeri*	G4	SNR			D
Merry melipotis moth	*Melipotis jucunda*	G5	SNR			D
Ornate bella moth	*Utetheisa ornatrix*	G5	SNR			D
Pine barrens fungus moth	*Chytonix sensilis*	G4	SNR			D
Pine barrens zanclognatha	*Zanclognatha martha*	G4	S1S3			B
Purple plagodis moth	*Plagodis kuetzingi*	G5	SNR			D
Sand wainscot moth	*Apamea lintneri*	G4	SNR			D
Seaside goldenrod stem borer	*Papaipema duovata*	G2G3	SU			D
Splendid palpita moth	*Palpita magniferalis*	GNR	SNR			D
Tuscarora emerald	*Nemoria tuscarora*	GU	SNR			D
Unexpected cycnia moth	*Cycnia inopinatus*	G4	SNR			D
Zeller's grass miner moth	*Ethmia zelleriella*	GNR	SNR			D
Bees						
A cellophane bee	*Colletes aestivalis*	GNR	SH			E
A cellophane bee	*Colletes speculiferus*	GNR	SNR			D
A cemolobus bee	*Cemolobus ipomoeae*	GNR	SNR			D
A cuckoo bee	*Nomada rubicunda*	GNR	S1S3			B
A cuckoo bee	*Nomada seneciophila*	GNR	S1			A
A dieunomia bee	*Dieunomia nevadensis*	G5	SU			D
A leafcutter bee	*Coelioxys immaculatus*	GNR	SNR			D

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
A leafcutter bee	*Paranthidium jugatorium*	GNR	SNR			D
A long-horned bee	*Epimelissodes comptus*	GNR	SNR			D
A mason bee	*Osmia chalybea*	G4G5	S1S3			B
A miner bee	*Perdita bradleyi*	GNR	SNR			D
A mining bee	*Andrena braccata*	GNR	SU			D
A mining bee	*Andrena fulvipennis*	GNR	SU			D
A mining bee	*Protandrena abdominalis*	GNR	SU			D
A sweat bee	*Lasioglossum arantium*	GNR	S2S3			B
A sweat bee	*Lasioglossum floridanum*	GNR	SNR			D
A sweat bee	*Lasioglossum nymphale*	GNR	S2S3			B
A sweat bee	*Lasioglossum raleighense*	GNR	SU			D
A sweat bee	*Lasioglossum sopinci*	GNR	SNR			D
A sweat bee	*Sphecodes brachycephalus*	GNR	SNR			D
American plasterer bee	*Colletes americanus*	GNR	SNR			D
An andrenid bee	*Andrena lamelliterga*	GNR	SNR			D
An andrenid bee	*Andrena phaceliae*	GNR	SNR			D
Azalea mining bee	*Andrena cornelli*	GNR	SNR			D
Cranesbill miner bee	*Andrena distans*	GNR	SNR			D
Felt's mason bee	*Osmia felti*	G3	SNR			D
Fringed loosestrife oil-collecting bee	*Macropis ciliata*	GNR	S1			A
George Eickwort's sweat bee	*Lasioglossum georgeickworti*	GNR	SU			D
Golden Alexanders miner bee	*Andrena ziziae*	GNR	SNR			D
Half-black bumble bee	*Bombus vagans*	G4	S3			C

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Howard's cuckoo nomad bee	*Epeolus howardi*	GNR	SNR			D
Mustard miner bee	*Andrena arabis*	GNR	SNR			D
Nude plasterer bee	*Colletes nudus*	GNR	SNR			D
Pearly-banded bee	*Nomia maneei*	G3?	S1S3			A
Pickerelweed long-horned bee	*Melissodes apicatus*	GNR	SNR			D
Puny cuckoo nomad bee	*Epeolus pusillus*	GNR	SNR			D
Rusty-patch bumble bee	*Bombus affinis*	G2	S1	E	E	A
Summer miner bee	*Protandrena aestivalis*	G5	SNR			D
Sunflower miner bee	*Andrena helianthi*	GNR	SNR			D
Sunflower sweat bee	*Dieunomia heteropoda*	G5	S1S3			B
Texas mason bee	*Osmia texana*	G5	SNR			D
Trout lily miner bee	*Andrena erythronii*	GNR	SNR			D
Two-spotted miner bee	*Andrena accepta*	GNR	SNR			D
Waterleaf mining bee	*Andrena geranii*	GNR	SNR			D
Yellowbanded bumble bee	*Bombus terricola*	G3G4	S1			A
Hoverflies						
Painted wood fly	*Blera pictipes*	G4G5	SNR			D
Fireflies						
Bethany Beach firefly	*Photuris bethaniensis*	G1	S1	PT		A
Keel-necked firefly	*Pyractomena ecostata*	G3	SNR			D
Mysterious lantern firefly	*Photuris mysticalampas*	G1G2	S1			A
Potomac firefly	*Photuris potomaca*	GU	SNR			D
Salt marsh firefly	*Photuris salina*	G3	SNR			D

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Tiger Beetles						
Appalachian tiger beetle	*Cicindela ancocisconensis*	G3	S1		E	A
Common claybank tiger beetle	*Cicindela limbalis*	G5	SNR			D
Cow path tiger beetle	*Cicindela purpurea*	G5	S3			C
Eastern beach tiger beetle	*Habroscelimorpha dorsalis dorsalis*	G3T2	S1	T	E	A
Eastern pinebarrens tiger beetle	*Cicindela abdominalis*	G3	S1		E	A
Ghost tiger beetle	*Ellipsoptera lepida*	G3	S1		E	A
Northern barrens tiger beetle	*Cicindela patruela*	G3	S1		E	A
Puritan tiger beetle	*Ellipsoptera puritana*	G1G2	S1S2	T	E	A
Splendid tiger beetle	*Cicindela splendida*	G5	S1			A
White tiger beetle	*Habroscelimorpha dorsalis media*	G3T3	S1		E	A
Other Invertebrates						
A carpenter ant	*Colobopsis mississippiensis*	GNR	SNR			D
A dytiscid beetle	*Hoperius planatus*	GNR	S2			B
A tenebrionid beetle	*Helops cisteloides*	GNR	S1		E	A
A tenebrionid beetle	*Schoenicus puberulus*	GNR	S1		E	A
Allegheny crayfish	*Faxonius obscurus*	G5	S3			C
An ash seed weevil	*Lignyodes bischoffi*	G5	SNR			D
An ash seed weevil	*Lignyodes fraxini*	GNR	SNR			D
An ash seed weevil	*Lignyodes helvolus*	GNR	SNR			D
An ash seed weevil	*Lignyodes horridulus*	GNR	SNR			D
Angular disc snail	*Discus catskillensis*	G5	S1			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Appalachian springsnail	*Fontigens bottimeri*	G2G3	S2		I	A
Ash bullet gall midge	*Dasineura pellex*	GNR	SNR			D
Ash flower gall mite	*Aceria fraxiniflora*	GNR	SNA			D
Ash key gall mite	*Aceria fraxinivora*	GNR	SNA			D
Ash leaf gall mite	*Aceria fraxini*	GNR	SNR			D
Blackheaded ash sawfly	*Tethida barda*	GNR	SNR			D
Blue Ridge springsnail	*Fontigens orolibas*	G3	S1		E	A
Cambarus sp. C (formerly acuminate crayfish)	*Cambarus sp. n.*	G4Q	S2		I	B
Charlie Brown's flea beetle	*Capraita sexmaculata*	GNR	SNR			D
Cherrystone drop	*Hendersonia occulta*	G4	S2		I	B
Eastern ash bark beetle	*Hylesinus aculeatus*	G5	SNR			D
Eastern sedge barrens leafhopper	*Limotettix minuendus*	G1	S1		E	A
Encircled borer	*Agrilus subcinctus*	GNR	SNR			D
Fringetree lace bug	*Leptoypha mutica*	GNR	SNR			D
Pitcher plant midge	*Metriocnemus knabi*	G5	SNR			D
Pitcher plant mite	*Sarraceniopus gibsoni*	GNR	SNR			D
Pitcher plant mosquito	*Wyeomyia smithii*	G5	S2			B
Pitcher plant flesh fly	*Fletcherimyia fletcheri*	G5	SNR			D
Riley's 13-year cicada	*Magicicada tredecim*	GNR	SNR			D
Rock crayfish	*Cambarus carinirostris*	G5	SNR			D
Seth Forest water scavenger beetle	*Hydrochus spangleri*	G1	S1		E	A
Spruce knob threetooth	*Triodopsis picea*	G3	S1			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Striped whitelip	*Webbhelix multilineata*	G5	S1			A
Swollen ash gall midge	*Dasineura tumidosae*	GNR	SNR			D

[1] = See Table 3.5 for S-rank and G-rank definitions
[2] = T (Threatened); E (Endangered); I (In Need of Conservation); PT (Proposed Threatened)
[3] = See Table 3.7 for Conservation Status definitions

Plants of Maryland

Plants form the basis of nearly every ecosystem, provide essential habitat and/or food for most faunal life forms and, of course, are intricately linked, directly or indirectly, to the survival of all SGCN. Native plants are also economically important, as they support pollinators necessary for agricultural production and healthy ecosystems globally. Furthermore, plant diversity is becoming especially important as ecosystems are pressured by the effects of climate change (Spohn et al. 2023).

Plants are reliable indicators of site conditions and reflect biological and ecological patterns across landscapes. Plants are more readily measurable than other biota or environmental conditions. Most states did not include plants in their discussion of SGCN during the first SWAP process in 2005; however, the development and revision of SWAPs provide an excellent opportunity for states to advance the conservation of declining, rare, threatened, and endangered plants. MD DNR NHP developed a list of plant species for inclusion in the 2015 SWAP revision and now includes a refined version of this list in the 2025 SWAP revision as SGCN (Table 3.20). Maryland's contribution to regional biodiversity is far greater than its small size would suggest. Maryland ranks among the smaller states (42/50), and when compared with our close neighbors, Pennsylvania and Virginia, we are not only smaller, but we are also more densely populated. Yet Maryland DNR NHP tracks some 740 taxa of rare, threatened, and endangered plant species. The state's diverse hydrology and geology support 57 Key Wildlife Habitats (KWHs) within 75 broader Ecological Community Groups (Harrison 2022). Owing to its longitude—from the barrier islands along the Atlantic Coast to the high elevations of Garrett County, about 250 miles west—Maryland is comprised of five distinctly different Physiographic Provinces: Atlantic Coastal Plain, Piedmont, Blue Ridge, Ridge and Valley, and the Appalachian Plateau. As previously stated in Chapter 2, the Coastal Plain has been split into the Lower and Upper Coastal Plain for the purposes of this SWAP revision. Chapter 2 also contains descriptions of rare plant species and communities that can be found in each province.

Additional floristic complexity has been provided by the ebb and flow of climatic changes over geological time. Maryland is located south of the Wisconsinan glacial maxima during the Pleistocene Epoch (ending approximately 11,700 years before present), during which time the southern states, like Maryland, served as a refuge for migrating plant and animal species, many of which remain as part of our natural heritage today (Maryland Botanical Heritage Workgroup 2014). Maryland flora includes more than 2,918 taxa of which 2,099 are considered native (Knapp & Naczi 2021); totals have been amended as needed by the Maryland Plant Atlas Working Group. Understanding the distribution and abundance of all plant species is the goal of the Maryland Plant Atlas. The Maryland Plant Atlas aims to provide distribution maps for all

native and naturalized plants in Maryland based on the most recent and accurate data, to provide information about Maryland's plants to the public, and to promote conservation by increasing public awareness of plant diversity.

Canby's dropwort (Tiedemannia canbyi)
(Dave Suiter, USFWS)

Plant SGCN of Maryland

Since 1980, staff of MD DNR NHP have worked with partners to review, research, and revise the list of rare plants in the state. Of the 740 plants currently considered by NHP as rare, threatened, endangered, or extirpated—all of which were included as SGCN in the previous SWAP—454 have been listed by the 2025 SWAP process as SGCN in Maryland (Table 3.20). Given that plants are not typically included in a state's SWAP, plant SGCN were determined in a different manner than the other taxonomic groups. MD DNR NHP applied the SGCN categorization matrix (Figure 3.1) to the 740 listed plant species and included all species in status groups A and B on the SGCN list. This restricts the designation to plants that are globally rare and vulnerable, imperiled, or critically imperiled within Maryland. By limiting plant SGCN to these two categories, Maryland focuses its conservation resources on the most biologically precarious flora.

Of these 454 SGCN, 83 are state-listed as Threatened and 241 are listed as Endangered. The remaining 130 species are of conservation concern due to factors such as high threats, limited habitat, declines in the species' range, and/or the number and size of the remaining populations. Seventy SGCN taxa are considered globally rare (G1–G3, T1–T3). Not including the two federally listed plants that no longer occur in Maryland, seven species are federally listed (three Threatened and four Endangered), and seven species are narrow endemics. For additional state and global ranks, see Appendix 3a.

In Maryland regulations, Threatened species are defined in part as "any species of flora or fauna which appears likely, within the foreseeable future, to become endangered…" (COMAR 08.03.08.01). Plant species with this status occur in less than 20 populations in Maryland and typically have a limited within-state range. For example, white fringed orchid (*Platanthera blephariglottis*), a species restricted to the Atlantic Coastal Plain, occurs in the Coastal Plain Seepage Acidic Fen KWH (see Chapter 4 for more information on KWHs). This species occurs in approximately 19 populations, but 83% of these populations are very small, containing 1–25 individuals. Additionally, the range of this species in Maryland has contracted from seven to only four counties having extant populations.

Maryland regulations define Endangered species in part as "any species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy..." (COMAR 08.03.08.01). Plant species with this status occur in fewer than five populations and typically are extremely habitat-limited and often occur at single sites. An illustrative example is Appalachian sandwort (*Geocarpon glabrum*), a plant of high elevations in the Appalachian

Mountains that occupies a single site in the Blue Ridge of Maryland in the Cliff, Talus, and Rock Outcrop KWH.

