Chapter 7

Conservation Actions

APPENDICES

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Chapter 7 Appendices

7a. Conservation Action Prioritization Criteria

Key Wildlife Habitat Conservation Actions

7b. Conservation Actions for Upland Habitats

7c. Conservation Actions for Wetland Habitats

7d. Conservation Actions for Aquatic Habitats

7e. Conservation Actions for Subterranean Habitats

7f. Conservation Actions for Other Habitats

Species of Greatest Conservation Need Conservation Actions

7g. Conservation Actions for Mammal Species of Greatest Conservation Need

7h. Conservation Actions for Bird Species of Greatest Conservation Need

7i. Conservation Actions for Reptile and Amphibian Species of Greatest Conservation Need

7j. Conservation Actions for Fish Species of Greatest Conservation Need

7k. Conservation Actions for Insect Species of Greatest Conservation Need

7l. Conservation Actions for Crayfish Species of Greatest Conservation Need

7m. Conservation Actions for Mussel Species of Greatest Conservation Need

Appendix 7a. Conservation Action Prioritization Criteria

The process of prioritizing conservation actions for the Maryland SWAP revision focused on identifying priorities for implementation. Table 1 summarizes how each of these criteria was ranked for every conservation action to determine that action's overall prioritization status. More information about these seven criteria, as well as factors the SWAP Development Team considered while prioritizing conservation actions, can be found in Table 2.

Table 1 Summary of criteria used to prioritize conservation actions.

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

Table 2. Additional information about the criteria used to prioritize conservation actions.

Terms	Explanation/Content	Factors to Consider	Priority Ranking
Urgency	The urgency of the action should estimate the ideal timeframe for completing the action. How quickly does the action need to be taken? This is a relative estimate of the urgency of the action given the severity, immediacy, or extent of the threats and the priority of the species or habitat.	Extinction risk Potential for loss of opportunity if delayed Threat to the species/habitat, including: • Immediacy: this characteristic assesses the time scale over which impacts of the threat will be observable. • Severity of threat • Spatial extent: how much of species' population or habitat is negatively effected	(Mark High) **Urgent:** Initiate immediately, within two years (Mark Medium) **Moderately Urgent:** Initiate within 5 years (2017-2020) (Mark Low) **Less Urgent:** Initiate within 5-10 years (2020-2025) or can wait 10 years to initiate
Cost/Value	Cost estimates, even very rough ones, are helpful for prioritization. This should include total future costs in current dollar values, but not include any past expenses for infrastructure that will be used by proposed action. Avoid using the unknown category if possible.	Cost evaluations are for life of the project (as opposed to per year) Direct and indirect costs of the project Cost/acre treated or cost/species	(Mark High) **Expensive:** >$500,000 (Mark Medium) **Moderately costly:** $50,000-$500,000 (Mark Low) **Relatively Inexpensive:** <$50,000 **Unknown**

Terms	Explanation/Content	Factors to Consider	Priority Ranking
Likelihood/ chance of success	To what degree will the action address the threat or improve species' populations or habitats? An assessment of whether or not the project will work	Will it meet its specified objectives? Will the project work/be successful?	(Mark High) **Achievable/Certain or Very Likely:** 90-100% (demonstrated by other projects) (Mark Medium) **Somewhat likely or uncertain:** 30-90% (e.g., BMP or sufficient information available) (Mark Low) **Highly uncertain/Unlikely/Unknown:** <30% (not tested/implemented anywhere)
Benefits	A measure of how much good will result from the project. These answers will likely be suggested by defining what the action is and why it is being taken. However, efforts to prioritize actions will probably require specific benefits to be considered. Answering this question clearly may also help define the measures of project success. Consider the direct benefits and contrast them with the indirect benefits.	Depending on the action, benefits (direct or indirect) may be habitat improvements, species' responses, reductions in threat risk, or public or stakeholder benefits. Reduction in extinction risk Increase in population size and/or range Responsibility – how much of the species' status depends on this project? Fundamental contribution	(Mark High) **Highly beneficial** (Mark Medium) **Moderately beneficial** (Mark Low) **Unclear benefits**

Terms	Explanation/Content	Factors to Consider	Priority Ranking
Collateral Benefits	Defining the ecological/biological benefits to other species, habitats, or processes. Is the species considered a keystone species, umbrella species, indicator species, or other species that has management practices that will provide collateral benefits to other species or habitats?	Keystone species have a disproportionate effect on their ecosystem, due to their size or activity, and any change in their population will have correspondingly large effects on their ecosystem Umbrella species have such demanding habitat requirements that, if we can conserve enough land to ensure their viability, the viability of smaller and more abundant species is almost guaranteed Indicator species are intended either to represent community composition or to reflect environmental change. Indicator species must respond to the particular environmental change of concern and demonstrate that change when monitored.	(Mark High) **Highly beneficial to other species/habitat** (Mark Medium) **Moderately beneficial to other species/habitat** (Mark Low) **Unclear benefits to other species/habitat**
Likelihood of Implementation/ Feasibility	How easy is this action to achieve? An assessment of the difficulty associated with this project Can the action be implemented?	Logistical and political factors Source of funds Community attitudes Biological factors	(Mark High) **Feasible/Certain/Very Likely:** 90-100% (Mark Medium) **Moderately Difficult/Likely:**30-90% (Mark Low) **Difficult/Unlikely/Unknown:** <30%

Terms	Explanation/Content	Factors to Consider	Priority Ranking
Public Support	A measure of the amount of support there is likely to be and how important the species or habitat is perceived; weighing the cultural/social values. Does anyone care? Would there be enough public support or might there be a need for additional outreach efforts?	Social and cultural importance Local community attitudes, as well as broader regional or statewide attitudes Education factor Flagship species are chosen to raise public awareness or financial support for conservation action	(Mark High) **Very Important or well supported** (Mark Medium) **Moderately Important or somewhat supported** (Mark Low) **Unimportant, might be a liability, or might need intensive outreach efforts**

Appendix 7b. Conservation Actions for Upland Habitats

Appendices 7b – 7f list conservation actions recommended for key wildlife habitats in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to habitats. This appendix lists conservation actions specific to **Upland Habitats**. Individual habitats classified as **Upland Habitats** are marked **P** if the listed action is a **priority action** for implementation in that habitat and **X** if the action is a **non-priority action** for implementation in that habitat. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. Complete IUCN threat codes are defined in Appendix 5a.

This Appendix (7b) includes three separate Upland key wildlife habitat sections: 1) Forests, 2) Glades, Barrens, and Cliffs, and 3) Coastal Beaches and Dunes.

Conservation Actions for Forests

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
IUCN 1: Residential and Commercial Development												
1	Residential and Commercial Development	Conserve and restore seepage, floodplain, and tidal wetlands associated with streams and rivers.	P	P	P	P	P					
1	Residential and Commercial Development	Work with local jurisdictions to effect adequate zoning considerations in order to protect SGCN habitat.					P	P	P	P	P	
1.3.1	Tourism and recreation	Limit infrastructure development for recreation (such as trails, parking lots, etc.) in key areas for SGCN that are sensitive to disturbance (e.g., wood turtle, timber rattlesnake, salamanders).	P	X	X	P	P					
IUCN 2: Agriculture and Aquaculture												
2	Agriculture and Aquaculture	Encourage beneficial agricultural practices (e.g., late mowing, grass forb buffers in agricultural settings, farm bill programs, other landowner incentives), involvement in Conservation Reserve programs, and the development of incentives to conserve and restore habitats of SGCN.				X	X	X	X	X		
IUCN 3: Energy Production and Mining												
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site and configure hydraulic fracturing development in a manner that avoids or minimizes impacts to SGCN and habitats.	X	X	X	X	P	P	P			
3.2.1	Mining and quarrying: surface mining - Coal strip mining	Site and configure industrial surface mines in a manner that avoids and minimizes impacts to SGCN and habitats.			X	X	X	X	X			
3.3.1	Wind power	Site industrial wind development (including roads) in a manner that avoids or minimizes impacts to SGCN and habitats.	P	X		X		X	X	X		

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
3.3.1	Wind power	Work to develop and implement operational BMPs to reduce impacts of wind farms on key habitats and associated SGCN.	P	X	X	X	X	X	X	X		
IUCN 4: Transportation and Service Corridors												
4.1.1	Roads and railroads: land conversion to roads and railroads	Work with Maryland Department of Transportation to improve transportation planning for new roads to minimize fragmentation of habitat and negative impacts to SGCN.	X	X	X	X	X	X	X	X	X	
4.1.2	Roads and railroads: movement of cars and other vehicles on roads and railroads	Work with Maryland Department of Transportation to encourage and facilitate additional opportunities for public mass-transportation.					X	X	X	X	X	
IUCN 5: Biological Resource Use												
5.3	Logging and wood harvesting	Establish and maintain adequate forest buffers along streams and rivers using strategies such as working with watershed groups to encourage forest conservation.		P	P	P	P	P	P	P	X	
5.3.2	Logging and wood harvesting; intentional use – large scale	Utilize appropriate silvicultural treatments to ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls, downed wood, dense thickets, snags).	P	P	P	P	P	P	P	P	P	P
5.3.2	Logging and wood harvesting; intentional use – large scale	Conserve and encourage conifer dominated forests in western Maryland.	X	P	X	P						
5.3.2	Logging and wood harvesting; intentional use – large scale	Protect, and where possible, restore old growth forest (including adequate no-cut buffers) on public and private lands, and where possible, expand these areas and promote the establishment of additional extensive tracts of old growth forest.	P	P	P	P	P	P	P	P	P	P

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IUCN 6: Human Intrusions and Disturbance												
6.1	Recreational activities	Limit access when or where necessary to protect SGCN and their sensitive habitats.	X	X	X	X	X	X	X	X	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Educate the public about the value of wildlife habitats and their conservation to address and minimize human disturbance issues from off-road vehicle use.	X	X	X	X	X	X	X	X	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Work closely with all stakeholders to; 1) avoid potential impacts to natural resources by eliminating ORV use in sensitive habitats where appropriate and, 2) educate user groups on the value and importance of conserving SGCN habitat.	X	X	X	X	X	X	X	X	X	X
IUCN 7: Natural Systems Modifications												
7.1.2	Fire: suppression of fire frequency/ intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation. NGOs, USFWS	P			P	P			P	P	X
7.1.2	Fire: suppression of fire frequency/ intensity	Utilize appropriate prescribed burning in or light disking of selected portions of individual fields to maintain early-successional seral stages and increase coverage of tall forbs, where appropriate.				P	P	P	P	P		
7.3.4	Lack of ecosystem functions due to species loss	Manage habitat by mimicking natural disturbance patterns for the benefit of SGCN.					P			P	P	
7.3.4	Lack of ecosystem functions due to species loss	Reintroduce blight resistant American chestnut to appropriate habitats, where feasible.	X		X	X	X	X	X			