Threats to Plant SGCN

Threats to plants are similar to the threats faced by Maryland's animal species with one added source of risk: plants cannot physically move away from any direct or indirect threat. The limited colonizing ability of many plant species is a major obstacle to the restoration of plant communities. The alteration of historical ecosystem processes, such as fire, and changes in the spatial arrangement of habitats via habitat destruction and fragmentation are key threats largely because plants are not mobile. Further, even if ecosystem processes are reinstituted, many previously occupied habitat patches may remain unoccupied and the linkages between habitat patches will remain fragmented due to insurmountable barriers to gene flow via seed and pollen. Loss of historical disturbance regimes, intensive urbanization, and human-mediated manipulation of species composition have led to the homogenization of plant species and loss of diversity over large areas. These, coupled with the limited capacity of the underground seed bank to aid recovery, have led to a rapid decline in both species diversity and composition of plant communities. Finally, the overabundance of white-tailed deer has been directly implicated in the altered species richness and abundance of Maryland orchids (Knapp & Wiegand 2014) and other rare species (Maryland Botanical Heritage Workgroup 2014). Other major threats include widespread infestation of invasive species, the emergence of new diseases, and pervasive shifts in climatic patterns (Stein et al. 2000).

Conservation Actions and Information Needs for Plant SGCN

Conservation efforts for plants are a relatively recent trend in conservation planning. While the U.S. Endangered Species Act was established in 1970, it was not until 1977 that the first plant species were federally listed. Inequalities still exist between federally listed animals and plants: under law, Threatened and Endangered animals cannot be captured or killed anywhere in the U.S., but the taking of Threatened and Endangered plants is prohibited only on federal or state-owned lands (USFWS 1973). The U.S. Fish and Wildlife Service lists only four SGCN Maryland plants as Endangered and three as Threatened, while state regulations list 241 plants as Endangered and 83 as Threatened. In addition to this formal listing, MD DNR maintains a larger list of 740 plant species that are either rare, Threatened, Endangered or Endangered Extirpated, the result of a thorough review process by state botanists and other plant experts.

Outreach and education are important actions in advancing the conservation of rare plants. To this end, MD DNR provides information to assist with identifying and maintaining habitat for Maryland's rare, Threatened, and Endangered plant species and other native plants in general, in an effort to keep additional species from becoming rare. Maryland's Wild Acres program was developed to help landowners with habitats for plants and wildlife, as well as the quarterly HabiChat newsletter. As stated above, the Maryland Plant Atlas provides online distribution maps for all native and naturalized plants in Maryland based on the most recent and accurate data. This effort aims to promote plant conservation by increasing public awareness of and interest in plant diversity.

Additional conservation actions for plant SGCN are similar to those for animal SGCN. Properties with significant or unique KWHs and SGCN are directly conserved through land

acquisition and easement programs. These properties are then managed to maintain or restore ecosystem processes that those habitats and species need to survive. Fortunately, some plant conservation actions are effective at relatively small scales, making them more practical to implement. These actions may include conducting targeted research and inventory projects, creating no-mow areas or time periods, removing encroaching invasive species, installing deer exclosures around rare plants, conducting prescribed burns, working with developers to avoid and minimize impacts from developments, designating habitat buffers, and plugging drainage ditches to restore wetlands with rare wetland plants.

Rare plants take on the role of "canary in the coal mine" for Maryland's habitats, signaling through their decline that the system is unhealthy. Plants factor into many conservation decisions and actions in Maryland. By incorporating plants into the SWAP through habitat classifications and the SGCN plant list, the Plan highlights the importance of conserving plant life along with wildlife. Because SGCN plants are so closely aligned with KWHs, the threats and conservation actions listed in Appendix 6b are essentially the same as would apply to each KWH.

Table 3.19 Existing federal recovery plans for plant SGCN

Plant Species	Federal Recovery Plan	Recent Action
Canby's dropwort	USFWS 1990	2021: Initiation of 5-year review
Harperella	USFWS 1991	2024: Finalized 5-year review
Northeastern bulrush	USFWS 1993	2024: Proposed for deletion
Blue Ridge false foxglove	USFWS 1989	2019: Finalized 5-year review; needs taxonomic work
Seabeach amaranth	USFWS 1996	2023: Finalized 5-year review
Sensitive joint-vetch	USFWS 1995	2025: Finalized 5-year review
Swamp pink	USFWS 1991	2019: Initiation of 5-year review