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IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases												
8.1	Invasive and Other Problematic Species, Genes, and Diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P	P	P	P	P	P	P	P	P
8.1.4	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland animals	Implement appropriate IPM practices to minimize the effects of serious animal and plant pest species while protecting SGCN and other non-target species.	X	X	X	X	X	X	X	X	X	X
8.1.4	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland animals	Manage the feral horse population on Assateague Island to reduce adverse habitat impacts.										P
8.1.5	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland plants	Develop and implement effective programs and methods to control invasive animals and plants and to prevent their establishment in a manner compatible with SGCN.	P	P	P	P	P	P	P	P	P	P
8.1.5	Invasive non-native/alien species/diseases: invasive non-native terrestrial/ wetland plants	Increase training and awareness of operational BMPs for public land managers (federal, state, local) to control and reduce the spread of invasive species.	P	P	P	P	P	P	P	P	P	

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8.2.2	Problematic native species: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity; control populations to reduce negative browsing impacts in SGCN habitats; consider a more liberal doe season in specific areas.	X	X	X	X	P	P	P	P	P	P
IUCN 9: Pollution												
9.5.5	Air-borne pollutants: herbicides and pesticides	Develop a statewide inter-agency (MDA, MDE, MD DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.										P
9.5.5	Air-borne pollutants: herbicides and pesticides	Limit the use of pesticides such that SGCN and key wildlife habitats are not adversely affected.	X	X	X	X	X	X	X	X	X	X
IUCN 11: Climate Change and Severe Weather												
11.1.1	Habitat shifting or alteration: sea-level rise	Work with partners to develop climate change adaptation strategies, such as assisted migration for select species and habitats of conservation concern.	P	P	P	P	P	P	P	P	P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Use dredge spoil to protect and restore habitat from alterations due to sea-level rise.										P
IUCN 12: Resource Management Needs												
12.1.1	Lack of initial baseline inventory	Conduct surveys to document the location and quality of key wildlife habitats.	X	X	X	X	X	X	X	X	X	X
12.1.3	Need to answer research questions	Determine historical range of this key wildlife habitat and target priority sites for monitoring and research.	X	X						X	P	
12.2.1	Need to provide technical assistance	Develop and assist with implementation of habitat management guidelines for use by foresters and land managers including forest stewardship plans.	P	P	P	P	P	P	P	P	P	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Forest Habitats	High Elevation Ridge Forest	Hemlock-Northern Hardwood Forest	Cove Forest	Montane-Piedmont Oak Pine Forest	Oak-Hickory Forest	Basic Mesic Forest	Mesic Mixed Harwood Forest	Coastal Plain Oak Pine Forest	Coastal Plain Pitch Pine Forest	Maritime Forest and Shrubland
12.2.1	Need to provide technical assistance	Include habitat protection and conservation needs in land management plans.	P	P	P	P	P	P	P	P	P	P
12.2.2	Need to conduct environmental reviews	Conduct reviews of land use change plans and encourage local, state, and federal agencies to incorporate habitat conservation actions and BMPs into land use change decisions.	P	P	P	P	P	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Work with local, state, and federal agencies to Include habitat conservation BMPs and protection needs and actions into land use planning efforts and land management plans.	P	P	P	P	P	P	P	P	P	P
IUCN 14: Education/ Outreach Needs												
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding the conservation of key wildlife habitats, their value, and SGCN through social media, Master Naturalist training, and other efforts.	X	X	X	X	X	X	X	X	X	X
IUCN 15: Administrative Needs												
15.1.2	Need to maintain or improve information management systems	As new forest land cover data are developed, update GIS layer that identifies forest interior habitat for use in planning/zoning.	X	X	X	X	X	X	X	X	X	
15.3.2	Need for coordination for effective program/project management	Work with conservation partners to implement forest conservation on private lands adjacent to public land.	X	X	X	X	X	X	X	X	X	X
15.3.3	Need for updates to existing laws/regulations and enacting new laws/regulations	Clarify the Maryland Seed Tree law through regulations to more easily allow for mixed hardwood-pine stands.					X	X	X	X	X	

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15.3.5	Need for changes in government policies	Develop policies that better regulate broadcast spray programs to avoid impacts to SGCN.	X	X	X	X	P	X	X			
15.3.5	Need for changes in government policies	Work with other resources professionals, partners, and elected officials to evaluate and address potential legal barriers to prescribed burning activities.	P			P	P					

Conservation Actions for Glades, Barrens, and Cliffs

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
IUCN 1-4: Urbanization / Development								
1 - 4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	X
1 - 4	Habitat loss (from various causes)	Encourage implementation of BMPs that minimize and reduce habitat fragmentation in land use plans, especially for large, contiguous forest blocks and old growth conditions.	P	P	P	P	P	P
1 - 4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P	P	P	P	P
IUCN 2: Agriculture and Aquaculture								
2	Agriculture and Aquaculture	Encourage beneficial agricultural practices (e.g., late mowing, grass forb buffers in agricultural settings, farm bill programs, other landowner incentives), involvement in Conservation Reserve programs, and the development of incentives to conserve and restore habitats of SGCN.	P	P	X	X	X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
IUCN 3: Energy Production and Mining								
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site and configure hydraulic fracturing development in a manner that avoids or minimizes impacts to SGCN and habitats.		X	X	X	X	
3.3.1	Wind power	Work to develop and implement operational BMPs to reduce impacts of wind farms on key habitats and associated SGCN.					P	
IUCN 6: Human Intrusions and Disturbance								
6.1	Recreational activities	Limit access when or where necessary to protect SGCN and their sensitive habitats.	X	X	X	X	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Educate the public about the value of wildlife habitats and their conservation to address and minimize human disturbance issues.	P	P	P	P	P	P
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Work closely with all stakeholders to; 1) avoid potential impacts to natural resources by eliminating off-road vehicle use in sensitive habitats where appropriate and, 2) educate user groups on the value and importance of conserving SGCN habitat.	P	P	P	P	P	P
6.1.5	Recreational activities: rock climbing	Work with climbing clubs to minimize habitat degradation and disturbance.					P	
IUCN 7: Natural Systems Modification								
7.1.2	Fire: suppression of fire frequency / intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation.	P	P	P	P	X	
7.3.1	Shoreline Stabilization	Develop and implement shore erosion control practices (including living shoreline designs) that are compatible with cliff maintenance and the needs of SGCN.						P
7.3.1	Shoreline stabilization	Repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines.						X
7.3.4	Lack of ecosystem functions due to species loss	Reintroduce blight resistant American chestnut to appropriate habitats, where feasible.					X	

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IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases								
8	Invasive and Other Problematic Species, Genes, and Diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P	P	P	P	P
8.1.4	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland animals	Implement appropriate integrated pest management practices to minimize the effects of serious animal and plant pest species while protecting SGCN and other non-target species.	P	P	P	P	P	X
8.1.5	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland plants	Develop and implement effective programs and methods to control invasive animals and plants and to prevent their establishment in a manner compatible with SGCN.	P	P	P	P	P	P
8.1.5	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland plants	Work with partners to control or eradicate populations of invasive, non-native terrestrial / wetland plants, such as phragmites and purple loosestrife, using appropriate BMPs and effective education campaigns.						P
8.2.2	Problematic native species / diseases: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity; control populations to reduce negative browsing impacts in SGCN habitats; consider a more liberal doe season in specific areas.	P	P	P	P		
IUCN 9: Pollution								
9.4.1	Garbage and solid waste	Develop and implement improved, effective trash pick-up systems in natural areas and other priority habitats.	P					
9.5.5	Air-borne pollutants: herbicides and pesticides	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.	P	P	P	P	P	X

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IUCN 11: Climate Change								
11.1.1	Habitat shifting or alteration: sea-level rise	Work with partners to develop climate change adaptation strategies, such as assisted migration for select species and habitats of conservation concern.	P	P	P	P	P	P
IUCN 12: Resource Management Needs								
12.1.1	Lack of initial baseline inventory	Conduct surveys to document the location and quality of key wildlife habitats.	X	X	X	X	X	X
12.1.2	Lack of up-to-date information	Establish and maintain long-term habitat monitoring programs in targeted areas.						X
12.1.3	Need to answer research questions	Conduct habitat research to determine BMPs, effects of fire, and natural fire regimes.	P	P	P	P		
12.1.3	Need to answer research questions	Determine forest matrix requirements to sustain functionality of smaller patch habitats found within forested systems.		P	P	P	P	
12.1.3	Need to answer research questions	Determine historical range of this key wildlife habitat and target priority sites for monitoring and research.	P	P	P	P	P	
12.2.1	Need to provide technical assistance	Develop and assist with implementation of habitat management guidelines for use by foresters and land managers including forest stewardship plans.	P	P	P	P	P	
12.2.1	Need to provide technical assistance	Maintain functioning subsurface habitats.					X	
12.2.1	Need to provide technical assistance	Include habitat protection and conservation needs in land management plans.	P	P	P	P	P	P
12.2.2	Need to conduct environmental reviews	Conduct reviews of land use change plans and encourage local, state, and federal agencies to incorporate habitat conservation actions and BMPs into land use change decisions.	P	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Work with local, state, and federal agencies to include habitat conservation BMPs and protection needs and actions into land use planning efforts and land management plans.	P	P	P	P	P	P
IUCN 14: Education / Outreach Needs								
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding the conservation of key wildlife habitats, their value, and their SGCN through social media, Master Naturalist training, and other efforts.	P	P	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Glade, Barren, and Cliff Key Wildlife Habitats	Serpentine Barren	Shale Barren	Acidic Glade & Barren	Basic Glade & Barren	Cliff & Rock Outcrop	Coastal Bluff
IUCN 15: Administrative Needs								
15.3.2	Need for coordination for effective program/project management	Utilize USACE, MDE, and CAC regulatory processes to protect habitat.						P
15.3.2	Need for coordination for effective program/project management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts.						X
15.3.2	Need for coordination for effective program/project management	Continue partnership with MDA to maintain a viable CREP agreement with FSA that achieves enrollment goals. Modify 2009 amendment and make changes as necessary.						X
15.3.2	Need for coordination for effective program/project management	Develop Conservation Innovation Grants (CIG) with NRCS to stimulate development and adoption of innovative conservation approaches and technologies in conjunction with agricultural and forestry practices.						X
15.3.2	Need for coordination for effective program/project management	Develop Regional Conservation Partnership Program to leverage federal Farm Bill dollars with State and private funding to maximize effectiveness of conservation efforts.						X
15.3.2	Need for coordination for effective program/project management	Work closely with USDA and Congressional representatives to develop and implement subsequent Farm Bills.						X
15.3.2	Need for coordination for effective program/project management	Partner with National Association of Conservation Districts, National Association of State Conservation Agencies, National Association of Resource Conservation and Development Councils, National Conservation District Employees Association, and NRCS in developing the National Conservation Planning Partnership, a multi-year commitment to conservation planning.						X

Conservation Actions for Coastal Beaches and Dunes

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Coastal Beaches and Dunes Key Wildlife Habitats	Coastal Beach	Maritime Dune & Grassland
IUCN 1 – 4: Urbanization / Development				
1 - 4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	X	X
1 - 4	Habitat loss (from various causes)	Encourage implementation of BMPs that minimize and reduce habitat fragmentation in land use plans, especially for large, contiguous forest blocks and old growth conditions.	P	P
1 - 4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P
1 - 4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	
IUCN 2: Agriculture and Aquaculture				
2.4.2	Marine and freshwater aquaculture	Design and site aquaculture facilities in a manner that positively impacts estuarine and marine ecosystems.	P	
IUCN 6: Human Intrusions and Disturbance				
6.1	Human Intrusions and Disturbance	Limit access when or where necessary to protect SGCN and their sensitive habitats.	X	X
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Work closely with all stakeholders to; 1) avoid potential impacts to natural resources by eliminating ORV use in sensitive habitats where appropriate and, 2) educate user groups on the value and importance of conserving SGCN habitat.	P	P
IUCN 7: Natural System Modifications				
7.3.1	Shoreline stabilization	Develop and implement shore erosion control practices (including living shoreline designs) that are compatible with cliff maintenance and the needs of SGCN.	P	
7.3.1	Shoreline stabilization	Repeat the shoreline inventory of 2004 to determine the change in hardened versus soft shorelines.	X	
7.3.4	Lack of ecosystem functions due to species loss	Restore functional dunes and native vegetation.	X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Coastal Beaches and Dunes Key Wildlife Habitats	Coastal Beach	Maritime Dune & Grassland
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1	Invasive non-native/alien species/diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P
8.1.4	Invasive non-native/alien species/diseases: invasive native terrestrial/ wetland animals	Manage the feral horse population on Assateague Island to reduce adverse habitat impacts.		P
8.1.5	Invasive non-native/alien species/ diseases: invasive native terrestrial/ wetland plants	Develop and implement effective programs and methods to control invasive animals and plants and to prevent their establishment in a manner compatible with SGCN.	P	P
IUCN 9: Pollution				
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X
9.4.1	Garbage and solid waste	Develop and implement improved, effective trash pick-up systems in natural areas and other priority habitats.	P	
9.5.5	Air-borne pollutants: pesticides and herbicides	Develop a statewide inter-agency (MDA, MDE, MD DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.		P
9.5.5	Air-borne pollutants: pesticides and herbicides	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.		P
IUCN 11: Climate Change				
11.1.1	Habitat shifting or alteration: sea-level rise	Work with partners to develop climate change adaptation strategies, such as assisted migration for select species and habitats of conservation concern.	P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Use dredge spoil to protect and restore habitat from alterations due to sea-level rise.	P	P
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Conduct surveys to document the location and quality of key wildlife habitats.	X	X
12.2.1	Need to provide technical assistance	Include habitat protection and conservation needs in land management plans.	P	P
12.2.2	Need to conduct environmental reviews	Conduct reviews of land use change plans and encourage local, state, and federal agencies to incorporate habitat conservation actions and BMPs into land use change decisions.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Work with local, state, and federal agencies to include habitat conservation BMPs and protection needs and actions into land use planning efforts and land management plans.	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Coastal Beaches and Dunes Key Wildlife Habitats	Coastal Beach	Maritime Dune & Grassland
12.2.3	Need for fish, wildlife and/or habitat planning	Work with the CAC and coastal counties to identify important Habitat Protection Areas for terrapins so those sites can be incorporated into local plans.	P	
IUCN 14: Education/Outreach Needs				
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding the conservation of key wildlife habitats, their value, and their SGCN through social media, Master Naturalist training, and other efforts.	P	P

Appendix 7c. Conservation Actions for Wetland Habitats

Appendices 7b – 7f list conservation actions recommended for key wildlife habitats in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to habitats. This appendix lists conservation actions specific to **Wetland Habitats**. Individual habitats classified as **Wetland Habitats** are marked **P** if the listed action is a **priority action** for implementation in that habitat and **X** if the action is a **non-priority action** for implementation in that habitat. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. Complete IUCN threat codes are defined in Appendix 5a.

This Appendix (7c) includes three separate Wetland key wildlife habitat sections: 1) Floodplain Wetlands, 2) Groundwater Wetlands, and 3) Tidal Wetlands.

Conservation Actions for Floodplain Wetlands

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
IUCN 1-4: Urbanization/Development				
1-4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P
1-4	Habitat loss (from various causes)	Establish and maintain landscape-scale network of protected floodplain habitat as species dispersal and movement corridors.	P	P
1-4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P
1-4	Habitat loss (from various causes)	Establish and maintain appropriate buffers to wetlands through landowner incentive programs, acquisition, easements, regulatory means and implementation of BMPs. Expand buffers provided by regulation to afford adequate protection.	P	P
1-4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, BioNet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P
1-4	Habitat loss (from various causes)	Maintain wetland breeding habitat and adjacent upland non-breeding habitats (life zones) of SGCN.	P	P
1-4	Habitat loss (from various causes)	Protect rare natural communities associated with floodplain wetland systems (e.g., riverside prairies, Atlantic white cedar swamps, bald cypress swamps).	P	P
1-4	Habitat loss (from various causes)	Restore floodplain forests including reestablishment of old growth, natural hydrology, and improved water quality.	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
IUCN 2: Agriculture and Aquaculture				
2	Agriculture and aquaculture	Work with landowners, farming community, and MD Department of Agriculture (MDA) to develop and encourage the implementation of BMPs for agricultural practices and to conserve, restore, and protect wetlands through Farm Bill programs (e.g. Conservation Reserve Program) and other landowner incentives for the maintenance of habitats of SGCN.	P	P
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing	Ensure that sufficient regulatory protection is in place to prevent or minimize hydraulic fracturing impacts on wetlands and the surrounding forest matrix and watershed.	P	
3.2.2	Surface mining - rock quarry	Prevent/minimize rock and sand quarrying impacts to wetland areas and surrounding watersheds, including appropriate buffers.	X	X
IUCN 4: Transportation and Service Corridors				
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MDOT to improve transportation planning for new roads to minimize loss and fragmentation of habitat and negative impacts to SGCN; explore options for off-site mitigation.	P	P
4.1.1	Roads and railroads; land conversion from natural habitat to roads and railroads	Work with MDOT to construct roads in such a way that minimizes effects on movement patterns of SGCN, especially for amphibians and reptiles that use these wetlands year-round or seasonally as breeding habitat.	P	P
4.2.1	Utility and service lines	Coordinate with utility companies to improve habitat management in wetlands and wetland buffers.	X	X
IUCN 5: Biological Resource Use				
5.3	Logging and wood harvesting	Establish and maintain adequate forest buffers along streams and rivers using strategies such as working with watershed groups to encourage forest conservation.	P	P
5.3	Logging and wood harvesting	Restore forest cover to deforested watersheds/catchment basins/buffers by developing wetland habitat protection, restoration and management guidelines for public land managers and foresters.	P	P
5.3	Logging and wood harvesting	Work with forestry community to improve and enforce timber harvest BMPs for private landowners that protect wetlands and, where appropriate, the surrounding forest matrix with adequate connectivity between wetlands.	P	P
5.3.2	Logging and wood harvesting; intentional use - large scale	Utilize appropriate silvicultural treatments to ensure adequate structural diversity, especially regarding canopy and understory components (shrubs, treefalls, downed wood, dense thickets, snags).	X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
IUCN 6: Human Intrusions and Disturbance				
6.1	Recreational activities	Coordinate with public land managers to protect wetlands from impacts of active recreational use.	P	P
6.1.1	Recreational activities: off-road vehicles (motorized and non-motorized)	Reduce and, wherever possible, eliminate ORV use in wetlands and other fragile habitats; work with ORV industry to better inform riders of ecological impacts and responsibility; limit access when necessary.	P	P
IUCN 7: Natural Systems Modifications				
7	Natural systems modifications	Restore prior converted and other degraded wetlands to naturally functioning systems.	X	X
7.2	Dams and water management/use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology (includes beaver dams in wetland areas, which can be beneficial in small quantities, harmful when there are too many).	P	P
7.2	Dams and water management/use	Restore hydrology through ditch plugging, water control structures, and other appropriate practices.	P	P
7.3.3	Removal of coarse woody debris	Establish and maintain effective natural buffers adjacent to wetlands by restoring natural communities.	P	P
7.2.5 - 7.2.7	Dams and water management/use: groundwater withdrawal	Ensure that groundwater and surface water withdrawal for development and agriculture is adequately monitored and regulated such that these activities do not negatively impact SGCN and their habitats.	P	P
7.2.9	Dams and water management/use: small dams	Work with landowners to encourage retention of emergent wetlands (e.g. DO NOT impound).	X	X
7.2.14	Dams and water management/use: impervious surfaces	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to wetland areas.	P	P
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Allow natural reestablishment of beaver and manage populations to approximate natural conditions.	X	X
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore the Atlantic white-cedar component in Coastal Plain wetland systems.		X
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8	Invasive and other problematic species, genes, and diseases	Develop and implement protocols to control invasive species and prevent their establishment that is compatible with SGCN.	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
8.1.2	Invasive and other problematic species, genes, and diseases	Limit or prohibit the use of non-native fish as BMPs for mosquito control and vegetation management in wetlands.	X	X
8.1.2	Aquatic animals	Determine the ranges/current distribution of *Gambusia*.	X	X
8.1.4	Terrestrial/ wetland animals	Work with partners to control or eradicate populations of invasive, non-native terrestrial / wetland animals, such as nutria and emerald ash borer, using appropriate BMPs and effective education campaigns.	P	P
8.2.2	Problematic native species / diseases: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity to control populations and reduce browsing levels.	P	P
8.5.2	Viral/prion-induced diseases: *Ranavirus*	Promote disinfection protocols to minimize spread of *Ranavirus*.	P	P
IUCN 9: Pollution				
9.1.1	Domestic and urban waste water: sewage	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff to improve water quality within wetlands.	X	X
9.1.2	Domestic and urban waste water: run-off	Protect wetlands from contamination, siltation, and eutrophication by improving stormwater management practices and erosion control measures.	P	P
9.1.2	Domestic and urban waste water: run-off	Work with MDOT and local and county governments to reduce impacts from road salt, silt, pesticides and other runoff contaminants on wetlands.	X	X
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil and gas spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X
9.2.2	Industrial and military effluents: seepage from Mining	Restore wetlands affected by coal mining and acid mine drainage.	X	X
9.2.2	Industrial and military effluents: seepage from Mining	Work with mining industry and regulators to improve regulations and implementation in order to eliminate detrimental impacts to hydrology and water quality of wetlands.	P	P
9.2.3	Agricultural and forestry effluents: hydraulic fracturing	Establish baseline and follow-up monitoring of streams and wetlands that may be impacted by hydraulic fracturing.	X	
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian and wetland buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P
9.3.1	Agriculture and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
9.5.5	Air-borne pollutants: pesticides and herbicides	Promote use of only highly selective pesticides to control pest insect species.	X	X
9.5.5	Air-borne pollutants: pesticides and herbicides	Prevent/minimize mosquito control impacts on wetlands; develop a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.	X	X
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Improve understanding (via surveys, remote sensing data, etc.) of the historical and current distribution, characteristics and condition of wetland habitats.	X	X
12.2.2	Need to conduct environmental reviews	Incorporate habitat conservation actions and BMPs into project reviews and land use change decisions by local, state, and federal agencies.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat conservation needs and actions into local, state, and federal land use planning efforts and land management plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore wetlands on public lands and incorporate these measures in public land management plans, including forest stewardship plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P
IUCN 14: Education/Outreach Needs				
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Update information on rare wetland types by working with certified wetland delineators and agency regulators to more easily recognize these significant wetlands.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding necessary conservation of wildlife habitats and their SGCN.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Encourage landowners to reduce the use of fertilizers, such as through the Bay Wise Program.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Increase public awareness of sensitivity of wetlands to encroachment of introduced plants, including native species.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Promote guidelines for restoration of wetlands that incorporate natural processes and native natural communities.	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, UME service professionals, and other resource professionals to help educated private landowners on the value of wetlands and buffers and provide management guidance (BMPs) on how to best conserve important habitats.	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Floodplain Wetland Habitats	Montane - Piedmont Floodplain	Coastal Plain Floodplain
IUCN 15: Administrative Needs				
15.1.2	Need to maintain or improve information management systems	Regularly update GIS layers that identify forest interior habitats, Wetlands of Special State Concern, and other significant resources for use in local, state, and federal land planning and management.	P	P
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts.	X	X
15.3.3	Need for updates to existing laws/regulations and enacting new laws/regulations	Modify the loblolly pine seed tree law to so that forestry practices can more easily encourage the establishment of mixed deciduous-pine stands and more natural forest communities.		X
15.3.3	Need for increased legal protection	Modify, as needed, nontidal wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern, to better protect wetlands and surrounding wetlands.	P	P
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.	P	P
15.3.5	Need for changes in government policies	Work with public and private entities to improve SGCN habitat in areas that are managed for waterfowl.	X	X