Table 3.20 Plant SGCN in Maryland

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Alderleaf buckthorn	*Rhamnus alnifolia*	G5	S1			A
Allegheny plum	*Prunus alleghaniensis*	G4	S2		T	B
American bugbane	*Actaea podocarpa*	G4	S2			B
American chestnut	*Castanea dentata*	G3	S2S3			A
American feverfew	*Parthenium integrifolium*	G5	S1		E	A
American fly honeysuckle	*Lonicera canadensis*	G5	S1		E	A
American frog's-bit	*Limnobium spongia*	G4	S1		E	A
American ginseng	*Panax quinquefolius*	G3G4	S2S3			A
American gromwell	*Lithospermum latifolium*	G4	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
American harebell	*Campanula rotundifolia*	G5	S2			B
American larch	*Larix laricina*	G5	S1		E	A
American mannagrass	*Glyceria grandis*	G5	S1		E	A
Angular-fruit milkvine	*Gonolobus suberosus* var. *suberosus*	G5T5	S2			B
Appalachian sandwort	*Geocarpon glabrum*	G4	S1		E	A
Atamasco lily	*Zephyranthes atamasca*	G4G5	S1		E	A
Balsam fir	*Abies balsamea*	G5	S1			A
Bashful bulrush	*Trichophorum planifolium*	G4G5	S2			B
Beach plum	*Prunus maritima*	G4	S1		E	A
Beaked dodder	*Cuscuta rostrata*	G4	S1		E	A
Bearberry	*Arctostaphylos uva-ursi*	G5	S1		E	A
Big floatingheart	*Nymphoides aquatica*	G5	S1		E	A
Big shellbark hickory	*Carya laciniosa*	G5	S1		E	A
Black-fruit mountain-ricegrass	*Patis racemosa*	G5	S2S3			B
Black-fruit spikerush	*Eleocharis melanocarpa*	G4	S1		E	A
Black-stem spleenwort	*Asplenium resiliens*	G5	S1			A
Blue monkshood	*Aconitum uncinatum*	G4	S1		E	A
Blue Ridge false foxglove	*Agalinis decemloba*	G3G4	S1	E*	E	A
Blue Ridge sedge	*Carex lucorum*	G5	S1			A
Blue wild indigo	*Baptisia australis*	G3G4	S2		T	A
Blunt-lobe grapefern	*Sceptridium oneidense*	G4	S1		E	A
Bog buckbean	*Menyanthes trifoliata*	G5	S1		E	A
Bog clubmoss	*Lycopodiella inundata*	G5	S2			B
Bog fern	*Coryphopteris simulata*	G4G5	S2		T	B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Bog Jacob's ladder	*Polemonium vanbruntiae*	G3G4	S2		T	B
Box huckleberry	*Gaylussacia brachycera*	G3	S1		E	A
Bradley's spleenwort	*Asplenium bradleyi*	G4	S1		T	A
Braun's robin's-plantain	*Erigeron pulchellus* var. *brauniae*	G5T4	S1			A
Bristly sarsaparilla	*Aralia hispida*	G5	S1		E	A
Broad-glumed brome	*Bromus latiglumis*	G5	S1		E	A
Broadleaf bunchflower	*Veratrum hybridum*	G5	S1		E	A
Broadleaf water-milfoil	*Myriophyllum heterophyllum*	G5	S1			A
Brown-fruit rush	*Juncus pelocarpus*	G5	S1		E	A
Bulb-bearing water-hemlock	*Cicuta bulbifera*	G5	S1		E	A
Bunchberry	*Chamaepericl-ymenum canadese*	G5	S1		E	A
Bur oak	*Quercus macrocarpa*	G5	S1S2			A
Butternut	*Juglans cinerea*	G3	S2S3			A
Buxbaum's sedge	*Carex buxbaumii*	G5	S2		T	B
Canada burnet	*Sanguisorba canadensis*	G5	S2		T	B
Canada yew	*Taxus canadensis*	G5	S2		T	B
Canadian milkvetch	*Astragalus canadensis*	G5	S1		E	A
Canby's dropwort	*Tiedemannia canbyi*	G2	S1	E	E	A
Canby's lobelia	*Lobelia canbyi*	G4	S2		E	B
Canby's mountain-lover	*Paxistima canbyi*	G2?	S1		E	A
Capitate beakrush	*Rhynchospora cephalantha*	G5	S1		E	A
Carey's sedge	*Carex careyana*	G4G5	S1		E	A
Carolina anglepod	*Matelea carolinensis*	G4	S2S3		T	B
Carolina ash	*Fraxinus caroliniana*	G4G5	S2			B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Carolina clubmoss	*Pseudolycopodiella caroliniana*	G4	S1		E	A
Carolina fimbry	*Fimbristylis caroliniana*	G4	S1S2			A
Carolina sandwort	*Sabulina caroliniana*	G5	S1		E	A
Catchfly cutgrass	*Leersia lenticularis*	G5	S1		E	A
Chapman's redtop	*Tridens chapmanii*	G5T3	S1			A
Cliff stonecrop	*Sedum glaucophyllum*	G4	S2		T	B
Climbing dogbane	*Thyrsanthella difformis*	G4G5	S1		E	A
Climbing fern	*Lygodium palmatum*	G4	S2		T	B
Climbing fumitory	*Adlumia fungosa*	G4	S2		T	B
Climbing milkweed	*Matelea obliqua*	G4?	S1S2		E	A
Clinton lily	*Clintonia borealis*	G5	S2		T	B
Clinton's woodfern	*Dryopteris clintoniana*	G5	S1		E	A
Cloud sedge	*Carex haydenii*	G5	S1		E	A
Club-head cutgrass	*Leersia hexandra*	G5	S1		E	A
Coast bedstraw	*Galium hispidulum*	G5	S1		E	A
Coastal sedge	*Carex exilis*	G5	S1		E	A
Coastal butterfly pea	*Centrosema virginianum*	G5	S2			B
Coastal water-hyssop	*Bacopa monnieri*	G5?	S1			A
Common clammyweed	*Polanisia dodecandra*	G5	S1		E	A
Common snowberry	*Symphoricarpos albus*	G5	S1		T	A
Coppery St. John's-wort	*Hypericum denticulatum*	G5	S2		T	B
Coville's phacelia	*Phacelia covillei*	G3	S2		T	A
Cream tick-trefoil	*Desmodium ochroleucum*	G2G3	S1		E	A
Creeping burhead	*Echinodorus cordifolius*	G5	S1		E	A
Creeping snowberry	*Gaultheria hispidula*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Creeping St. John's-wort	*Hypericum adpressum*	G3	S1		E	A
Crested coralroot	*Hexalectris spicata*	G5	S1		E	A
Crossleaf milkwort	*Polygala cruciata*	G5	S2		T	B
Cymose beakrush	*Rhynchospora recognita*	G5?	S2			B
Cypress-knee sedge	*Carex decomposita*	G3G4	S1		E	A
Davis' sedge	*Carex davisii*	G4	S1		E	A
Pinebarrens death-camas	*Stenanthium leimanthoides*	G4Q	S1		E	A
Deciduous holly	*Ilex decidua*	G5	S2			B
Devil's-bit	*Chamaelirium luteum*	G4G5	S2			B
Downy phlox	*Phlox pilosa*	G5	S1		E	A
Downy willowherb	*Epilobium densum*	G5	S1		E	A
Drooping bluegrass	*Poa saltuensis*	G5	S1		E	A
Drowned hornrush	*Rhynchospora inundata*	G4	S1		E	A
Drummond's aster	*Symphyotrichum drummondii*	G5	S1			A
Dwarf bulrush	*Cyperus subsquarrosus*	G5	S1		E	A
Dwarf crested iris	*Iris cristata*	G5	S1		E	A
Dwarf huckleberry	*Gaylussacia dumosa*	G5	S1		E	A
Dwarf iris	*Iris verna* var. *verna*	G5T5	S1		E	A
Dwarf prairie willow	*Salix occidentalis*	G5T5	S2			B
Dwarf sundew	*Drosera brevifolia*	G5	S1			A
Dwarf umbrella-sedge	*Fuirena pumila*	G5	S2S3			B
Earleaf false foxglove	*Agalinis auriculata*	G3	S1		E	A
Early buttercup	*Ranunculus fascicularis*	G5	S1		E	A
Early coralroot	*Corallorhiza trifida*	G5	S1		E	A
Eastern bloodleaf	*Iresine rhizomatosa*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Eastern featherbells	*Stenanthium gramineum*	G4	S1		T	A
Eastern leatherwood	*Dirca palustris*	G5	S2		T	B
Eastern silvery aster	*Symphyotrichum concolor*	G5	S1		E	A
Eastern straw sedge	*Carex straminea*	G5	S1S2			A
Ebony sedge	*Carex eburnea*	G5	S1		E	A
Elliott's rush	*Juncus elliottii*	G4G5	S1			A
Engelmann's arrowhead	*Sagittaria engelmanniana*	G5?	S2		T	B
Epling's hedge-nettle	*Stachys eplingii*	G1G2	S1			A
Evergreen bayberry	*Morella caroliniensis*	G5	S2		T	B
Featherfoil	*Hottonia inflata*	G4	S1		T	A
Fernald's mannagrass	*Torreyochloa pallida* var. *fernaldii*	G5T5Q	S1			A
Fernald's tick-trefoil	*Desmodium fernaldii*	G4	S1			A
Few-flowered tick-trefoil	*Hylodesmum pauciflorum*	G5	S2		E	B
Few-flowered witchgrass	*Dichanthelium oligosanthes* var. *oligosanthes*	G5T5?	S2S3			B
Fibrous bladderwort	*Utricularia striata*	G4G5	S1		E	A
Field sedge	*Carex conoidea*	G5	S1		E	A
Filmy angelica	*Angelica triquinata*	G4	S1		E	A
Flat-spiked sedge	*Carex planispicata*	G4Q	S1S2			A
Flat-stem spikerush	*Eleocharis compressa* var. *compressa*	G5T5	S1		E	A
Flatleaf bladderwort	*Utricularia intermedia*	G5	S1			A
Flatsedge	*Cyperus hystricinus*	G4	S2			B
Flatstem pondweed	*Potamogeton zosteriformis*	G5	S1		E	A
Flattened pipewort	*Eriocaulon compressum*	G5	S2			B
Fly-poison	*Amianthium muscitoxicum*	G4G5	S2			B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Fowl bluegrass	*Poa palustris*	G5	S1			A
Fraser's sedge	*Carex fraseriana*	G4	S1		E	A
Fringe-top bottle gentian	*Gentiana andrewsii*	G5	S2		T	B
Fringed gentian	*Gentianopsis crinita*	G5	S1		E	A
Fringed yellow-eyed-grass	*Xyris fimbriata*	G5	S1		E	A
Giant-seed goosefoot	*Chenopodiastr-um simplex*	G5	S2		T	B
Gibbous panic-grass	*Sacciolepis striata*	G5	S1		E	A
Glade fern	*Homalosorus pycnocarpos*	G5	S2		T	B
Glade mallow	*Napaea dioica*	G4	S1		E	A
Glade spurge	*Euphorbia purpurea*	G3	S1		E	A
Globe beakrush	*Rhynchospora globularis*	G5?	S1		E	A
Golden heather	*Hudsonia ericoides*	G4	S1		E	A
Golden-seal	*Hydrastis canadensis*	G3G4	S2		T	A
Goldie's fern	*Dryopteris goldieana*	G4G5	S2			B
Goldthread	*Coptis trifolia*	G5	S1		E	A
Goosefoot cornsalad	*Valerianella chenopodiifolia*	G4	S1		E	A
Green adder's-mouth orchid	*Malaxis unifolia*	G5	S2			B
Gritty hedge-nettle	*Stachys aspera*	G4?	S1		E	A
Grooved yellow flax	*Linum sulcatum*	G5	S1		E	A
Grove sandwort	*Moehringia lateriflora*	G5	S1		E	A
Hair-awn muhly	*Muhlenbergia capillaris*	G5	S1		E	A
Hairy false gromwell	*Lithospermum parviflorum*	G4G5T4	S1		E	A
Hairy lettuce	*Lactuca hirsuta*	G5?	S1			A
Hairy ludwigia	*Ludwigia hirtella*	G5	S1		E	A
Hairy needle-leaved witchgrass	*Dichanthelium filiramum*	GNR	S2			B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Hairy rockcress	*Arabis adpressipilis*	G4	S1S2			A
Hairy snoutbean	*Rhynchosia tomentosa*	G5	S2		T	B
Hairy wild petunia	*Ruellia humilis*	G5	S1		E	A
Hairy woodmint	*Blephilia hirsuta*	G5	S1S2			A
Hairy-fruited sedge	*Carex trichocarpa*	G4	S2			B
Harned's clintonia	*Clintonia alleghaniensis*	G1Q	S1			A
Harper's fimbristylis	*Fimbristylis perpusilla*	G2	S2		E	A
Harperella	*Harperella nodosa*	G2	S1	E	E	A
Hazel dodder	*Cuscuta coryli*	G4	S1			A
Highland rush	*Oreojuncus trifidus*	G5	S1		E	A
Hitchcock's sedge	*Carex hitchcockiana*	G5	S1		E	A
Hooded skullcap	*Scutellaria galericulata*	G5	S2			B
Horned bladderwort	*Utricularia cornuta*	G5	S1			A
Horse-tail paspalum	*Paspalum fluitans*	G5	S2		T	B
Horsetail spikerush	*Eleocharis equisetoides*	G4	S1		E	A
Houghton's umbrella-sedge	*Cyperus houghtonii*	G4?	S1			A
Hyssopleaf hedge-nettle	*Stachys hyssopifolia*	G4G5	S1			A
Illinois pondweed	*Potamogeton illinoensis*	G5	S2			B
Inflated sedge	*Carex vesicaria*	G5	S1		T	A
Inland sedge	*Carex interior*	G5	S1			A
Jointed rush	*Juncus articulatus*	G5	S1			A
Kate's Mountain clover	*Trifolium virginicum*	G3	S2S3		T	A
Kidneyleaf grass-of-parnassus	*Parnassia asarifolia*	G4	S1		E	A
Kidneyleaf twayblade	*Neottia smallii*	G4	S1		E	A
Koehne ammannia	*Ammannia latifolia*	G5	S2			B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Lake-bank sedge	*Carex lacustris*	G5	S2			B
Lake-cress	*Armoracia lacustris*	G4?	S1		E	A
Lanceleaf grapefern	*Botrychium angustisegment-um*	G4	S1		X	A
Large purple fringed orchid	*Platanthera grandiflora*	G5	S2		T	B
Large-flower bellwort	*Uvularia grandiflora*	G5	S1			A
Large-leaf waterleaf	*Hydrophyllum macrophyllum*	G5	S2		T	B
Large-leaved pondweed	*Potamogeton amplifolius*	G5	S1S2			A
Late goldenrod	*Solidago tarda*	G4?Q	S1			A
Leafy pondweed	*Potamogeton foliosus*	G5	S2			B
Leatherleaf	*Chamaedaphne calyculata*	G5	S1		T	A
Leopard's-bane	*Arnica acaulis*	G4	S1		E	A
Lesser panicled sedge	*Carex diandra*	G5	S1		E	A
Limestone wild petunia	*Ruellia strepens*	G4G5	S2S3			B
Linear-leaf willowherb	*Epilobium leptophyllum*	G5	S2S3			B
Little floatingheart	*Nymphoides cordata*	G5	S1		E	A
Little-head nutrush	*Scleria oligantha*	G5	S1			A
Lobed spleenwort	*Asplenium pinnatifidum*	G4	S1		E	A
Loesel's twayblade	*Liparis loeselii*	G5	S1S2			A
Long-beaked baldrush	*Rhynchospora scirpoides*	G4	S2		T	B
Long-bract green orchis	*Dactylorhiza viridis*	G5	S1		E	A
Long-bristle Indian grass	*Sorghastrum elliottii*	G5	S1		E	A
Long-stalk greenbrier	*Smilax pseudochina*	G4G5	S2		T	B
Long-stalked crowfoot	*Ranunculus hederaceus*	G5	S1		E	A
Long-stalked sedge	*Carex pedunculata*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Long's bittercress	*Cardamine longii*	G3?	S2		E	A
Long's rush	*Juncus longii*	G3Q	S1		E	A
Low bindweed	*Convolvulus spithamaeus*	G5T4	S2			B
Low nutrush	*Scleria verticillata*	G5	S1		E	A
Low rough aster	*Eurybia radula*	G5	S1		E	A
Low showy aster	*Eurybia spectabilis*	G5	S1		E	A
Lowland loosestrife	*Steironema hybridum*	G5	S2		T	B
Many-flowered umbrella-sedge	*Cyperus lancastriensis*	G5	S2S3			B
Marsh fleabane	*Pluchea camphorata*	G5	S2		T	B
Marsh speedwell	*Veronica scutellata*	G5	S1		E	A
Maryland bur-marigold	*Bidens bidentoides*	G3G4	S3.1			B
Matted spikerush	*Eleocharis intermedia*	G5	S1		E	A
McDowell's sunflower	*Helianthus occidentalis*	G5	S1		T	A
Mead's sedge	*Carex meadii*	G4G5	S1		E	A
Michaux's stitchwort	*Sabulina michauxii*	G5	S2		T	B
Mid-Atlantic beakrush	*Rhynchospora mesoatlantica*	G1	S1		E	A
Mississippi buttercup	*Ranunculus laxicaulis*	G5?	S1		E	A
Missouri rockcress	*Borodinia missouriensis*	G5	S1		E	A
Mitchell's sedge	*Carex mitchelliana*	G4	S2			B
Mountain parsley	*Taenidia montana*	G3	S2		T	A
Mountain woodfern	*Dryopteris campyloptera*	G5	S1		E	A
Mudwort	*Limosella australis*	G5	S2		E	B
Muehlenberg's nutrush	*Scleria muehlenbergii*	G5	S1S2			A
Nannyberry	*Viburnum lentago*	G5	S1			A
Nantucket shadbush	*Amelanchier nantucketensis*	G3Q	S1		T	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Narrow-panicle rush	*Juncus tweedyi*	G5	S2			B
Narrowleaf bluecurls	*Trichostema setaceum*	G5	S1			A
Narrowleaf willow	*Salix interior*	G5	S1		E	A
Necklace sedge	*Carex projecta*	G5	S2			B
New Jersey rush	*Juncus caesariensis*	G2G3	S1		E	A
Nodding pogonia	*Triphora trianthophoros*	G4?	S1		E	A
Nodding trillium	*Trillium flexipes*	G5	S1		E	A
Northeastern bladderwort	*Utricularia resupinata*	G4	S1		E	A
Northeastern bulrush	*Scirpus ancistrochaetus*	G3	S1	E (PD)	E	A
Northeastern white water-crowfoot	*Ranunculus trichophyllus*	G5	S1		E	A
Northern bedstraw	*Galium boreale*	G5	S1		E	A
Northern beechfern	*Phegopteris connectilis*	G5	S2			B
Northern dropseed	*Sporobolus heterolepis*	G5	S1		E	A
Northern oak fern	*Gymnocarpium dryopteris*	G5	S1		E	A
Northern pitcherplant	*Sarracenia purpurea*	G5	S2		T	B
Northern prickly-ash	*Zanthoxylum americanum*	G5	S1S2		E	A
Northern white-cedar	*Thuja occidentalis*	G5	S1		T	A
Octoraro Creek chickweed	*Cerastium velutinum* var. *villosissimum*	G5T1	S1			A
One-flower sclerolepis	*Sclerolepis uniflora*	G3	S2		T	A
Ostrich fern	*Matteuccia struthiopteris*	G5	S2S3			B
Ozark milkvetch	*Astragalus distortus*	G5	S2		T	B
Pale beardtongue	*Penstemon pallidus*	G5	S1			A
Pale false foxglove	*Agalinis skinneriana*	G3G4	S1		E	A
Pale green orchid	*Platanthera flava*	G4?	S2S3			B