Conservation Actions for Groundwater Wetlands

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
IUCN 1-4: Urbanization/Development														
1-4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	P	P	P	P	P	P	P
1-4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	P	P	P	P	P	P	P	P	P	P	P	P

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

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

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
7.1.2	Fire and fire suppression: suppression of fire frequency / intensity	Re-establish natural fire regimes to restore and maintain habitats.										X		
7.2	Dams and water management/ use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology (includes beaver dams in wetland areas, which can be beneficial in small quantities, harmful when there are too many).	P	P	P	P	P	P	P	P	P	P	P	P
7.2	Dams and water management/ use	Restore hydrology through ditch plugging, water control structures, and other appropriate practices.	P	P	P	P	P	P	P	P	P	P	P	P
7.2.5-7.2.7	Dams and water management/ use: groundwater withdrawal	Ensure that groundwater and surface water withdrawal for development and agriculture is adequately monitored and regulated such that these activities do not negatively impact SGCN and their habitats.	P	P	P	P	P	P	P	P	P	P	P	P
7.2.5-7.2.7	Dams and water management/ use: groundwater withdrawal	Protect the immediate catchment basin and groundwater supply feeding springs that support SGCN.												P
7.2.14	Dams and water management/ use: impervious Surfaces	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to wetland areas.				X	X	X			X		X	
7.3.3	Removal of coarse woody debris (streams, forests)	Establish and maintain effective natural buffers adjacent to wetlands by restoring natural communities.	P	P	P	P	P	P	P	P	P	P	P	P
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Allow natural reestablishment of beaver and manage populations to approximate natural conditions.		X	X				X					

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Promote the establishment and growth of floating-leaved and submerged vegetation.									X			
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore the Atlantic white-cedar component in Coastal Plain wetland systems.						X	X					
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore the northern conifer component (e.g., red spruce, eastern white pine, eastern hemlock) of bog-fen wetland complexes on the Allegheny Plateau.	X	X	X								X	
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	To the extent possible, manage habitats by mimicking natural disturbance patterns.									X			
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases														
8	Invasive and other problematic species, genes, and diseases	Develop and implement protocols to control invasive species and prevent their establishment that is compatible with SGCN.	P	P	P	P	P	P	P	P	P	P	P	P
8.1.2	Invasive non-native aquatic animals	Limit or prohibit the use of non-native fish as BMPs for mosquito control and vegetation management in wetlands.									X		X	
8.2.2	Problematic native species: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity to control populations and reduce browsing levels.	P	P	P	P	P	P	P	P	P	P	P	P
8.5.2	Viral/prion-induced diseases: *Ranavirus*	Promote disinfection protocols to minimize spread of *Ranavirus.*	P	P	P	P	P	P	P	P	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
IUCN 9: Pollution														
9	Pollution	Initiate measures to prevent and minimize pollution by surrounding the habitat with adequate buffers of native plant communities.					X	X			X		X	
9.1.1	Domestic and urban wastewater: sewage	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff to improve water quality within wetlands.	X	X	X	X	X	X	X	X	X	X	X	X
9.1.2	Domestic and urban wastewater: Run-off	Protect wetlands from contamination, siltation, and eutrophication by improving stormwater management practices and erosion control measures.	P	P	P	P	P	P	P	P	P	X	P	P
9.1.2	Domestic and urban wastewater: Run-off	Work with MDOT and local and county governments to reduce impacts from road salt, silt, pesticides and other runoff contaminants on wetlands.	X	X	X	X	X	X	X	X	X		X	X
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil and gas spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X	X	X	X	X	X	X	X	X	X	X
9.2.2	Industrial and military effluents: seepage from mining	Restore wetlands affected by coal mining and acid mine drainage.	X	X	X								X	
9.2.2	Industrial and military effluents: seepage from mining	Work with mining industry and regulators to improve regulations and implementation in order to eliminate detrimental impacts to hydrology and water quality of wetlands.	P	P	P	P			P	P				P
9.2.3	Hydraulic fracturing	Establish baseline and follow-up monitoring of streams and wetlands that may be impacted by hydraulic fracturing.	X	X	X								X	X
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian and wetland buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P	P	P	P	P	P	P	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Groundwater Wetland Habitats	Montane Bog and Fen	Montane - Piedmont Acidic Seepage Swamp	Montane - Piedmont Basic Seepage Swamp	Piedmont Seepage Wetland	Piedmont Upland Depression Swamp	Coastal Plain Flatwood and Depression Swamp	Coastal Plain Seepage Swamp	Coastal Plain Seepage Bog and Fen	Delmarva Bay	Maritime Swamp	Vernal Pool	Spring
9.3.1	Agricultural and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.	X	X	X	X	P	P	X	X	P	X	P	X
9.4.1	Garbage and solid waste	Reduce wetland degradation from filling and garbage dumping by educating the public.		P										P
9.5.5	Air-Bourne Pollutants	Promote use of only highly selective pesticides to control pest insect species.	X	X	X	X	X	X	X	X	X	X	X	X
9.5.5	Air-borne pollutants: herbicides and pesticides	Prevent/minimize mosquito control impacts on wetlands; develop a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.	X	X	X	X	X	X	X	X	X	P	X	X
IUCN 11: Climate Change and Severe Weather														
11.1.1	Habitat shifting or alteration: sea-level rise	Plan for landward "migration" or shifting of habitats in coastal areas, such as increasing emphasis on conserving buffers and migration corridors.										P		
IUCN 12: Resource Management Needs														
12.1.1	Lack of initial baseline inventory	Complete a statewide inventory and ecological assessment of targeted wetlands, such as vernal pools, Delmarva bays, and intertidal flats.									P		P	X
12.1.1	Lack of initial baseline inventory	Improve understanding (via surveys, remote sensing data, etc.) of the historical and current distribution, characteristics and condition of wetland habitats.	X	X	X	X			X	X				X
12.1.2	Lack of up-to-date information	Establish and maintain long-term habitat monitoring programs, determine extent of marshes and economic value of ecosystem services.									P		P	P
12.1.3	Need to answer research question	Delineate the catchment areas for springs, seeps, and runs/headwater streams that support SGCN to improve effectiveness of conservation actions for those habitats.		X	X	X			X	X				P

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

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

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

Conservation Actions for Tidal Wetlands

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

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
IUCN 7: Natural Systems Modifications							
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Implement BMPs and adaptive management methods for tidal marshes and associated impoundments.		X	X	X	
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Continue research on effects of fire on habitat, including loss of peat/soil substrate.			P	X	
7.2	Dams and water management/ use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology (includes beaver dams in wetland areas, which can be beneficial in small quantities, harmful when there are too many).	P	P	P	P	
7.2	Dams and water management/ use	Restore tidal flows to marshes by plugging ditches in a manner that minimizes conversion of marsh to open water.		P	P	P	
7.2.14	Dams and water management/ use: impervious Surfaces	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to wetland areas.		X			
7.3.3	Removal of coarse woody debris (streams, forests)	Establish and maintain effective natural buffers adjacent to wetlands by restoring natural communities.	P	P	P	P	
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases							
8	Invasive and other problematic species, genes, and diseases	Develop and implement protocols to control invasive species and prevent their establishment that is compatible with SGCN.	P	P	P	P	P
8.1.4	Terrestrial/ wetland animals	Manage the feral horse population on Assateague Island to reduce adverse impacts to habitats and SGCN.				P	
8.1.4	Terrestrial/ wetland animals	Work with partners to control or eradicate populations of invasive, non-native terrestrial /wetland animals, such as nutria and emerald ash borer, using appropriate BMPs and effective education campaigns.	P		P	P	
8.1.5	Terrestrial/ wetland plants	Work with partners to control or eradicate populations of invasive, non-native terrestrial /wetland plants, such as phragmites and purple loosestrife, using appropriate BMPs and effective education campaigns.	P	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
8.1.5	Terrestrial/ wetland plants	Develop and implement more effective methods of controlling phragmites.	X	X	X	X	X
8.2.2	Problematic native species: white-tailed deer	Work with partners to reduce and control white-tailed deer populations in riparian buffers to reverse browsing damage.	X				
IUCN 9: Pollution							
9	Pollution	Enhance point-source pollution control, such as upgrading wastewater treatment plants.	X	X	X		
9.1.1	Domestic and urban wastewater: sewage	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff to improve water quality within wetlands.	X	X	X	X	X
9.1.2	Domestic and urban wastewater: Run-off	Protect wetlands from contamination, siltation, and eutrophication by improving stormwater management practices and erosion control measures.	X	X	X	X	
9.1.3	Domestic and urban wastewater	Reduce impacts of water pollution from boats.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Implement all procedures to minimize risk of oil and gas spills and respond immediately to contain spills when they occur; maintain chemical spill response readiness.	X	X	X	X	X
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian and wetland buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.	X	X	X	X	X
9.4.1	Garbage and solid waste	Reduce wetland degradation from filling and garbage dumping by educating the public.		X	X	X	
9.5.5	Air-borne pollutants: herbicides and pesticides	Promote use of only highly selective pesticides to control pest insect species.	X	X	X	X	
9.5.5	Air-borne pollutants: herbicides and pesticides	Prevent/minimize mosquito control impacts on wetlands; develop a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.	X	P	P	P	
IUCN 11: Climate Change and Severe Weather							
11.1.1	Habitat shifting or alteration: sea-level rise	Plan for landward "migration" or shifting of habitats in coastal areas, such as increasing emphasis on conserving buffers and migration corridors.	P	P	P	P	

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
11.1.1	Habitat shifting or alteration: sea-level rise	Develop new technologies to accelerate tidal marsh accretion, including the use of dredge spoil and thin-layering techniques.	X	P	P	P	
11.1.1	Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss compared to predicted changes due to sea level rise to better inform and improve models.	X	X	X	X	X
11.1.1	Habitat shifting or alteration: sea-level rise	Take measures to mitigate habitat change resulting from sea-level rise.	X	X	X	X	X
IUCN 12: Resource Management Needs							
12.1.1	Lack of initial baseline inventory	Complete a statewide inventory and ecological assessment of targeted wetlands, such as vernal pools, Delmarva bays, and intertidal flats.					X
12.1.2	Lack of up-to-date information	Establish and maintain long-term habitat monitoring programs, determine extent of marshes and economic value of ecosystem services.	X	X	X	X	X
12.1.3	Need to answer research question	Develop more effective methods to restore hydrology to wetlands degraded by ditching.	P	P	P	P	
12.2.2	Need to conduct environmental reviews	Incorporate habitat conservation actions and BMPs into project reviews and land use change decisions by local, state, and federal agencies.	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat conservation needs and actions into local, state, and federal land use planning efforts and land management plans; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.	P	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate best BMPs into land management plans.	X	X	X	X	X
IUCN 14: Education/Outreach Needs							
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public regarding necessary conservation of wildlife habitats and their SGCN.	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Encourage landowners to reduce the use of fertilizers, such as through the Bay Wise Program.	X	X	X	X	

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Promote guidelines for restoration of wetlands that incorporate natural processes and native natural communities.	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, extension service professionals, and other resource professionals to help educated private landowners on the value of wetlands and buffers and provide management guidance (BMPs) on how to best conserve important habitats.	P	P	P	P	P
IUCN 15: Administrative Needs							
15.1.2	Infrastructure needs: need to maintain or improve information management systems	Regularly update GIS layers that identify forest interior habitats, Wetlands of Special State Concern, and other significant resources for use in local, state, and federal land planning and management.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Collaborate with the implementation of the North American Waterfowl Plan.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Continue partnership with MDA to maintain a viable CREP agreement with FSA that achieves enrollment goals. Modify 2009 amendment and make changes as necessary.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Coordinate efforts among agencies and NGOs to conserve habitat and maintain the integrity of aquatic and wetland systems across wide geographic areas and state boundaries, including targeting the highest quality areas.	P	P	P	P	P
15.3.2	Need for coordination for effective management	Develop Conservation Innovation Grants (CIG) with NRCS to stimulate development and adoption of innovative conservation approaches and technologies in conjunction with agricultural and forestry practices.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Develop Regional Conservation Partnership Program (RCPP) to leverage federal Farm Bill dollars with State and private funding to maximize effectiveness of conservation efforts.	X	X	X	X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Tidal Wetland Habitats	Tidal Forest	Tidal Freshwater Marsh and Shrubland	Tidal Brackish Marsh and Shrubland	Tidal Salt Marsh and Shrubland	Intertidal Mudflat and Sand Flat
15.3.2	Need for coordination for effective management	Partner with National Association of Conservation Districts, National Association of State Conservation Agencies, National Association of Resource Conservation and Development Councils, National Conservation District Employees Association, and NRCS in developing the National Conservation Planning Partnership, a multi-year commitment to conservation planning.	X	X	X	X	X
15.3.2	Need for coordination for effective management	Work with the Coastal Bay Program and other partnering entities to educate the public on land use and conservation issues	X	X	X	X	X
15.3.2	Need for coordination for effective management	Work with and utilize U.S. Army Corp of Engineers, MDE, and Critical Area Commission regulatory processes to protect habitat and ensure that appropriate resource protection measures are employed	P	P	P	P	P
15.3.2	Need for coordination for effective management	Work closely with USDA and Congressional representatives to develop and implement subsequent Farm Bills.	P	P	P	P	P
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, and federal programs to expand and coordinate wetland conservation efforts	X	X	X	X	X
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.	X	X	X	X	X

Appendix 7d. Conservation Actions for Aquatic Habitats

Appendices 7b – 7f list conservation actions recommended for key wildlife habitats in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to habitats. This appendix lists conservation actions specific to **Aquatic Habitats**. Individual habitats classified as **Aquatic Habitats** are marked **P** if the listed action is a **priority action** for implementation in that habitat and **X** if the action is a **non-priority action** for implementation in that habitat. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. Complete IUCN threat codes are defined in Appendix 5a.

This Appendix (7d) includes two separate Aquatic key wildlife habitat sections: 1) Streams and Rivers, and 2) Bay and Ocean.

Conservation Actions for Streams and Rivers

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
IUCN 1: Residential and Commercial Development											
1	Residential and Commercial Development	Conserve and restore seepage, floodplain, and tidal wetlands associated with streams and rivers.	X	X	X	X	X	X	X	X	X
1	Residential and Commercial Development	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	P	P	P	P	P	P	P	P
1	Residential and Commercial Development	Pursue land protection/ conservation easements in stronghold watersheds and high quality aquatic habitats, and assess acquisition by evaluating SGCN and their key wildlife habitats.	P	P	P	P	P	P	P	P	P
1	Residential and Commercial Development	Use low impact development design, retrofits, and state-of-the-art storm water management and sediment erosion control practices to minimize development impacts.	P	P	P	P	P	P	P	P	P
1	Residential and Commercial Development	Preserve and enhance connectivity of critical habitats.	X	X	X	X	X	X	X	X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
1.3.1	Land conversion from natural habitat to recreation or tourism areas (large and small)	Limit infrastructure development for recreation (such as trails, parking lots, etc.) in key areas for SGCN that are sensitive to disturbance (e.g., wood turtle, timber rattlesnake, salamanders).	X	X	X	X	X	P	X	X	X
IUCN 2: Agriculture and Aquaculture											
2	Agriculture and Aquaculture	Encourage farmers and landowners to become involved in Farm Bill programs and other landowner incentives, including the Conservation Reserve programs, for the maintenance of stream and riparian habitats and protection/conservation of wetlands, highly erodible lands, at-risk species and other wildlife on working lands.	P	P	P	X	X	X	X	X	X
2	Agriculture and Aquaculture	Work with landowners and farming community to develop and encourage BMPs for agricultural practices to conserve, restore and protect key wildlife habitats.	X	X	X	X	X	X	X	X	X
2.3	Livestock farming and ranching	Explore options to work with farmers to require stream buffers and livestock exclusion from streams.			X	X	X	X	P	X	X
IUCN 3: Energy Production and Mining											
3.1.2	Hydraulic fracturing	Site hydraulic fracturing development, gas extraction, and deep mining in a manner that avoids or minimizes impacts on SGCN and habitats.				X	X	X	X		
3.1.2	Hydraulic fracturing	Develop and implement BMPs for hydraulic fracturing that includes recommendations to address sediments and thermal pollution.				X		X	X		
3.1.2	Hydraulic fracturing	Limit groundwater and surface water withdrawals from industry, public consumption, and agriculture to maintain adequate stream flow and volume to sustain SGCN; use hydroassessments and permitting.	P	P	P	P	P	P	P	P	P
3.3.1	Wind power	Site industrial wind development (including roads) in a manner that avoids or minimizes species and habitat impacts.	X	X	X	X	X	X	X	X	X
IUCN 4: Transportation and Service Corridors											
4.1	Roads and railroads	Improve habitat connectivity in streams via blockage removal, culvert retrofit, and transportation BMPs; Prioritize these efforts into areas with the largest/best populations of SGCN and forage species supporting SGCN.	X		X	X	X	X		X	