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Parker's pipewort	*Eriocaulon parkeri*	G3	S2		T	A
Partridge pea	*Chamaecrista fasciculata* var. *macrosperma*	G5T3	S1		E	A
Pineland tick-trefoil	*Desmodium strictum*	G4	S1		E	A
Pink milkwort	*Senega incarnata*	G5	S2S3			B
Pink sundew	*Drosera capillaris*	G5	S1		E	A
Pipevine	*Isotrema macrophyllum*	G5	S2		T	B
Plains frostweed	*Crocanthemum bicknellii*	G5	S1		E	A
Plukenet's flatsedge	*Cyperus plukenetii*	G5	S1		E	A
Pondspice	*Litsea aestivalis*	G3?	S1		E	A
Porcupine sedge	*Carex hystericina*	G5	S1		E	A
Potato dwarf-dandelion	*Krigia dandelion*	G5	S2S3			B
Prairie blazing star	*Liatris spicata*	G5	S1			A
Prairie goldenrod	*Solidago rigida*	G5	S1		E	A
Primrose-willow	*Ludwigia decurrens*	G5	S2S3			B
Puerto Rico sea-purslane	*Sesuvium maritimum*	G5	S1		E	A
Purple bladderwort	*Utricularia purpurea*	G5	S1		T	A
Purple clematis	*Clematis occidentalis*	G5	S1		E	A
Purple fringeless orchid	*Platanthera peramoena*	G5	S1S2		T	A
Purple giant-hyssop	*Agastache scrophulariifolia*	G4	S1S2		T	A
Purple meadow-parsnip	*Thaspium trifoliatum*	G5	S1		E	A
Purple mecardonia	*Mecardonia acuminata*	G5	S2		E	B
Purple milkweed	*Asclepias purpurascens*	G4G5	S2			B
Purple oat	*Schizachne purpurascens*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Pursh's wild petunia	*Ruellia purshiana*	G3	S1		E	A
Queen-of-the-prairie	*Filipendula rubra*	G4G5	S1		E	A
Racemed milkwort	*Senega polygama*	G5	S1		T	A
Racemose goldenrod	*Solidago racemosa*	G5T3?	S1		T	A
Ravenel's witchgrass	*Dichanthelium ravenelii*	G5	S1			A
Red bay	*Tamala palustris*	G5	S1		E	A
Red milkweed	*Asclepias rubra*	G4G5	S1		E	A
Red root	*Lachnanthes caroliniana*	G4	S1		E	A
Red turtlehead	*Chelone obliqua*	G4	S2		T	B
Reticulated nutrush	*Scleria reticularis*	G4	S2S3			B
Richardson's sedge	*Carex richardsonii*	G5	S1		E	A
Rigid sedge	*Carex tetanica* var. *canbyi*	G4G5T1T2Q	S1		E	A
Ringed witchgrass	*Dichanthelium annulum*	G4	S1			A
Robbins' spikerush	*Eleocharis robbinsii*	G4G5	S1		E	A
Rock goldenrod	*Solidago rupestris*	G4?	S1			A
Rock grape	*Vitis rupestris*	G3	S1			A
Rock skullcap	*Scutellaria saxatilis*	G3G4	S1		E	A
Rose coreopsis	*Coreopsis rosea*	G3	S1		E	A
Rosy twisted-stalk	*Streptopus lanceolatus*	G5	S1S2		T	A
Rough dropseed	*Sporobolus clandestinus*	G4G5	S2			B
Rough flatsedge	*Cyperus retrofractus*	G5	S2			B
Roundleaf dogwood	*Swida rugosa*	G5	S1		E	A
Roundleaf fameflower	*Phemeranthus teretifolius*	G4	S2		T	B
Roundleaf serviceberry	*Amelanchier sanguinea*	G5	S1		E	A
Running serviceberry	*Amelanchier spicata*	G5	S2			B
Running shadbush	*Amelanchier humilis*	G5	S1		T	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Rusty woodsia	*Woodsia ilvensis*	G5	S2		T	B
Salad violet	*Viola esculenta*	G4G5	S2			B
Saltmarsh bulrush	*Bolboschoenus novae-angliae*	G3	S2			A
Saltmarsh spikerush	*Eleocharis uniglumis*	G4Q	S1		E	A
Sandplain flax	*Linum intercursum*	G4	S2		T	B
Sandyland blue-eyed grass	*Sisyrinchium arenicola*	GNR	S1		E	A
Scaly gayfeather	*Liatris squarrosa*	G5	S1		E	A
Scarlet Indian-paintbrush	*Castilleja coccinea*	G5	S1		E	A
Scribner's witchgrass	*Dichanthelium oligosanthes* var. *scribnerianum*	G5T5	S2			B
Sea chickweed	*Honckenya peploides*	G5	S1		E	A
Seabeach amaranth	*Amaranthus pumilus*	G2	S1	T	E	A
Seabeach knotweed	*Polygonum glaucum*	G3	S1		E	A
Seabeach orach	*Atriplex mucronata*	G3G4	S1S2			A
Seabeach sedge	*Carex silicea*	G5	S1		E	A
Seaside alder	*Alnus maritima*	G3	S3.1			B
Seneca snakeroot	*Senega officinalis*	G4G5	S2		T	B
Sensitive joint-vetch	*Aeschynomene virginica*	G2	S1	T	E	A
Serpentine aster	*Symphyotrichum depauperatum*	G2	S1		E	A
Sessile-fruit arrowhead	*Sagittaria rigida*	G5	S1		E	A
Sessile-leaf bugleweed	*Lycopus amplectens*	G5	S1		E	A
Seven-angle pipewort	*Eriocaulon aquaticum*	G5	S1		E	A
Shale barren skullcap	*Scutellaria leonardii*	G5	S2		T	B
Sharp-scaled mannagrass	*Glyceria acutiflora*	G5	S1		E	A
Sharpscale sedge	*Carex oxylepis*	G5?	S1			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Shining ladies'-tresses	*Spiranthes lucida*	G4	S1		E	A
Shoreline sedge	*Carex hyalinolepis*	G4G5	S2S3			B
Short-beaked baldrush	*Rhynchospora nitens*	G4	S1		E	A
Short's hedge-hyssop	*Gratiola viscidula*	G4G5	S1		E	A
Shortleaf beardgrass	*Gymnopogon brevifolius*	G5	S1		E	A
Showy goldenrod	*Solidago speciosa*	G5	S2		T	B
Shriver's frilly orchid	*Platanthera shriveri*	G1	S1			A
Shumard oak	*Quercus shumardii*	G5	S2		T	B
Side-oats grama	*Bouteloua curtipendula*	G5	S2			B
Single-head pussytoes	*Antennaria solitaria*	G5	S2		T	B
Slender blueflag	*Iris prismatica*	G4G5	S2		E	B
Slender cottongrass	*Eriophorum gracile*	G5	S1		E	A
Slender marsh pink	*Sabatia campanulata*	G4	S1		E	A
Slender nutrush	*Scleria minor*	G4	S1		E	A
Slender plume grass	*Erianthus strictus*	G5	S1		E	A
Slender rattlesnake-root	*Nabalus autumnalis*	G4G5	S1		E	A
Slender sedge	*Carex lasiocarpa*	G5	S1		E	A
Slender-leaved bluets	*Houstonia tenuifolia*	G5T4T5	S1			A
Small cranberry	*Vaccinium oxycoccos*	G5	S2		T	B
Small purple fringed orchid	*Platanthera psycodes*	G5	S1		X	A
Small white lady's-slipper	*Cypripedium candidum*	G4	S1		E	A
Small-flower baby-blue-eyes	*Nemophila aphylla*	G5	S2			B
Small-headed beakrush	*Rhynchospora microcephala*	G5T5	S2			B
Small's yellow-eyed-grass	*Xyris smalliana*	G4G5	S1		E	A
Smartweed dodder	*Cuscuta polygonorum*	G4G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Smooth cliffbrake	*Pellaea glabella*	G5	S1		E	A
Smooth false buttonweed	*Spermacoce glabra*	G4G5	S1		E	A
Smooth orange milkweed	*Asclepias lanceolata*	G5	S1			A
Smooth phlox	*Phlox glaberrima*	G5	S1		E	A
Smooth rose	*Rosa blanda*	G5	S1		E	A
Smooth sunflower	*Helianthus laevigatus*	G4	S1		E	A
Snow trillium	*Trillium nivale*	G4	S1		E	A
Snowy campion	*Silene nivea*	G4?	S1		E	A
Sourwood	*Oxydendrum arboreum*	G5	S1		E	A
Southern waxy sedge	*Carex glaucescens*	G4	S1		E	A
Southern wild rice	*Zizaniopsis miliacea*	G5	S1		E	A
Spiked hoary-pea	*Tephrosia spicata*	G4G5	S1S2		T	A
Spongy arrowhead	*Sagittaria spatulata*	G5T4	S2			B
Spreading pogonia	*Cleistesiopsis divaricata*	G4	S1		E	A
Spreading rockcress	*Arabis patens*	G3	S2			A
Spring coralroot	*Corallorhiza wisteriana*	G5	S1		E	A
Standley's goosefoot	*Chenopodium standleyanum*	G5	S2S3			B
Star duckweed	*Lemna trisulca*	G5	S1		E	A
Starflower Solomon’s-plume	*Maianthemum stellatum*	G5	S2		E	B
Stiff gentian	*Gentianella quinquefolia*	G5	S1		E	A
Stiff tick-trefoil	*Desmodium obtusum*	G4G5	S1		E	A
Stiff-hair sunflower	*Helianthus hirsutus*	G5	S1			A
Striped gentian	*Gentiana villosa*	G4	S1		E	A
Summer sedge	*Carex aestivalis*	G4	S1		E	A
Sundial lupine	*Lupinus perennis*	G5	S2		T	B
Susquehanna doll's-daisy	*Boltonia asteroides* var. *asteroides*	G5TNR	S1			A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Swamp lousewort	*Pedicularis lanceolata*	G4	S1		E	A
Swamp pink	*Helonias bullata*	G3	S2	T	E	A
Swamp wedgescale	*Sphenopholis pensylvanica*	G4	S2		T	B
Sweet pinesap	*Monotropsis odorata*	G3	S1		E	A
Sweet-scented Indian-plantain	*Hasteola suaveolens*	G4	S1		E	A
Switch cane	*Arundinaria tecta*	G5	S2			B
Swollen bladderwort	*Utricularia inflata*	G5	S2			B
Tall dock	*Rumex altissimus*	G5	S1		E	A
Tall larkspur	*Delphinium exaltatum*	G3	S1		E	A
Tall swamp witchgrass	*Dichanthelium scabriusculum*	G4	S1		T	A
Tall tickseed	*Coreopsis tripteris*	G5	S1		E	A
Ten-angle pipewort	*Eriocaulon decangulare*	G5	S1			A
Tennessee bladderfern	*Cystopteris tennesseensis*	G5	S1			A
Threadleaf gerardia	*Agalinis setacea*	G5?	S2		E	B
Three-angle spikerush	*Eleocharis tricostata*	G4	S1		E	A
Three-flower melicgrass	*Melica nitens*	G5	S2		T	B
Three-ribbed arrow-grass	*Triglochin striata*	G5	S1S2		E	A
Tobaccoweed	*Elephantopus tomentosus*	G5	S2		T	B
Toothed tick-trefoil	*Desmodium cuspidatum*	G5	S1			A
Torrey's beakrush	*Rhynchospora torreyana*	G4	S2		T	B
Torrey's bulrush	*Schoenoplectus torreyi*	G4	S1			A
Torrey's dropseed	*Muhlenbergia torreyana*	G3	S1		E	A
Torrey's mountainmint	*Pycnanthemum torreyi*	G2	S1		E	A
Trailing stitchwort	*Stellaria alsine*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Tuberous grass-pink	*Calopogon tuberosus*	G5	S1		E	A
Tuckerman's sedge	*Carex tuckermanii*	G5	S1		E	A
Tufted hairgrass	*Deschampsia cespitosa*	G5	S1		E	A
Two-formed pink	*Sabatia difformis*	G4G5	S1		E	A
Umbrella flats flatsedge	*Cyperus diandrus*	G5?	S1			A
Upland dwarf iris	*Iris verna* var. *smalliana*	G5T4T5	S1			A
Valerian	*Valeriana pauciflora*	G4	S1		E	A
Vanilla grass	*Hierochloe hirta*	G5	S1		E	A
Vasey's goldenrod	*Solidago vaseyi*	G4	S1			A
Veined skullcap	*Scutellaria nervosa*	G5	S1S2		T	A
Velvety sedge	*Carex vestita*	G5	S2		T	B
Vetchling peavine	*Lathyrus palustris*	G5	S1		E	A
Virginia false gromwell	*Lithospermum virginianum*	G4	S1		E	A
Virginia heartleaf	*Hexastylis virginica*	G4	S1		E	A
Virginia least trillium	*Trillium pusillum* var. *virginianum*	G4T3	S2		T	A
Virginia mallow	*Ripariosida hermaphrodita*	G3	S1		E	A
Virginia mountainmint	*Pycnanthemum virginianum*	G5	S2			B
Walter's paspalum	*Paspalum dissectum*	G4?	S2		T	B
Wand-like three-awn grass	*Aristida virgata*	G4G5	S2		T	B
Warty spurge	*Euphorbia spathulata*	G5	S1		E	A
Water bulrush	*Schoenoplectus subterminalis*	G5	S1		E	A
Water horsetail	*Equisetum fluviatile*	G5	S1		E	A
Water loosestrife	*Lysimachia thyrsiflora*	G5	S1		E	A
Water pygmyweed	*Crassula aquatica*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Water-plantain spearwort	*Ranunculus ambigens*	G4	S1			A
Western hairy rockcress	*Arabis pycnocarpa*	G5	S1			A
Eastern doll's-daisy	*Boltonia asteroides var. glastifolia*	G5TNR	S1		E	A
White fringed orchid	*Platanthera blephariglottis*	G4G5	S2		T	B
White-grained mountain-ricegrass	*Oryzopsis asperifolia*	G5	S2		T	B
White spikerush	*Eleocharis albida*	G4G5	S2S3			B
White trout lily	*Erythronium albidum*	G5	S2		T	B
White-bracted boneset	*Eupatorium leucolepis*	G5	S2S3		T	B
White-margin panicgrass	*Dichanthelium tenue*	GNR	S1			A
Whorled mountainmint	*Pycnanthemum verticillatum*	G5	S2		T	B
Whorled water-milfoil	*Myriophyllum verticillatum*	G5	S1			A
Wild black currant	*Ribes americanum*	G5	S1		X	A
Wild bleedinghearts	*Dicentra eximia*	G4	S2		T	B
Wild calla	*Calla palustris*	G5	S1		E	A
Willow aster	*Symphyotrichum praealtum*	G5	S1			A
Winged loosestrife	*Lythrum alatum*	G5	S1		E	A
Wiry witch grass	*Panicum flexile*	G5	S1		E	A
Woodland agrimony	*Agrimonia striata*	G5	S1		E	A
Woodland horsetail	*Equisetum sylvaticum*	G5	S1		E	A
Woolly three-awn	*Aristida lanosa*	G5	S1		E	A
Wright's witchgrass	*Dichanthelium wrightianum*	G4	S1		E	A
Wrinkled joingrass	*Mnesithea rugosa*	G5	S1		E	A
Yellow avens	*Geum aleppicum*	G5	S1		E	A

Common Name	Scientific Name	G-Rank[1]	S-Rank[1]	Federally listed[2]	State-listed[2]	Conservation status group[3]
Yellow fringed orchid	*Platanthera ciliaris*	G5	S2		T	B
Yellow nailwort	*Paronychia virginica*	G4	S1		E	A
Yellow nodding ladies' tresses	*Spiranthes ochroleuca*	G4	S1		E	A
Yellow water-crowfoot	*Ranunculus flabellaris*	G5	S1		E	A
Yellowleaf tinker's-weed	*Triosteum angustifolium*	G5	S1		E	A

[1] = See Table 3,5 for S-rank and G-rank definitions
[2] = T (Threatened); E (Endangered); X (Endangered Extirpated); PD (Proposed for Delisting)
[3] = See Table 3.7 for Conservation Status definitions
* = a qualifier denoting the species is listed in a limited geographic area only

Using the best available current information, this chapter summarized the full array of species found in Maryland and identified Species of Greatest Conservation Need (SGCN) in each taxonomic group (addressing **Element #1**). The next chapter will provide detailed information about the distribution and condition of the identified Key Wildlife Habitats (KWHs), including their associated SGCN and natural communities (addressing **Element #2**).

Citations and Sources

Abarca, M., E.A. Larsen, and L. Ries. 2019. "Heatwaves and Novel Host Consumption Increase Overwinter Mortality of an Imperiled Wetland Butterfly." *Frontiers in Ecology and Evolution* 7: 193. https://doi.org/10.3389/fevo.2019.00193.