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Incorporate state-of-the-art stream crossing design in planning for new roads to minimize geomorphic and hydrologic alterations and impacts to aquatic habitat and biota.	X	X	X	X	X	X	X	X	X
IUCN 5: Biological Resource Use											
5.1.3	Hunting and collecting terrestrial animals: persecution/ control	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating SGCN habitat; do so in a manner that avoids and minimizes nuisance issues and conflicts with other SGCN, unique natural communities, etc.	X	X	X	X	X	X	X	X	X
5.3.1	Logging and wood harvesting; intentional use - small scale	Work with foresters and land managers in implementing riparian habitat management guidelines.	X	X	X	X	X	X	X	X	X
IUCN 7: Natural Systems Modifications											
7.2	Dams and water management/use	Restore channelized streams to natural meanders.	X		X						
7.2	Dams and water management/use	Restore and conserve brook trout habitat in watersheds, especially in areas where populations are declining.				X					
7.2.3	Dams and water management/use: abstraction of surface water (domestic use)	Reduce stream channelization, ditching, impoundments which reduce access to spawning areas and take away habitat.	X	X	X	X	X	X	X	X	X
7.2.9	Dams and water management/use: small dams	Promote removal of dams and implement Executive Order 13508 that prompted the adoption of the 2014 Chesapeake Bay Watershed Agreement that included an outcome for opening 1000 miles of migratory fish passage by 2025.	P	P	P	X	P	X	X	P	P
7.2.14	Dams and water management/use: impervious surfaces	Limit impervious surfaces in watersheds; utilize MD DNR-developed impervious thresholds in land use planning to minimize SGCN and their habitats.	P	P	P	P	P	P	P	P	P
7.2.14	Dams and water management/use: impervious surfaces	Maintain and increase forest cover in watersheds including land acquisition.	P	P	P	P	P	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
7.2.3	Dams and water management/use: abstraction of surface water (agricultural use)	Minimize stream channelization and maintenance of ditched streams.	P		P	X	X	X		X	
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Reintroduce or augment certain SGCN in suitable habitats, when and where appropriate.	P	X	P	P	X	X	P	X	X
IUCN 8: Invasive and other Problematic Species, Genes, and Diseases											
8.1	Invasive non-native/alien species/diseases	Focus invasive species control efforts where they are most likely to be successful and have high biological return.	P	P	P	P	P	P	P	P	P
8.1.2	Invasive non-native aquatic animals	Limit stocking of non-native trout in fall in streams that support hellbenders.				P			P		
8.1.2	Invasive non-native aquatic animals	Work with partners to control populations of invasive, non-native aquatic plants and animals, such as hydrilla, zebra mussel, northern snakehead and blue/flathead catfish, using appropriate BMPs and effective education campaigns.	P	P	P	X	X	X	X	X	P
8.2.2	Problematic native species/diseases: white-tailed deer	Work with partners to reduce and control white-tailed deer populations to reverse browsing damage; advocate for more liberal doe season to control white-tailed deer populations in specific areas.	X	X	X	X	X	X	X	X	X
IUCN 9: Pollution											
9	Pollution	Reduce impacts of water pollution from boats.		X							X
9	Pollution	Direct TMDL development and implementation into watersheds that will have the greatest benefit to SGCN.	X	X	P	X	X	X	X	P	P
9.1	Domestic and urban wastewater	Enhance point source pollution control.	X	X	X				X		P
9.1, 9.2, 9.3	Domestic and urban wastewater; industrial and military effluents; agricultural and forestry effluents	Reduce pollution from urban, industrial and agricultural sources by promoting activities that effectively lower TMDL's and meet water quality standards, as agreed upon in the 2014 Chesapeake Bay Watershed Agreement.	X	X	X	X	X	X	X	X	X
9.1.1	Domestic and urban wastewater: sewage	Work with partners to reduce deleterious contaminant (e.g., endocrine disrupting compounds) concentrations and upgrade wastewater treatment plants to improve water quality.	X	P	X	X	X	X	P	X	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
9.1.2	Domestic and urban wastewater: run-off	Assess impacts of road salt and fly ash application to stream habitats and SGCN and develop abatement measures or alternatives for road salt and fly ash application in sensitive stream habitats. Conduct a comprehensive examination of state-to-state road salt use and policy, study trends in stream conductivity and chloride levels, identify regional SGCN most vulnerable to high chloride levels, and identify areas where rare aquatic habitats and species coincide with high levels of salt application.	P	P	P	P	P	P	P	P	P
9.1.2	Domestic and urban wastewater: run-off	Develop education and outreach efforts regarding impacts from road salt and promote possible BMPs and alternatives to use in sensitive stream habitats and propose to MDOT/SHA. Include public health in advocacy and outreach efforts.	P	P	P	P	P	P	P	P	P
9.2.1	Industrial and military effluents: oil spills	Minimize risk of oil and chemical spills and respond immediately to contain spills when they occur; improve capacity for eliminating spills.	X	X	X	X	X	X	X	X	X
9.2.2	Industrial and military effluents: seepage from mining	Minimize acid mine drainage and mitigate damages resulting from such drainage.				X		P	X		
9.3	Agricultural and forestry effluents	Restore, protect, and maintain riparian buffers to block siltation, pesticide, and fertilizer runoff to wetlands, streams, and rivers.	P	P	P	P	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Implement BMPs for livestock grazing near streams.	X	X	X	P	P	P	P	P	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Work with partners, such as watershed groups, to implement BMPs to reduce non-point nutrient inputs and nutrient loads to protect and restore aquatic/riparian communities.	X	X	X	X	X	X	X	X	X
9.3.2	Agricultural and forestry effluents: soil erosion and sedimentation	Improve sediment and erosion control practices.	X	X	P	X	X	X	X	X	X
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Work with landowners and farming community to implement BMPs for nutrient and pesticide application.	X	X	X	X	X	X	X	X	X
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Work with landowners and farming community to develop and encourage BMPs for agricultural practices to reduce and restrict the flow of pesticides and other toxic contaminants into aquatic systems.	X	X	X	X	X	X	X	X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Streams and Rivers	Blackwater Stream	Coastal Plain River	Coastal Plain Stream	Coldwater Stream	Limestone Stream	Highland Stream	Highland River	Piedmont Stream	Piedmont River
9.4.1	Garbage and solid waste: fishing line and other trash	Reduce trash dumping and fishing line dumping by educating the public.	X	X	X	X	X	X	X	X	X
9.5.1	Air-borne pollutants: acid rain	Increase efforts to continue research and monitoring for impacts and causes of acidic atmospheric deposition into Chesapeake Bay with specific restoration goals established in the 2014 Chesapeake Bay Watershed Agreement.	X	X	X	X	X	X	X	X	X
9.6.2	Excess energy: thermal pollution	Work with power companies to address thermal pollution (e.g., warmwater discharges, hypolimnetic releases, utility rights-of-way clearings from electric power generation.		X					X		X
IUCN 11: Climate Change and Severe Weather											
11.1.1	Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss to predicted changes in sea level.	X	X	X						
11.1.1	Habitat shifting or alteration: sea-level rise	Take measures to mitigate habitat change resulting from sea-level rise.	X	X	X						
11.3	Temperature extremes	Evaluate habitat change and loss predicted due to changes in thermal regime and precipitation patterns.	P	P	P	P	P	P	P	P	P
11.3	Temperature extremes	Take measures to mitigate habitat change resulting from changes in thermal regime and precipitation patterns, including limiting impervious surfaces, surface and groundwater abstraction, damming, and buffer encroachment in streams with sensitive species.	P	P	P	P	P	P	P	P	P
IUCN 12: Resource Management Needs											
12.1.1	Lack of initial baseline inventory	Assess stream habitats and identify areas where restoration is feasible with high likelihood of success and prioritize for biological recovery.	X	X	X	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Establish and maintain long-term habitat monitoring programs for health and condition of stream.	P	X	P	P	P	P	X	P	X
12.1.2	Lack of up-to-date existing information	Encourage and assist with the development of citizen science groups (e.g. Trout Unlimited) to participate in stream assessments, spawning surveys, etc.	X	X	X	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Continue annual stream surveys for water quality and rapid assessment of habitat conditions, with special focus on brackish, tannic, and freshwater habitats.	P	P	P	X	X	X	X	X	X

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

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

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

Conservation Actions for Bay and Ocean

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
IUCN 1: Residential and Commercial Development							
1	Residential and Commercial Development	Preserve and enhance connectivity of critical habitats.	X	X	X	X	X
1	Residential and Commercial Development	Use low impact development design, retrofits, and state-of-the-art storm water management and sediment erosion control practices to minimize development impacts.	P	P	P	P	P
IUCN 2: Agriculture and Aquaculture							
2	Agriculture and Aquaculture	Encourage farmers and landowners to become involved in Farm Bill programs and other landowner incentives, including the Conservation Reserve programs, for the maintenance of stream and riparian habitats and protection/conservation of wetlands, highly erodible lands, at-risk species and other wildlife on working lands.	P	P	X	P	X
IUCN 3: Energy Production and Mining							
3.2.4	Mining and quarrying: sand dredging (outside shipping lanes)	Ensure sand mining activity is limited to areas of least impact.	P	P	P	X	X
3.3.1	Wind power	Site offshore wind energy development in a manner that avoids or minimizes impacts on SGCN and habitats.	P	P	P		
3.3.1	Wind power	Develop and implement BMPs for offshore wind that includes recommendations to address impacts to habitats and SGCN.	P	P	P		
3.3.1	Wind power	Determine potential impacts of offshore wind energy development and take measures to avoid and minimize these impacts.	P	P	P		
IUCN 4: Transportation and Service Corridors							
4.3.2	Shipping lanes: dredging impacts	Provide Environmental Review and resource managers with information on habitat use by species so that dredging of those habitats is strongly discouraged.	P	P	P	P	P
IUCN 5: Biological Resource Use							
5.4.2	Fishing and harvesting of aquatic resources: intentional use (large scale)	Assess impacts of fishing gear and practices to habitats and SGCN and develop BMPs to mitigate these effects.	X	X	X	X	X

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
9.2.1	Industrial and military effluents: oil spills	Maintain capacity for efficient wildlife oil spill response by training personnel in Incident Command System.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Respond to oil spills immediately and efficiently by maintaining reliable watercraft and train personnel in their safe operation.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Maintain contact with the Mid-Atlantic Regional Response Team.	X	X	X	X	X
9.2.1	Industrial and military effluents: oil spills	Monitor key beach habitats and wildlife populations in areas vulnerable to oil spills and have a mechanism to share maps and data at short notice.	X	X	X	X	X
9.3.1	Agricultural and forestry effluents: nutrient loads	Work with landowners and farming community to implement BMPs for nutrient and pesticide application.	P	P	X	P	P
IUCN 11: Climate Change and Severe Weather							
11.1.1	Habitat shifting or alteration: sea level rise	Evaluate climate change (e.g., sea level rise, warming temperatures, brown tide) impacts to habitat quality and quantity; evaluate coastal resiliency information.	X	P	X	P	P
11.1.1	Habitat shifting or alteration: sea level rise	Take measures to mitigate habitat change resulting from sea-level rise.	X	P	X	P	P
11.1.1	Habitat shifting or alteration: sea level rise	Evaluate ocean acidification impacts to habitat quality and quantity and SGCN.	P	P	P	P	P
IUCN 12: Resource Management Needs							
12.1.1	Lack of initial baseline inventory	Characterize critical offshore habitat, migratory pathways, biological populations and ecological processes for use in long-term ecosystem-based management.	X	X	X		
12.1.2	Lack of up-to-date existing information	Maintain Coastal Bay water quality monitoring programs (and collaboration between listed partners) to assess nutrient loading ecosystem stressors and living resource responses.	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Monitor and assess harmful algae species, frequency, duration, and effects in aquatic habitats.	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Expand and update data and information in MD DNR's Coastal Atlas for use in coastal planning activities.	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Develop a cooperative management protection plan for Assateague Island that addresses SGCN seasonal needs.	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Implement recommendations in the Maryland Coastal Bays Management Plan.	X	X	X	X	X
12.2.3	Need for fish, wildlife and/or habitat planning	Implement required management actions in approved fishery management plans.	X	X		X	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Bay and Ocean Habitats	Pelagic-Open Water	Shellfish Bed	Hard Bottom	Submerged Aquatic Vegetation	Macroalgae Bed
IUCN 14: Education/Outreach Needs							
14.3.1	Need to develop and/or maintain a broad base of support for agency goals and objectives	Improve and promote education and public outreach efforts to engage them in promoting conservation and restoration of high quality habitats and SGCN.	X	X	X	X	X
IUCN 15: Administrative Needs							
15.3.2	Need for coordination for effective program/project management	Coordinate conservation efforts between various interest groups and agencies and across states boundaries, especially in shared waterbodies.	X	X	X	X	X
15.3.2	Need for coordination for effective program/project management	Coordinate efforts with various programs including the Chesapeake Bay Foundation, Alliance for the Chesapeake Bay, Chesapeake Bay Program, etc. to initiate measures to protect, maintain and improve all species habitats and populations.	X	X	X	X	X
15.3.5	Need for changes in government policies	Establish policies that reduce oil spill likelihood (e.g., vessel mandates).	P	X	X	X	X

Appendix 7e. Conservation Actions for Subterranean Habitats

Conservation Actions for Cave and Karst

Appendices 7b – 7f list conservation actions recommended for key wildlife habitats in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to habitats. This appendix lists conservation actions specific to **Subterranean Habitats**. Individual habitats classified as **Subterranean Habitats** are marked **P** if the listed action is a **priority action** for implementation in that habitat and **X** if the action is a **non-priority action** for implementation in that habitat. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. Complete IUCN threat codes are defined in Appendix 5a.

This Appendix (7e) includes one Subterranean key wildlife habitat: 1) Cave and Karst.

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Cave and Karst Habitats	Action Priority Type
IUCN 7: Natural Systems Modifications			
7.2	Dams and water management/use	Protect groundwater supply feeding subterranean springs inhabited by SGCN.	P
7.2.14	Dams and water management/use: impervious surfaces	Improve stormwater management practices and sediment erosion control measures to avoid or minimize development impacts to groundwater aquifers.	P
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases			
8	Invasive and Other Problematic Species, Genes, and Diseases	Develop and implement protocols to control invasive species in a manner compatible with SGCN.	X
8.1.2	Invasive non-native aquatic animals: white-nose syndrome	Rigorously perform protocols for decontamination of equipment and clothing to avoid the spread of fungal spores by humans.	P
IUCN 9: Pollution			
9.1, 9.3	Domestic and urban wastewater; agricultural and forestry effluents	Initiate measures to prevent pollution of sinking or losing streams associated with subterranean habitats through retention or development of adequate vegetated buffers.	P
9.3.1	Agricultural and forestry effluents: nutrient loads	Protect water quality of cave ecosystems and surrounding buffer habitats by restricting livestock access to vital groundwater components, particularly sinkholes, springs, sinking streams and cave entrance areas.	X
9.3.2	Agricultural and forestry effluents: soil erosion and sedimentation	Minimize or eliminate soil disturbance in estimated catchment basins; restore forest cover to deforested catchment basins.	X
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.	X
IUCN 12: Resource Management Needs			
12.1.1	Lack of Initial Baseline Inventory	Determine the extent of groundwater aquifers for highest priority cave systems harboring SGCN.	P
12.1.2	Lack of up-to-date information	Continue research into the composition, distribution, and abundance of groundwater and cave obligate fauna in Maryland.	X
12.1.3	Need to answer research question	Determine reasons for bat survival in tunnels and extend knowledge to restore bat populations in caves.	P
12.2.1	Need to provide technical assistance	Work with MDE Mining Program to protect deep mines supporting SGCN.	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions for Cave and Karst Habitats	Action Priority Type
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate habitat conservation actions and protection needs into land planning efforts and public land management plans by local, state, and federal agencies.	P

Appendix 7f. Conservation Actions for Other Habitats

Appendices 7b – 7f list conservation actions recommended for key wildlife habitats in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to habitats. This appendix lists conservation actions specific to **Other Habitats**. Individual habitats classified as **Other Habitats** are marked **P** if the listed action is a **priority action** for implementation in that habitat and **X** if the action is a **non-priority action** for implementation in that habitat. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. Complete IUCN threat codes are defined in Appendix 5a.

This Appendix (7f) includes one separate key wildlife habitat sections: 1) Other.

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
IUCN 1-4: Urbanization/Development									
1 - 4	Habitat loss (from various causes)	Conserve and protect habitat and appropriate corridors for movement and dispersal of SGCN.	P	X		P			P
1 - 4	Habitat loss (from various causes)	Focus land preservation efforts on protecting large tracts of contiguous habitat to minimize fragmentation and edge effects for area-dependent species.	X	X	X	X			
1 - 4	Habitat loss (from various causes)	Establish and maintain appropriate buffers to wetlands through landowner incentive programs, acquisition, easements, regulatory means and implementation of BMP's.				X			
1-4	Habitat loss (from various causes)	Protect high priority wetlands (e.g., WSSC, ESA, Bionet Tier 1-3 sites) through land acquisition and conservation easements; where appropriate, extend protection to the surrounding forest matrix and watershed with adequate landscape connectivity between wetland systems.				X			
1 - 4	Habitat loss (from various causes)	Avoid and minimize development impacts within wetland areas and their surrounding buffers.				X			

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
1 - 4	Habitat loss (from various causes)	Encourage implementation of BMP's that minimize and reduce habitat fragmentation in land use plans.	X	X	X	X			
IUCN 2: Agriculture and Aquaculture									
2	Agriculture and Aquaculture	Work with farmers to conserve and manage for this habitat for SGCN on marginal croplands and encourage beneficial agricultural practices (e.g., late mowing, grass forb buffers in agricultural settings, farm bill programs, other landowner incentives) through existing programs (Farm Bill and Conservation Reserve programs) and by developing new incentives.	P	P		P			
2	Agriculture and Aquaculture	Work with farming community to create and maintain ecologically functioning artificial wetlands.				X			
IUCN 3: Energy Production and Mining									
3.1.1	Drilling and distribution of petroleum and other liquid hydrocarbons	Avoid and minimize all impacts to wetlands and their surrounding buffers from gas and oil pipelines.				P			
3.1.2	Hydraulic fracturing	Ensure that sufficient regulatory protection is in place to prevent or minimize hydraulic fracturing impacts on wetlands and the surrounding forest matrix and watershed.				P			
3.2.1	Surface mining – coal strip mining	Site and configure industrial surface mines in a manner that avoids and minimizes impacts to SGCN and habitats.	X					X	
3.2.2	Surface mining – rock quarry	Prevent/minimize rock and sand quarrying to wetland areas and surrounding watersheds, including appropriate buffers.				X			
3.3.1	Wind power	Work to develop and implement operational BMPs to reduce impacts of wind farms on this habitat and associated SGCN.	X						
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes impacts to SGCN and habitats.	X						

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
IUCN 4: Transportation and Service Corridors									
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MD DOT to better plan and construct transportation infrastructure, including planning for new roads, to minimize habitat fragmentation, and to provide adequate dispersal/movement corridors for SGCN.	X	X		P			
4.1.1	Roads and railroads: land conversion from natural habitat to roads and railroads	Work with MD DOT to avoid and minimize wetland impacts and to better target offsite wetland mitigation.				P			
IUCN 5: Biological Resource Use									
5.3	Logging and wood harvesting	Work with the forestry community to develop timber harvest BMPs for private landowners that protect wetlands and other KWHs, and, where appropriate, the surrounding forest matrix with adequate connectivity between habitats.	P	X	P	P			X
5.3	Logging and wood harvesting	Protect water quality within catchment basins of SGCN inhabited caves, sinkholes, and subterranean springs by maximizing forest cover and implementing appropriate forestry BMPs.						X	
IUCN 6: Human Intrusions and Disturbance									
6.1.1	Recreational activities: off-road vehicles	Reduce and, wherever possible, eliminate off-road vehicle (ORV) use in wetlands and other fragile habitats; work with ORV industry to better inform riders of ecological impacts and responsibility; limit access when necessary.	X	P				X	P
6.1.4	Recreational activities: exploration of caves/mines	Educate spelunkers about the value of these habitats and the impacts of disturbance to mines supporting SGCN.						X	

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
6.1.4	Recreational activities: exploration of caves/mines	Install and maintain appropriate gates at entrances to mines and tunnels that support SGCN to minimize human disturbance.						P	
IUCN 7: Natural Systems Modifications									
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Restore and maintain habitat through re-establishing natural fire regimes where feasible and implementing prescribed burn programs to control woody vegetation.	X	X					X
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Utilize appropriate prescribed burning in or light disking of selected portions of individual fields to maintain early-successional seral stages and increase coverage of tall forbs.		X					
7.2	Dams and water management/use	Protect wetlands from drainage, ditching, filling, water withdrawal, and other damaging practices that alter hydrology.				P			
7.2.5 & 7.2.6	Dams and water management/use: abstraction of ground water (domestic use; commercial use)	Protect groundwater supply feeding springs inhabited by SGCN from excessive withdrawal for both domestic and commercial uses.						X	
7.2.5-7.2.7	Dams and water management/use: abstraction of ground water (domestic use; commercial use; agricultural use)	Ensure that groundwater and surface water withdrawal for development and agriculture is adequately monitored and regulated such that these activities do not negatively impact SGCN and their habitats.				P			