Allender, Matthew C., M. Dreslik, S. Wylie, C. Phillips, D.B. Wylie, C. Maddox, M.A. Delaney, and M.J. Kinsel. 2011. "*Chrysosporidium sp*. Infection in Eastern Massasauga Rattlesnake." *Emerging Infectious Diseases* 17(12): 2383-2384. https://doi.org/10.3201/eid1712.110240.

Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. "Population estimates of North American shorebirds, 2012." *Wader Study Group Bulletin* 119(3): 178–194.

Ascher, J.S. and J. Pickering. 2020. "Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila)." Discover Life. http://www.discoverlife.org/mp/20q?guide=Apoidea_species

Association of Fish & Wildlife Agencies (AFWA). 2012. *Best Practices for State Wildlife Action Plans: Voluntary Guidance to States for Revision and Implementation.* Teaming With Wildlife Committee's State Wildlife Action Plan (SWAP) Best Practices Working Group: Washington, DC. https://www.fishwildlife.org/application/files/3215/1856/0300/SWAP_Best_Practices_Report_Nov_2012.pdf.

Association of Fish & Wildlife Agencies (AFWA). 2024a. *Bsal guidance for state wildlife action plans 2024.* Amphibian & Reptile Conservation Committee. https://www.fishwildlife.org/application/files/7717/1268/4602/Bsal_for_SWAPS_2024_v.1.pdf.

Association of Fish & Wildlife Agencies (AFWA). 2024b. *Illegal and unsustainable trade of reptiles and amphibians guidance for state wildlife action plans 2024.* Amphibian & Reptile Conservation Committee. https://www.fishwildlife.org/application/files/2317/3462/3853/Illegal_Herp_Trade_for_SWAPs_2024.pdf.

Atlantic Coast Joint Venture (ACJV). 2005. *North American Waterfowl Management Plan*. Hadley, MA.

Atlantic Coast Joint Venture (ACJV). 2020. *Eastern Black Rail Conservation Plan for the Atlantic Coast*. https://www.acjv.org/documents/BLRA_Plan.pdf.

Atlantic Coast Joint Venture (ACJV). 2024. *Saltmarsh Restoration Priorities for the Saltmarsh Sparrow: Maryland.* https://acjv.org/documents/MD_SALS_comp_guidance_doc.pdf.

Atlantic States Marine Fisheries Commission (ASMFC). 1985. *Fishery management plan for the anadromous alosid stocks of the eastern United States: American shad,*

hickory shad, alewife, and blueback herring: phase II in interstate management planning for migratory alosids of the Atlantic coast. Washington, DC.

Atlantic States Marine Fisheries Commission (ASMFC). 1998. *Interstate fishery management plan for Atlantic sturgeon.* Washington, DC.

Atlantic States Marine Fisheries Commission (ASMFC). 1999. *Amendment 1 to the Interstate Fishery Management Plan for Shad & River Herring.* Washington, DC.

Atlantic States Marine Fisheries Commission (ASMFC). 2009. *Amendment 2 to the Interstate Fishery Management Plan for Shad & River Herring (River Herring Management).* Arlington, VA.

Atlantic States Marine Fisheries Commission (ASMFC). *2010. Amendment 3 to the Interstate Fishery Management Plan for Shad & River Herring (American Shad Management).* Arlington, VA.

Atlantic States Marine Fisheries Commission (ASMFC). 2020. *2020 American Shad Benchmark Stock Assessment and Peer Review Report.* https://asmfc.org/wp-content/uploads/2025/01/AmShadBenchmarkStockAssessment_PeerReviewReport_2020_web.pdf.

Atlantic States Marine Fisheries Commission (ASMFC). 2024. *River Herring Benchmark Stock Assessment and Peer Review Report.* https://asmfc.org/resources/stock-assessment/river-herring-benchmark-stock-assessment-and-peer-review-report-2024/.

Bárcenas-García, A., F. Michalski, W.H. Morgan, R K. Smith, W.J. Sutherland, J.P. Gibbs, and D. Norris. 2022. "Impacts of dams on freshwater turtles: A global review to identify conservation solutions." *Tropical Conservation Science* 15. https://doi.org/10.1177/19400829221103709.

Barrett, K. and S.J. Price. 2014. "Urbanization and stream salamanders: a review, conservation options, and research needs." *Freshwater Science* 33: 927-940. https://doi.org/10.1086/677556.

Beale, D.J., K. Hillyer, S. Nilsson, D. Limpus, U. Bose, J.A. Broadbent, and S. Vardy. 2022a. "Bioaccumulation and metabolic response of PFAS mixtures in wild-caught freshwater turtles (*Emydura macquarii macquarii*) using omics-based ecosurveillance techniques." *Science of the Total Environment* 806(3): e151264. https://doi.org/10.1016/j.scitotenv.2021.151264.

Beale, D.J., S. Nilsson, U. Bose, N. Bourne, S. Stockwell, J.A. Broadbent, V. Gonzalez-Astudillo, C. Braun, B. Baddiley, D. Limpus, T. Walsh, and S. Vardy. 2022b. "Bioaacumulation and impact of maternal PFAS offloading on egg biochemistry from wild-caught freshwater turtles (*Emydura macquarii macquarii*)." *Science of the Total Environment* 817: e153019. http://dx.doi.org/10.1016/j.scitotenv.2022.153019.

Berger, L., A.A. Roberts, J. Voyles, J.E. Longcore, K.A. Murray, and L.F. Skerratt. 2015. "History and recent progress on chytridiomycosis in amphibians." *Fungal Ecology* 19: 89-99. https://doi.org/10.1016/j.funeco.2015.09.007.

Bogan, A.E., M.J. Ashton, and J.M. Pfieffer. 2026. *Manual of the freshwater bivalves of Maryland.* Maryland Department of Natural Resources, Resource Assessment Service, Monitoring and Non-Tidal Assessment Division: Annapolis, MD. https://dnr.maryland.gov/streams/publications/manual-freshwater%20mussels%20of%20md.pdf.

Bourdon, R.J. 2021. *American Shad Habitat Plan for Maryland.* Maryland Department of Natural Resources, Fishing and Boating Services. https://asmfc.org/wp-content/uploads/2025/02/MD_ShadHabitatPlan_2020.pdf.

Boward, D.M., P.F. Kazyak, S.A. Stranko, M.K. Hurd, and T.P. Prochaska. 1999. *From the mountains to the sea: the state of Maryland's freshwater streams.* Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. U.S. Environmental Protection Agency: Washington, DC.

Brand, A., A.N.M. Wiewel, and E.H. Campbell Grant. 2014. "Potential reduction in terrestrial salamander ranges associated with Marcellus shale development." *Biological Conservation* 180: 233-240.

Brinker, D.F., B. Williams, B.D. Watts, and R.M. Erwin. 2007. "Colonial nesting seabirds in the Chesapeake region: Where have we been and where are we going?" *Waterbirds* 30: 93-104.

Brinker, D.F., G.D. Therres, P.J. Tango, M. O'Brien, E.A.T. Blom, and H.L. Wierenga. 2001. *Distribution and relative abundance of breeding rails and other marshbirds in Maryland's tidal marshes.* Maryland Department of Natural Resources: Annapolis, MD.

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. *The U.S. Shorebird Conservation Plan,* 2nd edition. Manomet Center for Conservation Sciences: Manomet, MA. https://www.shorebirdplan.org/wp-content/uploads/2013/01/USShorebirdPlan2Ed.pdf.

Brunner, J.L., A. Storfer, E.H. Le Sage, T.W.J. Garner, M.J. Gray, and J.T. Hoverman. 2025. "Ranavirus Ecology: From Individual Infections to Population Epidemiology to Community Impacts." In *Ranaviruses: Emerging Pathogens of Ectothermic Vertebrates*, edited by M.J. Gray and V.G. Chinchar. Springer: New York, NY.

Cabrera-Cruz, S.A., J.J. Buler, S.R. Loss, and E.B. Cohen. In Preparation. "Threatscapes for the aeroconservation of birds (working title)."

Carter, M.F., W.C. Hunter, D.N. Pashley, and K.V. Rosenberg. 2000. "Setting conservation priorities for landbirds in the United States: the Partners in Flight approach." *The Auk* 117: 541-548.

Chambers, R.M. and J.C. Maerz. 2018. "Bycatch in Blue Crab Fisheries." In *Ecology and Conservation of the Diamond-backed Terrapin*, edited by W.M. Roosenburg and V.S. Kenedy. Johns Hopkins University Press: Baltimore, MD.

Chesapeake Bay Fisheries Ecosystem Advisory Panel. 2006. *Fisheries ecosystem planning for Chesapeake Bay. American Fisheries Society, Trends in Fisheries Science and Management 3.* National Oceanic and Atmospheric Administration Chesapeake Bay Office: Bethesda, MD.

Chesapeake Bay Program (CBP). 1989a. *Chesapeake Bay alosid (shad and herring) management plan.* Annapolis, MD.

Chesapeake Bay Program (CBP). 1989b. *Chesapeake Bay striped bass management plan.* Annapolis, MD.

Chesapeake Bay Program (CBP). 1991a. *Chesapeake Bay summer flounder fishery management plan.* Annapolis, MD.

Christman, M., K. Wixted, S.W. Buchanan, R. Boratto, N. Karraker, M. Ravesi, J. Slacum, N. Dulay, E.Y. Horton, C. Rettinger, L. Kisonak, T. Loring, B. Macdonald, S. Martiak, and D. Collins. 2025. "The Collaborative to Combat the Illegal Trade in Turtles: Addressing illegal wildlife trade with an adaptive socio-ecological approach." *Chelonian Conservation and Biology* 23(2): 176-188.

Clark, K.E. and L.J. Niles. 2000. *Northern Atlantic regional shorebird plan. Version 1.0.* Northern Atlantic Shorebird Habitat Working Group: Woodbine, NJ.

Clark, R.W., M.N. Marchand, B.J. Clifford, R. Stechert, and S. Stephens. 2011. "Decline of an isolated timber rattlesnake (Crotalus horridus) population: interactions between climate change, disease, and loss of genetic diversity." *Biological Conservation* 144: 886–891. https://doi.org/10.1016/j.biocon.2010.12.001.

Cooper, J. E. 1960. "Distributional survey V: Maryland and the District of Columbia. Amphibians and reptiles." *Bulletin of the Philadelphia Herpetological Society*, May–June: 18-24.

Cornell Lab of Ornithology. 2008. *Mainland North America extinctions.* Cornell University: Ithaca, NY. http://www.birds.cornell.edu/AllAboutBirds/conservation/extinctions/.

Corser, J.D. 2001. "Decline of disjunct green salamander (*Aneides aeneus*) populations in the southern Appalachians." *Biological Conservation* 97: 119-26.

Costanzo, G.R. and L.J. Hindman. 2007. "Chesapeake Bay breeding waterfowl populations." *Waterbirds* 30: 17-24.

Cox, N., B.E. Young, P. Bowles *et al.* 2022. "A global reptile assessment highlights shared conservation needs of tetrapods." *Nature* 605: 285-290. https://doi.org/10.1038/s41586-022-04664-7.

Crisfield, E. and the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC). 2022. *The 2022 Northeast Lexicon: Terminology conventions and data framework for State Wildlife Action Plans in the Northeast Region.* Northeast Association of Fish and Wildlife Agencies: Washington, DC.

Crosby, S.C., R. Raviraj, M. Fajardo *et al.* 2025. "Regional biodiversity monitoring reveals severe population decline of the Atlantic horseshoe crab (*Limulus polyphemus*) in Long Island Sound, USA." *Sci Rep* 15: 31528. https://doi.org/10.1038/s41598-025-14910-3.

Cunningham, H.R. and N.H. Nazdrowicz. 2018. *The Maryland Amphibian and Reptile Atlas*. Johns Hopkins University Press: Baltimore, MD.

Daleo, M.J., L. Medvedev, C.R. Harkey, A.L. Simmons, K.M. Moorhead, E.R. Whitmer, M.A. Delaney, L.A. Adamovicz, D. Collins, and M.C. Allender. 2025. "A longitudinal analysis of pathogen shedding patterns in confiscated eastern box turtles." *The Journal of Wildlife Management* 89: e70035. https://doi.org/10.1002/jwmg.70035.

De La Cruz, J.L., N.J. Kalen, E.L. Barr, E.D. Thorne, A. Silvis, R.J. Reynolds, and W.M. Ford. 2024. "Seasonal Activity Patterns of Northern Long-eared Bats on the Coastal Mid-Atlantic." *Journal of the Southeastern Association of Fish and Wildlife Agencies* 11: 185-195. https://seafwa.org/sites/default/files/journal-articles/j11-24-de-la-cruz-et-al-185-195.pdf.

Desneux, N., A. Decourtye, and J.M. Delpuech. 2007. "The sublethal effects of pesticides on beneficial arthropods." *Annual Review of Entomology* 52(1): 81-106. https://doi.org/10.1146/annurev.ento.52.110405.091440.

Downing, J.A., P. Van Meter, and D.A. Woolnough. 2010. "Suspects and evidence: a review of the causes of extirpation and decline in freshwater mussels." *Animal Biodiversity and Conservation* 33(2): 151-185. https://doi.org/10.32800/abc.2010.33.0151

Droege, S., D. Harvey, C. Maffei, T. McMahon, J. Selfridge, E. Scarpulla, S. Shumar, and D. Yuan. In preparation. *The bees (Hymenoptera: Apoidea) of Maryland and the District of Columbia: Notes on range, food habits, and natural history, with suggestions for management and research*.

Easter, T., J. Trautmann, M. Gore, and N. Carter. 2023. "Media portrayal of the illegal trade in wildlife: the case of turtles in the US and implications for conservation." *People and Nature* 2: 758-773. https://doi.org/10.1002/pan3.10448.

Eisenhauer, D. 2022: "Decades-long Partnership Eradicates Destructive Nutria Rodents from Maryland." U.S. Fish and Wildlife Service. https://www.fws.gov/press-release/2022-09/decades-long-partnership-eradicates-destructive-nutria-rodents-maryland.

Ellison, W.G., ed. 2010. *Second atlas of the breeding birds of Maryland and the District of Columbia.* Johns Hopkins University Press: Baltimore, MD.

Erb, L. 2019. *Bog turtle conservation plan for the Northern population.* Mid-Atlantic Center for Herpetology and Conservation: Oley PA. https://www.fws.gov/sites/default/files/documents/Bog_Turtle_Conservation_Plan_2019_508C_0.pdf.

Ernst, C.H. and E.M. Ernst. 2012. *Venomous Reptiles of the United States, Canada, and Northern Mexico*. Johns Hopkins University Press: Baltimore, MD.

Feinberg, J.A., C.E. Newman, G.J. Watkins-Colwell, M.D. Schlesinger, B. Zarate, B.R. Curry, H.B. Shaffer, and J. Burger. 2014. "Cryptic diversity in metropolis: Confirmation of a new leopard frog species (Anura: Ranidae) from New York City and surrounding Atlantic Coast regions." *PLOS One* 9(10): e108213. https://doi.org/10.1371/journal.pone.0108213.

Flynn, R.W., G. Hoover, M. Iacchetta, S. Guffey, C. de Perre, B. Huerta, W. Li, J.T. Hoverman, L. Lee, and M.S. Sepúlveda. 2022. "Comparative toxicity of aquatic per- and polyfluoroalkyl substance exposure in three species of amphibians." *Environmental Toxicology and Chemistry* 41(9): 1407-1415. https://doi.org/10.1002/etc.5319.

Flynn, R.W., T.D. Hoskins, M. Iacchetta, C. de Perre, L.S. Lee, J.T. Hoverman, M.S. Sepúlveda. 2021. "Dietary exposure and accumulation of per- and polyfluoroalkyl substances alters growth and reduces body condition of post metamorphic salamanders." *Science of the Total Environment* 765: e142730. https://doi.org/10.1016/j.scitotenv.2020.142730.

Ford, W.M., S.B. Castleberry, M.T. Mengak, J.L. Rodrigue, D.J. Feller, and K.R. Russell. 2006. "Persistence of Allegheny woodrats *Neotoma magister* across the mid-Atlantic Appalachian Highlands landscape, USA." *Ecography*, 29: 745-754. https://doi.org/10.1111/j.0906-7590.2006.04703.x.

Fredrickson, K., L. Adamovicz, K. Terio, A. Davidson, M. Ryan, M. Waligora, K. Schroder, S. Bradley, C. Lionetto, K. Andersson, A. Engel, W. Graser, C. Anchor, G. Glowacki, and M.C. Allender "*Emydomyces testavorans* surveillance in multiple free-ranging terrestrial and aquatic Chelonian species in Illinois, USA." *Journal of Wildlife Diseases* 60(4): 850-859. https://doi.org/10.7589/jwd-d-23-00164.

Gacheny, M., B. Durkin, T. Richards-Dimitrie, and R.A. Seigel. 2021. "Implications of anthropogenic habitat modification on the diet of northern map turtles (*Graptemys geographica*)." *Herpetological Conservation and Biology* 16: 482-490.

Galbraith, H.S., D.E. Spooner, and C.C. Vaughn. 2010. "Synergistic effects of regional climate patterns and local water management on freshwater mussel communities." *Biological Conservation* 143(5): 1175-1183. https://doi.org/10.1016/j.biocon.2010.02.025.

Galbraith, H.S., J.L. Devers, C.J. Blakeslee, J.C. Cole, B. St. John White, S. Minkkinen, and W.A. Lellis. 2018. "Reestablishing a host–affiliate relationship: migratory fish reintroduction increases native mussel recruitment." *Ecological Applications* 28(7): 1841-1852. https://doi.org/10.1002/eap.1775.

Gibbons, J.W., D.E. Scott, T.J. Ryan, K.A. Buhlmann, T.D. Tuberville, B.S. Metts, J.L. Greene, T. Mills, Y. Leiden, S. Poppy, and C.S. Winne. 2000. "The global decline of reptiles, déjà vu amphibians." *BioScience* 50(8): 653-666.

Glaser, J.H., H.G. Stevenson, and D.C. Ferguson. 2005. "Macromoths of Maryland: An Annotated List." Unpublished lists of verified data.

Golden-winged Warbler Working Group. 2013. "Best Management Practices for golden-winged warbler habitats in the Appalachian Region." https://gwwa.org/wp-content/uploads/2022/08/GWWA-APPLRegionalGuide_190711.pdf.

Goncalves, F., H. Farooq, M. Harfoot, M.M. Pires, N. Villar, L. Sales,, C. Carvalho, C. Bello, C. Emer, R.S. Bovendorp, C. Mendes, G. Beca, L. Lautenschlager, Y. Souza, F. Pedrosa, C. Paz, V.B. Zipparro, P. Akkawi, W. Bercê, F. Farah, A.V.L. Freitas, L.F. Silveira, F. Olmos, J. Geldmann, B. Dalsgaard, and M. Galetti. 2024. "A global map of species at risk of extinction due to natural hazards." *Proceedings of the National Academy of Science* 121: e2321068121. https://doi.org/10.1073/pnas.2321068121.

Gonkowski, S. and V. Ochoa-Herrera. 2024. "Poly- and perfluoroalkyl substances (PFASs) in amphibians and reptiles – exposure and health effects." *Aquatic Toxicology* 270: e106907. https://doi.org/10.1016/j.aquatox.2024.106907.

Graf, D.L. and K.S. Cummings. 2021. "A 'big data' approach to global freshwater mussel diversity (Bivalvia: Unionoida), with an updated checklist of genera and species." *Journal of Molluscan Studies* 87(2): eyab015. https://doi.org/10.1093/mollus/eyab015.

Gray, M.J, E.D. Carter, J. Piovia-Scott, J.P.W. Cusaac, A.C. Peterson, R.D. Whetstone, A. Hertz, A.Y. Muniz-Torres, M.C. Bletz, D.C. Woodhams, J.M. Romansic, W.B. Sutton, W. Sheley, A. Pessier, C.D. McCusker, M.Q. Wilber, and D.L. Miller. 2023. "Broad host susceptibility of North American amphibian species to *Batrachochytrium salamandrivorans* suggests high invasion potential and

biodiversity risk." *Nature Communications* 14: e3270. https://doi.org/10.1038/s41467-023-38979-4.

Grothues, T.M., D.K. Padilla, S. Kolatan, C.M.K. Kaunzinger, P. Parker, and S.N. Handel. 2025. "Life as a design element of hardened urban shorelines." *Estuaries and Coasts* 48: e48. https://doi.org/10.1007/s12237-024-01475-z.

Haag, W.R. 2010. "A hierarchical classification of freshwater mussel diversity in North America." *Journal of Biogeography* 37: 12-26.

Hall, S.P., J.B. Sullivan, J.W. Petranka, T. Feldman, D. George, J. Niznik, P. Backstrom, and T. Howard. 2026. *The Moths of North Carolina*. North Carolina Biodiversity Project and North Carolina State Parks: Raleigh, NC. https://auth1.dpr.ncparks.gov/moths/index.php.

Harris, Jr., H.S. 1975. "Distributional survey (amphibia/reptilia): Maryland and District of Columbia." *Bulletin of the Maryland Herpetological Society* 11: 73-167.

Harrison, J.W. 2022. *The Natural Communities of Maryland: 2022 Natural Community Classification Framework.* Maryland Department of Natural Resources, Wildlife and Heritage Service, Natural Heritage Program: Annapolis, MD. Unpublished report.

Hastie, L C., P.J. Cosgrove, N. Ellis, and M.J. Gaywood. 2003. "The threat of climate change to freshwater pearl mussel populations." *AMBIO: A Journal of the Human Environment* 32(1): 40-46.

Hillman, B. and A. Waling. 2025. "The response of brumating wood turtles (*Glyptemys insculpta*) to a severe flood event in New Hampshire, USA." *Herpetological Conservation and Biology* 20: 466-473.

Hoellein, T.J., C.B. Zarnoch, D.A. Bruesewitz, and J. DeMartini. 2017. "Contributions of freshwater mussels (Unionidae) to nutrient cycling in an urban river: filtration, recycling, storage, and removal." *Biogeochemistry* 135(3): 307-324. https://doi.org/10.1007/s10533-017-0376-z.

Hogan, P.N. and S.A. Grubbs. 2022. "Distributional Trends and Species Richness of Maryland, USA, Stoneflies (Insecta: Plecoptera), with an Emphasis on the Appalachian Region." *Ecologies 3*(3): 395-421. https://doi.org/10.3390/ecologies3030029.

Hogan, P.N., D.C. Houghton, K. Murray-Stoker, R.E. DeWalt, A.K. Rasmussen, and J.C. Morse. 2025. "An analytical synopsis of caddisfly (Insecta, Trichoptera) taxonomic history and progress in Canada and the United States." *ZooKeys* 1263: 105-122. https://doi.org/10.3897/zookeys.1263.147986.

Howell, H.J. and R.A. Seigel. 2019. "The effect of road mortality on small, isolated turtle populations." *Journal of Herpetology* 53: 39-46.

Hunter, W.C. 2003. *Southeastern Coastal Plains and Caribbean regional shorebird plan.* U.S. Fish and Wildlife Service: Atlanta, GA.

Indiana Department of Natural Resources (Indiana DNR). 2025. "Indiana Gray Fox Research 2020-2024." https://www.in.gov/dnr/fish-and-wildlife/files/wmr/fw-grayfox-report-2020-2024.pdf.

International Union for Conservation of Nature (IUCN). 2026. "The IUCN Red List of Threatened Species, Version 2025-2." https://www.iucnredlist.org.

Jackson, S.D., T.A. Langen, D.M. Marsh, and K.M. Andrews. 2015. "Natural History and Physiological Characteristics of Small Animals in Relation to Roads." In *Roads & Ecoglogical Infrsastructure*, edited by K.M. Andrews, P. Nanjappa, and S.P.D. Riley. Johns Hopkins University Press: Baltimore, MD.

Jacobson, M.M., E.M. Tucker, M.E. Mathiasson, and S.M. Rehan. 2018. "Decline of bumble bees in northeastern North America, with special focus on Bombus terricola." *Biological Conservation* 217: 437-445. https://doi.org/10.1016/j.biocon.2017.11.026.

Johnson, L.E., G.G. Turner, M.R. Scafini, E. Anis, and J.S. Johnson. 2024. "Widespread Use of Rocky Outcrops by Hibernating Bats in Ohio and Pennsylvania." *Journal of North American Bat Research* 2: 1-15. https://www.eaglehill.us/nabr-pdfs-regular/nabr-003-Johnson.pdf.

Jones, M.T. and P.R. Sievert. 2009. "Effects of stochastic flood disturbance on adult wood turtles, *Glyptemys insculpta*, in Massachusetts." *Canadian Field-Naturalist* 123: 313-322. https://doi.org/10.22621/cfn.v123i4.1000.

Jones, M.T., H., P. Roberts, and L.L. Wiley. 2018. *Conservation plan for the wood turtle in the northeastern United States.* U.S. Fish and Wildlife Service, Northeast Association of Fish and Wildlife Agencies, Massachusetts Division of Fisheries and Wildlife. https://www.northeastturtles.org/uploads/3/0/4/3/30433006/woodturtleplan_2018_final_v2.2.pdf.

Jordan G.W. 2020. "Status of an anomalous population of northern long-eared bats in coastal North Carolina." *Journal of Fish and Wildlife Management* 11(2): 665-678; e1944-687X. https://doi.org/10.3996/JFWM-20-018.

Jordan, A., H.M. Patch, C.M. Grozinger, and V. Khanna. 2021. "Economic dependence and vulnerability of United States agricultural sector on insect-mediated pollination service." *Environmental Science & Technology* 55(4): 2243-2253. https://doi.org/10.1021/acs.est.0c04786.

Kartesz, J.T. and the Biota of North America Program (BONAP). 2015. *North American Plant Atlas.* BONAP: Chapel Hill, NC. http://bonap.net/napa.

Katzner, T., B.W. Smith, T.A. Miller, D. Brandes, J. Cooper, M. Lanzone, D. Brauning, C. Farmer, S. Harding, D. Kramar, C. Koppie, C. Maisonneuve, M. Martell, E.K. Mojica, C. Todd, J.A. Tremblay, M. Wheeler, D.F. Brinker, T.E. Chubbs, R. Gubler, K. O'Malley, S. Mehus, B. Porter, R.P. Brooks, B.D. Watts, and K.L. Bildstein. 2012. "Status, biology and conservation priorities for North America's eastern Golden Eagle (*Aquila chrysaetos*) population." *The Auk* 29: 168-176.

Kearney, R.F. 2003. *Partners In Flight landbird conservation plan physiographic area 10: Mid-Atlantic Piedmont.* American Bird Conservancy.

Kennedy, V.S. 2018. "History of Commercial Fisheries and Artificial Propagation." In *Ecology and Conservation of the Diamond-backed Terrapin*, edited by W.M. Roosenburg and V.S. Kennedy. Johns Hopkins University Press: Baltimore, MD.

Knapp, W. and R.F.C. Naczi. 2021. *Vascular Plants of Maryland, USA: A Comprehensive Account of the State's Botanical Diversity.* Smithsonian Institution Scholarly Press: Washington, DC.

Knapp, W.M. and R. Wiegand. 2014. "Orchid (Orchidaceae) decline in the Catoctin Mountains, Frederick County, Maryland as documented by a long-term dataset." *Biodiversity and Conservation* 23(8): 1965-1976. https://doi.org/10.1007/s10531-014-0698-2.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I.J. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Syderman, J.L. Trapp, J. Wheeler, and K. Wohl. 2002. *Waterbird conservation for the Americas: the North America waterbird conservation plan, Version 1*. Waterbird Conservation for the Americas: Washington, DC.

Lambert, J.D., T.P. Hodgman, E.J. Laurent, G.L. Brewer, M.J. Iliff, and R. Dettmers. 2009. *The Northeast monitoring bird handbook.* American Bird Conservancy: The Plains, VA.

Lambert, M.R., O. Hernández-Gómez, A.R. Krohn, A. Mutlow, L. Patterson, E.B. Rosenblum, M. Timmer, J. Willis, and J. Bushell. 2021. "Turtle shell disease fungus (*Emydomyces testavorans*): first documented occurrences in California and prevalence in free-living turtles." *Icthyology and Herpetology* 109(4): 958-962. https://doi.org/10.1643/h2020151.

Lee, D.S. 1984. "Maryland's vanished birds and mammals: reflections of ethics past." In *Threatened and Endangered Plants and Animals of Maryland*, edited by A.W. Norden, D.C. Forester, and G.H. Fenwick. Maryland Department of Natural Resources, Natural Heritage Program: Special Publication. 454-471.

Levasseur, P., R. Prescott, M. Faherty, and C. Sutherland. 2023. "Factors affecting spatiotemporal patterns of nest site selection and abundance in diamondback terrapins." *Ecology and Evolution* 13: e9866. https://doi.org/10.1002/ece3.9866.

Limpert, D.L., D.L. Birch, M.S. Scott, M. Andre, and E. Gillam. 2010. "Tree Selection and Landscape Analysis of Eastern Red Bat Day Roosts." *Journal of Wildlife Management* 71: 478-486. https://doi.org/10.2193/2005-642.

Lips, K.R. 2016. "Overview of chytrid emergence and impacts on amphibians." *Philosophical Transactions of the Royal Society B Biological Sciences* 371: e20150465. https://doi.org/10.1098/rstb.2015.0465.

Litwiler, T. 2001. *Conservation plan for sea turtles, marine mammals, and the shortnose sturgeon in Maryland.* Maryland Department of Natural Resources Technical Report FS-S0COL-01-2: Oxford, MD.

Longo, A.V., R.C. Fleischer, and K.R. Lips. 2019. "Double trouble: co-infections of chytrid fungi will severely impact widely distributed newts." *Biological Invasions* 21: 2233-2245. https://doi.org/10.1007/s10530-019-01973-3.

Lorch, J.M., S. Knowles, J.S. Lankton, K. Michell, J.L. Edwards, J.M. Kapfer, R.A. Staffen, E.R. Wild, K.Z. Schmidt, A.E. Ballman, D. Blodgett, T.M. Farrell, B.M. Glorioso, L.A. Last, S.J. Price, K.L. Schuler, C.E. Smith, J.F.X. Wellehan, Jr., and D.S. Blehert. 2016. "Snake fungal disease: an emerging threat to wild snakes." *Philosophical Transactions of the Royal Society B Biological Sciences* 371: e20150457. https://doi.org/10.1098/rstb.2015.0457.

Losey, J. E. and M. Vaughan. 2006. "The economic value of ecological services provided by insects." *Bioscience* 56(4): 311-323.

Loss, S.R., T. Will, and P.P. Marra. 2013. "The impact of free-ranging domestic cats on wildlife of the United States." *Nature Communications* 4(1396): 1-7. https://doi.org/10.1038/ncomms2380.

Luedtke, J.A., J. Chanson, K. Neam *et al*. 2023. "Ongoing declines for the world's amphibians in the face of emerging threats." *Nature* 622: 308-314. https://doi.org/10.1038/s41586-023-06578-4.

Luiselli, L., A. Starita, G.M. Carpaneto, G.H. Segniagbeto, and G. Amori. 2016. "A short review of the international trade of wild tortoises and freshwater turtles across the world and throughout two decades." *Chelonian Conservation and Biology* 15: 167-172. https://doi.org/10.2744/CCB-1216.1.

MacIvor, J. S. and L. Packer. 2015. "'Bee hotels' as tools for native pollinator conservation: a premature verdict?" *PLOS One* 10(3): e0122126. https://doi.org/10.1371/journal.pone.0122126.

Marschang, R.E., J.I. Meddings, T.B. Waltzek, P. Hick, M.C. Allender, W. Wirth, and A.L.J. Duffus. 2025. "Ranavirus Distribution and Host Range." In *Ranaviruses: Emerging Pathogens of Ectothermic Vertebrates*, edited by M.J. Gray and V..G. Chinchar. Springer: New York, NY.

Marsh, D.M. and J.A.G. Jaeger. 2015. "Direct Effects of Roads on Small Animal Populations." In *Roads & Ecoglogical Infrsastructure*, edited by K.M. Andrews, P. Nanjappa, and S.P.D. Riley. Johns Hopkins University Press: Baltimore, MD.

Maryland Biodiversity Project (MBP). 2026. https://www.marylandbiodiversity.com/.

Maryland Botanical Heritage Work Group. 2014. *For the Governor and the General Assembly of Maryland: Concerning the preservation of Maryland's botanical heritage*. Maryland Department of Natural Resources: Annapolis, MD.

Maryland Botanical Heritage Workgroup. 2014. *Report for the Governor and General Assembly of Maryland concerning the preservation of Maryland's botanical heritage.* Annapolis, MD.

Maryland Department of Natural Resources (MD DNR). 2004b. "Fact sheet: Atlantic Coastal Bays." MD DNR, Maryland Coastal Program, Watershed Services: Annapolis, MD.

Maryland Department of Natural Resources (MD DNR). 2020. *Maryland White-Tailed Deer Management Plan 2020-2034.* MD DNR, Wildlife and Heritage Service. https://dnr.maryland.gov/wildlife/ documents/2020-2034marylandwtdeerplan.pdf

Maryland Department of Natural Resources (MD DNR). 2021. *Maryland Annual Deer Report 2020-2021.* MD DNR, Wildlife and Heritage Service. https://dnr.maryland.gov/wildlife/Documents/Maryland-Annual-Deer-Report-2020-2021.pdf.

Maryland Department of Natural Resources (MD DNR). 2025a. "Trout Stocking in Maryland." https://dnr.maryland.gov/fisheries/pages/trout/stocking.aspx.

Maryland Department of Natural Resources (MD DNR). 2026a. "Bats and Diseases." https://dnr.maryland.gov/wildlife/pages/plants_wildlife/bats/nhpbatdisease.aspx.

Maryland Department of Natural Resources (MD DNR). 2026b. "Stream Health." https://dnr.maryland.gov/streams/Pages/streamhealth/default.aspx.

Maryland Department of Natural Resources (MD DNR). 2026c. *Whole Watershed Program Annual Report and Expenditures Plan FY26.* MD DNR, Watershed and Climate Services: Annapolis, MD. https://dnr.maryland.gov/Documents/Whole-Watershed-Program-FY26-Annual-Report_10-15-25.pdf.

Maryland Department of Natural Resources (MD DNR). *DRAFT Fishery Management Plans 2022-2024 Natural Resources § 4-215*. Annapolis, MD. https://dnr.maryland.gov/fisheries/Documents/DRAFT_2022-2024_FMP_LegislativeReport.pdf

Maryland Ornithological Society (MOS). 2024. "Official List of the Birds of Maryland." Maryland / District of Columbia Records Committee of the Maryland

Ornithological Society. https://drive.google.com/file/d/17XlVh8o8qZ-4_gFUea9nooNPpupYj1Kn/view?usp=sharing,

Maryland Sea Grant (MDSG). 2009a. *Striped bass species team background and issue brief.* MDSG, Ecosystem-Based Fisheries Management Project for Chesapeake Bay: College Park, MD.

Maryland Sea Grant (MDSG). 2009b. *Menhaden species team background and issue brief.* MDSG, Ecosystem-Based Fisheries Management Project for Chesapeake Bay: College Park, MD.

Maryland Sea Grant (MDSG). 2011. *Alosine species team background and issue brief.* MDSG, Ecosystem-Based Fisheries Management Project for Chesapeake Bay: College Park, MD.

McCauley, R.H. 1945. T*he reptiles and amphibians of Maryland and the District of Columbia.* Private printing: Hagerstown, MD.

Mengak, M.T., C.M. Butchkoski, D.J. Feller, and S.A. Johnson. 2008. "Lessons From Long-Term Monitoring of Woodrat Populations." In *The Allegheny Woodrat*, edited by J.D. Peles and J. Wright. Springer: New York, NY. https://doi.org/10.1007/978-0-387-36051-5_7.

Moore, F. R. 2018. "Biology of landbird migrants: A stopover perspective." *The Wilson Journal of Ornithology* 130: 1-12. https://doi.org/10.1676/1559-4491-130.1.1.

Moth Photographers Group. 2026. Mississippi State University, Mississippi Entomological Museum. http://mothphotographersgroup.msstate.edu.

National Audubon Society. 2013. *Important bird areas in the U.S.* New York, NY. https://www.audubon.org/important-bird-areas.

National Fish and Wildlife Foundation (NFWF). 2018. *Atlantic Flyway Shorebird Business Plan.* https://www.nfwf.org/sites/default/files/2019-12/afsi-business-plan.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2024. NOAA, Fisheries Office of Science and Technology, Commercial Landings Query. www.fisheries.noaa.gov/foss.

National Oceanic and Atmospheric Administration (NOAA). 2025. "Fishery Stock Status Updates." NOAA Fisheries. https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates.

National Oceanic and Atmospheric Administration (NOAA). 2026a. "Humpback Whale." https://www.fisheries.noaa.gov/species/humpback-whale.

National Oceanic and Atmospheric Administration (NOAA). 2026b. "Blue Whale." https://www.fisheries.noaa.gov/species/blue-whale.

National Oceanic and Atmospheric Administration (NOAA). 2026c. "Fin Whale." https://www.fisheries.noaa.gov/species/fin-whale.

National Oceanic and Atmospheric Administration (NOAA). 2026d. "North Atlantic Right Whale." https://www.fisheries.noaa.gov/species/north-atlantic-right-whale.

National Oceanic and Atmospheric Administration (NOAA). 2026e. "Sperm Whale." https://www.fisheries.noaa.gov/species/sperm-whale.

National Oceanic and Atmospheric Administration (NOAA). 2026f. "Common Bottlenose Dolphin." https://www.fisheries.noaa.gov/species/common-bottlenose-dolphin.

National Oceanic and Atmospheric Administration (NOAA). 2026g. "Harbor Porpoise." https://www.fisheries.noaa.gov/species/harbor-porpoise.

National Oceanic and Atmospheric Administration (NOAA). 2026h. "Marine Mammal Take Reduction Plans and Teams." https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-take-reduction-plans-and-teams.

Near, T.J. 2008. "Rescued from synonymy: A redescription of *Percina bimaculate* Haldeman and a molecular phylogenetic analysis of logperch darters (Percidae: Etheostomatinae)." *Bulletin of the Peabody Museum of Natural History* 49: 3-18.

Newman, C.E., J.A. Feinberg, L.J. Rissler, J. Burger, and H.B. Shaffer. 2012. "A new species of leopard frog (Anura: Ranidae) from the urban northeastern U.S." *Molecular Phylogenetics and Evolution* 63(2): 445-455.

Newton, I. 2007. *The Migration Ecology of Birds*. Elsevier: Amsterdam, Netherlands.

Nickerson, M.A., A.L. Pitt, and M.D. Prysby. 2007. "The effects of flooding on hellbender salamander, *Cryptobranchus alleganiensis* Daudin, 1803, populations." *Salamandra* 43: 111-117.

Norden, A.W. 1999. "Flood induced winter mortality of wood turtles (*Clemmys insculpta* Le Conte) in Maryland." *The Maryland Naturalist* 43: 18-19.

North American Bird Conservation Initiative. 2025. *State of the Birds Report: United States of America.* https://www.stateofthebirds.org/2025/.

Northeast Partners for Amphibian and Reptile Conservation (NE PARC). 2010. *Northeast amphibian and reptile species of regional responsibility and conservation concern.*

Northeast Partners in Amphibian and Reptile Conservation (NE PARC). 2014. "*Ranavirus* frequently asked questions." http://www.northeastparc.org/products/pdfs/NEPARC_Ranavirus_FAQ.pdf.

Novotny, L., C.M. Powers, S.M. Royal, A.K. Preston, G.K. Hendrix, and M.F. Sola. 2024. "Chytridiomycosis in a colony of hellbenders *Cryptobranchus alleganiensis.*" *Journal of Aquatic Animal Health* 36: 303-309.

O'Connell, A.F., B. Gardner, A.T. Gilbert, and K. Laurent. 2009. *Compendium of avian occurrence information for the Continental Shelf waters along the Atlantic Coast of the United States, Final Report (Database Section - Seabirds).* U.S. Geological Survey, Patuxent Wildlife Research Center: Beltsville, MD.

Owens, A.C., P. Cochard, J. Durrant, B. Farnworth, E.K. Perkin, and B. Seymoure. 2020. "Light pollution is a driver of insect declines." *Biological Conservation* 241: e108259.

Paradiso, J.L. 1969. "Mammals of Maryland." *North American Fauna* 66. Bureau of Sport Fisheries and Wildlife: Washington, DC.

Partners for Amphibian and Reptile Conservation (PARC). 2012. *2012 Annual Report.* https://parcplace.org/wp-content/uploads/2017/07/2012_PARC_Annual_Report_MedQ.pdf.

Perring, F.H. and S.M. Walters. 1962. *Atlas of the British flora.* T. Nelson: London, England.

Powers, K.D. 1983. *Pelagic distributions of marine birds off the Northeastern United States.* National Oceanic and Atmospheric Administration (NOAA), Technical Memorandum NMFS-F /NEC- 27.

Price, S.J, K.K. Cecala, R.A. Browne, and M.E. Dorcas. 2011. "Effects of Urbanization on Occupancy of Stream Salamanders." *Conservation Biology* 25(3): 547-555. https://doi.org/10.1111/j.1523-1739.2010.01627.x.

Pruitt, L. and M. Reed. 2022. "Indiana Bat Fatalities at Wind Energy Facilities." U.S. Fish and Wildlife Service, Indiana Field Office. https://www.fws.gov/sites/default/files/documents/Indiana%20Bat%20Fatalities%20at%20Wind%20Energy%20Facilities.pdf.

Pyzik, L., J. Caddick, and P. Marx. 2004. *Chesapeake Bay: introduction to an ecosystem.* Chesapeake Bay Program: Annapolis, MD.

Rasmussen, A.K. and J.C Morse. 2023. *Distributional Checklist of Nearctic Trichoptera (2022 Revision).* Florida A&M University: Tallahassee, FL. https://trichoptera.org/nearctic-checklist.

Robbins, C.S. and E.A.T. Blom, eds. 1996. *Atlas of the breeding birds of Maryland and*

the District of Columbia. University of Pittsburgh Press: Pittsburgh, PA.

Roberts, H.P. and L.A. Erb. 2023. *Conservation plan for the eastern box turtle in the northeastern United States.* U.S. Fish and Wildlife Service, Northeast Association of Fish and Wildlife Agencies. https://northeastwildlifediversity.org/sites/default/files/2023-04/teca_conservation_plan_022823.pdf.

Rosen, G.E. and K.F. Smith. 2010. "Summarizing the evidence on the international trade in illegal wildlife." *Ecohealth* 7: 24-32. https://doi.org/10.1007/s10393-010-0317-y.

Rosenberg, K.V., J.A. Kennedy, R. Dettmers, R.P. Ford, D. Reynolds, J.D. Alexander, C. J. Beardmore, P.J. Blancher, R.E. Bogart, G.S. Butcher, A.F. Camfield, A. Couturier, D.W. Demarest, W.E. Easton, J.J. Giocomo, R.H. Keller, A.E. Mini, A. O. Panjabi, D.N. Pashley, T.D. Rich, J.M. Ruth, H. Stabins, J. Stanton, and T. Will. 2016. *Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States.* Partners in Flight Science Committee. https://www.partnersinflight.org/wp-content/uploads/2016/08/pif-continental-plan-final-spread-single.pdf.

Rowlett, R.A. 1980. *Observations of marine birds and mammals in the Northern Chesapeake Bight*. U.S. Fish and Wildlife Service, Biological Services Program. FWS/OBS-80/04.

Semlitsch, R.D. and J.R. Bodie. 2003. "Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles." *Conservation Biology* 17(5): 1219-1228. https://doi.org/10.1046/j.1523-1739.2003.02177.x.

Sevin, J., K. Wixted, L. Kisonak, B. MacDonald, J. Thompson-Slacum, S. Buchanan, and N. Karraker. 2022. "Turtles in trouble: Trafficking poses conservation concerns for America's turtles." *The Wildlife Professional* 16: 26-31.

Skevington, J.H., M.M. Locke, A.D. Young, K. Moran, W.J. Crins, and S.A. Marshall. 2019. *Field guide to the flower flies of northeastern North America*. Princeton University Press: Princeton, NJ.

Smallwood, S.K. 2013. "Comparing bird and bat fatality-rate estimates among North American wind-energy projects." *Wildlife Society Bulleti*n 37(1): 19-33.

Smith, H.M., and B.A. Bean. 1899. "List of fishes known to inhabit the water of the District of Columbia and vicinity." *Bulletin of the United States Fish Commission:* 179-187.

Southeast Partners for Amphibian and Reptile Conservation (SE PARC). 2004. "PARC habitat management guidelines: a national update and regional status report." *PARC News* 1: 1-2.

Spohn, M., S. Bagchi, L.A. Biederman *et al.* 2023. "The positive effect of plant diversity on soil carbon depends on climate." *Nature Communications* 14: 6624. https://doi.org/10.1038/s41467-023-42340-0.

Stein, B.A., L.S. Kutner, and J.S. Adams, eds. 2000. *Precious heritage: The status of biodiversity in the United States.* Oxford University Press: New York, NY.

Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton, and J.S. Nichols. 2004. "Changing perspectives on pearly mussels, North America's most imperiled animals." *BioScience* 54(5): 429-439.

Stuart, S., J.S. Chanson, N.A. Cox, B.E. Young, A.S.L. Rodrigues, D.L. Fishman, and R.W. Waller. 2004. "Status and trends of amphibian declines and extinctions worldwide." *Science* 306: 1783-1786.

Tallamy, D.W. 2021. *The nature of Oaks: the rich ecology of our most essential native trees*. Timber Press: Portland, OR.

Terwilliger Consulting, Inc. (TCI) and the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC). 2023. *Northeast Regional Conservation Synthesis for 2025 State Wildlife Action Plans.* Northeast Association of Fish and Wildlife Agencies: Washington, DC.

Thompson, E. 1984. "The eastern woodrat (NEOTOMA FLORIDANA) in Garrett County, Maryland." In *Threatened and Endangered Plants and Animals of Maryland*, edited by A.W. Norden, D.C. Forester, and G.H. Fenwick. Maryland Department of Natural Resources, Natural Heritage Program: Special Publication. 439-41.

Turner, G.G., D.M. Reeder, and J.T H. Coleman. 2011. "A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look to the future." *Bat Research News* 52: 13-27.

Turtle Conservation Coalition (TCC). 2018. *Turtles in Trouble: The World's 25+ Most Endangered Tortoises and Freshwater Turtles—2018*. Ojai, CA.

Turtle Conservation Coalition (TCC). 2025. *Turtles in Trouble: The World's Most Endangered Tortoises and Freshwater Turtles—2025*. Ojai, CA.

U.S. Fish and Wildlife Service (USFWS) and U.S. Census Bureau (USCB). 2011. *National survey of fishing, hunting and wildlife-associated recreation: Maryland*. Washington, DC.

U.S. Fish and Wildlife Service (USFWS). 1973. *The Endangered Species Act of 1973.* U.S. Department of the Interior: Washington, DC.

U.S. Fish and Wildlife Service (USFWS). 1996. *Piping plover (Charadrius melodus), Atlantic coast population, revised recovery plan.* Hadley, MA.

U.S. Fish and Wildlife Service (USFWS). 2001. *Bog turtle (Clemmys muhlenbergii), northern population, recovery plan.* Hadley, MA.

U.S. Fish and Wildlife Service (USFWS). 2003. *Recovery plan for the red-cockaded woodpecker (Picoides borealis): second revision.* Atlanta, GA.

U.S. Fish and Wildlife Service (USFWS). 2024. "Land-based Wind Energy Voluntary Operational Avoidance Guidance for the Northern Long-eared Bat: Frequently Asked Questions (FAQs) Supplement." https://www.fws.gov/sites/default/files/documents/2024-10/faq_nleb-wind-operational-avoidance-guidance_508.pdf.

U.S. Geological Survey (USGS). 2015. "White-nose syndrome (WNS)." Washington, DC. https://www.usgs.gov/centers/nwhc/science/white-nose-syndrome.

Unger, S.D., L.A. Williams, and J.D. Groves. 2021. "*Cryptobranchus alleganiensis alleganiensis* (Eastern Hellbender). Larval displacement due to flooding." *Herpetological Review* 52(3): 598.

Vaughn, C.C. 2018. "Ecosystem services provided by freshwater mussels." *Hydrobiologia* 810(1): 15-27. https://doi.org/10.1007/s10750-017-3139-x.

Virginia Department of Wildlife Resources (Virginia DNR). 2025. *2025 Virginia Sea Turtle Conservation Plan.* Henrico, VA. https://dwr.virginia.gov/?page_id=86558&preview=1&_ppp=61fa11074b.

Wagner, D.L., E.M. Grames, M.L. Forister, M.R. Berenbaum, and D. Stopak. 2021. "Insect decline in the Anthropocene: Death by a thousand cuts." *Proceedings of the National Academy of Sciences* 118(2): e2023989118. https://doi.org/10.1073/pnas.2023989118.

Waldron, J.L. and W.J. Humphries. 2005. "Arboreal habitat use by the green salamander, *Aneides aeneus* in South Carolina." *Journal of Herpetology* 39: 486-492.

Watson, J.K. 2014. *The Piedmont Bird Conservation Region Implementation Plan.* U.S. Fish and Wildlife Service, Atlantic Coast Joint Venture. https://www.acjv.org/documents/PIEDMONT_final_nov2014.pdf.

Watts, B.D. 2013. *Waterbirds of the Chesapeake Bay: A monitoring plan.* Virginia Department of Game and Inland Fisheries: Richmond, VA.

Watts, B.D., G.D. Therres, and M.A. Byrd. 2007. "Status, distribution, and the future of bald eagles in the Chesapeake Bay area." *Waterbirds* 30: 25-38.

Webster, W.D., J.E. Parnell, and W.C. Biggs, Jr. 1985. *Mammals of the Carolinas, Virginia, and Maryland.* The University of North Carolina Press: Chapel Hill, NC and London, England.

Wesche. A. 1997. *Maryland's coastal bays as shark nursery areas: Fisheries Technical Memo No. 10.* Maryland Department of Natural Resources, Fisheries Service: Annapolis, MD.

White, A., T. Lim, E. Culver, M. Timmer, J. Bushell, A. Muttlow, J. Aymen, L. Hussain, K. Haman, M.R. Lambert, and O. Hernández-Gómez. "*Emydomyces testavorans* Infection and Shell Disease Prevalence in Threatened Northwestern Pond Turtle Populations of the San Francisco Bay Area, USA." *Herpetological Conservation and Biology* 20(3): 457–465. https://www.herpconbio.org/Volume_20/Issue_3/White_etal_2025.pdf.

White, H.B., J.D. Brighton, R. Cheicante, J.H. Gillespie, W.J. Hubick, R.W. Lake, M.C. Moore, R. Orr, A. Reb, S.M. Roble, J.F. White, E.F. Medina-Espinoza, and J.T. Johnson. 2024. "Status of Odonata on the Delmarva Peninsula." *Bulletin of American Odonatology* 13(4).

Wiley, L.L., M.K. Parren, and M.T. Jones. 2022. *Status assessment and conservation plan for spotted turtles in the eastern United States.* U.S. Fish and Wildlife Service, Virginia Department of Wildlife Resources. https://www.northeastturtles.org/uploads/3/0/4/3/30433006/clgu_conservation_plan_10_13_22.pdf.

Williams, J.D., M.L. Warren, Jr., K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. "Conservation status of freshwater mussels of the United States and Canada." *Fisheries* 18(9): 6-22.

Williams, K.A., E.E. Connelly, S.M. Johnson, and I.J. Stenhouse, eds. 2015. *Wildlife Densities and Habitat Use across Temporal and Spatial Scales on the Mid-Atlantic Outer Continental Shelf: Final Report to the Department of Energy EERE Wind & Water Power Technologies Office.* Biodiversity Research Institute: Portland, ME. Award Number DE-EE0005362. Report BRI 2015-11.

Wingfield, J.E., M. O'Brien V. Lyubchich, J.J. Roberts, P.N. Halpin, A.N. Rice, and H. Bailey. 2017. "Year-round spatiotemporal distribution of harbour porpoises within and around the Maryland wind energy area." *PLOS ONE* 12: e0176653. https://doi.org/10.1371/journal.pone.0176653.

Winters, J.M., H.W. Avery, E.A. Standora, and J.R. Spotilla. 2015. "Between the bay and a hard place: altered diamondback terrapin nesting movements demonstrate the effects of coastal barriers upon estuarine wildlife." *The Journal of Wildlife Management* 79: 682-688.

Wixted, K.L, ed. 2024. "Summary of the Midwest Illegal Turtle Trade Workshop: Enhancing partnerships to combat poaching and trafficking (2024, February 15–16, Virtual)." Partners in Amphibian and Reptile Conservation.

Wixted, K.L. and M.R. Christman, eds. 2022. "Summary of the Northeast Illegal Turtle Trade Workshop: Enhancing partnerships to combat poaching and trafficking

(2022, February 17–18, Virtual).” Partners in Amphibian and Reptile Conservation.

Wolter, F., S. Capel, D. Pashley, and S. Heath. 2008. *Managing land in the Piedmont of Virginia for the benefit of birds and other wildlife,* 2nd edition. American Bird Conservancy, Piedmont Environmental Council, and Virginia Department of Game and Inland Fisheries. The Plains, VA.

Wood, J., P. Bukaveckas, H. Galbraith, M. Gattis, M. Gray, T. Ihde, D. Kreeger, R. Mair, S. McLaughlin, S. Hahn, and A. Harvey. 2021. *Incorporating Freshwater Mussels into the Chesapeake Bay Restoration Effort.* Chesapeake Bay Scientific and Technical Advisory Committee (STAC): Edgewater, MD. STAC Publication Number 21-004.

Woodburn, D.B., A.N. Miller, M.C. Allender, C.W. Maddox, and K.A. Terio. 2019. “*Emydomyces testavorans*, a New Genus and Species of Onygenalean Fungus Isolated from Shell Lesions of Freshwater Aquatic Turtles.” *Journal of Clinical Microbiology* 57(2). https://doi.org/10.1128/jcm.00628-18.

Wren, S., A. Borzée, R. Marcec-Greaves, and A. Angulo, eds. 2024. “Amphibian conservation action plan: A status review and roadmap for global amphibian conservation.” International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) Amphibian Specialist Group. IUCN: Gland, Switzerland.

Zappalorti, R.T. 2023. *The Bog Turtle: Natural History and Conservation*. ECO Publishing.