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
7.2.9	Dams and water management/use: small dams	Work with landowners to encourage retention of natural emergent wetlands (e.g., careful review of proposals for new impoundments).				P			
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating SGCN habitat; do so in a manner that avoids and minimizes nuisance issues and conflicts with other SGCN, unique natural communities, etc.	P			X			
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Promote the establishment and growth of floating-leaved and submerged vegetation.				X			
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases									
8	Invasive and Other Problematic Species, Genes, and Diseases	Develop and implement protocols to control invasive plants in a manner compatible with SGCN; increase awareness outreach efforts.	P	P	X	P	X	X	P
8	Invasive and Other Problematic Species, Genes, and Diseases	Implement appropriate IPM practices to minimize the effects of serious forest animal and plant pest species while protecting non-target SGCN.	X		X				
8.1.2	Invasive non-native aquatic animals	Prohibit the use of non-native fish as BMPs for mosquito control and vegetation management in wetlands.				X			
8.1.2	Invasive non-native aquatic animals	Rigorously perform protocols for decontamination of equipment and clothing to avoid the spread of fungal spores by humans.						P	
8.1.5	Invasive non-native terrestrial/wetland plants	Implement training and operational BMPs to control and reduce the spread of invasive species by field personnel.	X	P		P		P	P
8.2.2	Problematic native species/diseases: white-tailed deer	Develop and implement measures to maintain deer populations at or below carrying capacity; control populations to reduce negative browsing impacts in habitats with SGCN.	P	P	X	P			P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
8.3.1	Introduced genetic material: herbicide resistant crops	Create and manage habitat for pollinators using locally native seed mixes; select these areas along roads and highways, adjacent to cropland, utility rights of way areas, and other habitat areas.	X	P		X			P
IUCN 9: Pollution									
9	Pollution	Initiate measures to prevent and minimize pollution by surrounding the habitat with adequate buffers of native plant communities.				X		X	
9	Pollution	Protect wetlands from contamination, siltation, and eutrophication. (improve stormwater management practices and emergent control measures).				P			
9.1	Domestic and urban wastewater	Implement nitrogen and phosphorus reduction strategies for septic and stormwater runoff.				X			
9.1.2	Domestic and urban wastewater: run-off	Minimize runoff from roads, which contains silt, salt, and other contaminants.				X			
9.2.2	Industrial and military effluents: seepage from mining	Restore wetlands affected by acid mine drainage.				X			
9.2.3	Industrial and military effluents: hydraulic fracturing	Establish baseline and follow-up monitoring of streams and wetlands that may be impacted by hydraulic fracturing.				X			
9.3.1	Agricultural and forestry effluents: nutrient loads	Reduce sources of groundwater contamination by implementing BMPs for nutrients on agricultural lands.				P			
9.3.3	Agricultural and forestry effluents: control of insect pests leading to mortality of non-target species	Limit the use of pesticides such that SGCN and this habitat are not adversely affected.	X	P		X		X	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
9.5.5	Air-borne pollutants: herbicides and pesticides	Prevent/minimize mosquito control impacts on wetland ecosystems; establish a statewide inter-agency (MDA, MDE, DNR) mosquito control policy that protects public health while avoiding and minimizing impacts on ecosystems and SGCN.				X			
IUCN 12: Resource Management Needs									
12.1.1	Lack of initial baseline inventory	Work with the public and land managers to identify important KWH areas.	X	X	X	X	X	X	X
12.1.2	Lack of up-to-date existing information	Work with MDE to update the list of Wetlands of Special Concern, including high quality vernal pools, and improve regulatory protection of these areas.				P			
12.1.3	Need to answer research question	Determine reasons for bat survival in tunnels and extend knowledge to restore bat populations in caves.						P	
12.1.3	Need to answer research question	Determine historical range of this key wildlife habitat and target priority sites for monitoring and research.		X					
12.1.3	Need to answer research question	Conduct habitat research to determine BMPS, effects from fire, and natural fire regime.		X					
12.1.3	Need to answer research question	Delineate watersheds for mines and tunnels with springs harboring rare subterranean aquatic invertebrates.						X	
12.2.1	Need to provide technical assistance	Encourage management for grassland species on reclaimed mine lands. Encourage the use of native seed stock for warm season grass plantings.		P					
12.2.1	Need to provide technical assistance			P					P
12.2.1	Need to provide technical assistance	Develop and assist with implementation of habitat management guidelines for use by foresters and land managers including forest stewardship plans.	P	P	X	X			P
12.2.3	Need for fish, wildlife, and/or habitat planning	Incorporate BMPs and habitat protection needs into land management plans to benefit SGCN.	X	X	P	P	X	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
12.2.3	Need for fish, wildlife, and/or habitat planning	Incorporate conservation actions and BMPs into land use change decisions, land planning efforts, and public land management plans by local, state, and federal agencies.	X	P		X	X	X	P
IUCN 14: Education/Outreach Needs									
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Educate the public on best practices to create and maintain artificial structures highly beneficial to SGCN.					X		
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Work with forestry professionals, extension service professionals, and other resource professionals to educate private landowners on the value of wildlife habitats and on BMPs to conserve them.	X	X	X	X	X	X	X
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Increase environmental education opportunities and training for the general public with Key Wildlife Habitats; coordinate with UME and conduct Master Naturalist Trainings.	X	X	X	X	X	X	X
IUCN 15: Administrative Needs									
15.3.2	Need for coordination for effective management	Work with Bureau of Mines to protect mines supporting SGCN.						X	
15.3.2	Need for coordination for effective management	Work with watershed groups, watershed-based initiatives, landowners, federal programs, and all conservation partners to expand and coordinate conservation efforts for key wildlife habitats.	X	X	X	X	X	X	X
15.3.3	Need for increased legal protection	Modify, as needed, nontidal wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern, to better protect wetlands and surrounding wetlands.				P			
15.3.4	Need for increased enforcement of laws	Increase enforcement of wetland protection regulations, especially as they relate to Nontidal Wetlands of Special State Concern.				X			X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Habitats	Managed Successional Forest	Managed Grassland	Managed Montane Conifer Forest	Artificial Impoundment and Wetland	Artificial Structures - Buildings and Other Structures	Artificial Structures - Mines and Tunnels	Roadsides and Utility Rights-of-way
15.3.5	Need for changes in government policies	Work with other resources professionals and partners to modify practices on artificial wetlands being managed for waterfowl to improve habitat for SGCN.				P			
15.3.5	Need for changes in government policies	Encourage the conversion of agricultural fields and mowed lawns on public lands to meadows and grassland habitat where feasible.		P					

Appendix 7g. Conservation Actions for Mammal Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **mammal** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a.

The actions listed move from broad to narrow in scope, with actions for the overall taxa group (**mammals**) listed first, then following in this order: 1) insectivores, 2) lagomorphs and rodents, 3) carnivores, 4) bats, and 5) marine mammals. Individual species for which the action applies are listed in the rightmost Species of Greatest Conservation Need column.

Conservation Actions for ALL Mammal SGCN

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

Conservation Actions for Insectivore SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Insectivores				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect large, contiguous forested landscapes that are connected by effective movement/dispersal corridors.	P	Southeastern star-nosed mole, smoky shrew, long-tailed shrew, southern pygmy shrew, southeastern shrew, southern water shrew
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	Long-tailed shrew, smoky shrew, southern pygmy shrew, southern water shrew
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes impacts on species and their habitats.	P	Long-tailed shrew, smoky shrew, southern pygmy shrew, southern water shrew
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on species and their habitats.	P	Long-tailed shrew, smoky shrew, southern pygmy shrew, southern water shrew
IUCN 5: Biological Resource Use				
5.3.1	Logging and wood harvesting; intentional use – small scale	Protect populations on public lands through streamside and watershed-scale habitat protection and restoration, and by providing habitat connectivity between drainages.	P	Southeastern star-nosed mole, southern water shrew
5.3.3	Logging and wood harvesting; intentional use – large scale	Protect populations on private lands through streamside and watershed-scale habitat protection and restoration, and by providing habitat connectivity between drainages.	P	Southeastern star-nosed mole, southern water shrew
IUCN 7: Natural Systems Modification				
7.2.6	Dams and water management/use: abstraction of groundwater (commercial use)	Avoid and minimize impacts of hydraulic fracturing-related groundwater extraction on stream and wetland habitats that support these species.	P	Southeastern star-nosed mole, southern water shrew
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1.4	Invasive non-native terrestrial/wetland animals: hemlock woolly adelgid	Determine the effects of adelgid-related loss of eastern hemlock forest in the Piedmont and Ridge and Valley physical provinces on species populations and identify measures that can be taken to minimize these effects.	X	Smoky shrew

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Insectivores				
IUCN 9: Pollution				
9.2.3	Industrial and military effluents: hydraulic fracturing	Monitor biological, chemical and physical stream parameters to assess potential impacts of hydraulic fracturing on stream and wetland habitats.	P	Southern water shrew
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Identify the types of pesticide use (e.g., mosquito control, gypsy moth control, various forms of agricultural pest control) that are known to or could potentially impact mammalian insectivore populations and take measures to avoid or minimize those impacts.	X	ALL SGCN lagomorphs and rodents
IUCN 12: Resource Management Needs				
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	ALL SGCN lagomorphs and rodents
12.1.3	Need to answer research question	Resolve taxonomic uncertainty of subspecies occurring in Maryland.	X	Southeastern star-nosed mole, southern pygmy shrew
12.1.3	Need to answer research question	Determine home range, dispersal behavior/capabilities, extent of gene flow between populations, and habitat connectivity needs.	P	Long-tailed shrew, southern water shrew
12.1.3	Need to answer research question	Determine reproductive ecology.	X	Long-tailed shrew, southern water shrew
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection, connectivity and restoration needs in public land management plans.	P	ALL SGCN lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	ALL SGCN lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	Least shrew, long-tailed shrew, smoky shrew, southern water shrew
12.1.4	Need to develop new technique	Developing more effective survey and monitoring techniques including live capture methods.	P	ALL SGCN lagomorphs and rodents
IUCN 15: Administrative Needs				
15.3.2	Need to answer research question	Work more collaboratively on priority inventory, monitoring and research needs.	X	ALL SGCN lagomorphs and rodents
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	P	ALL SGCN lagomorphs and rodents

Conservation Actions for Lagomorph and Rodent SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Lagomorphs and Rodents				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect large, contiguous forested landscapes that are connected by effective movement/dispersal corridors.	P	Appalachian cottontail, northern flying squirrel, Delmarva fox squirrel, southern rock vole, Allegheny woodrat, North American porcupine
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes impacts on species and their habitats.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on species and their habitats.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
IUCN 7: Natural Systems Modification				
7.2.6	Dams and water management/use: abstraction of groundwater (commercial use)	Avoid and minimize impacts of hydraulic fracturing-related groundwater extraction on stream and wetland habitats that support this species.	P	Southern rock vole
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Restore high elevation, red spruce-dominated forests.	P	Northern flying squirrel, southern rock vole
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.2.2	Problematic native species/ diseases: eastern cottontail	Use habitat protection and management practices that minimize the risk of encroachment by eastern cottontails.	P	Appalachian cottontail
IUCN 12: Resource Management Needs				
12.1.2	Lack of up-to-date existing information	Complete on-going acoustic surveys and refine/expand as needed to determine species' presence in Maryland.	P	Northern flying squirrel
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat, eastern harvest mouse, southern bog lemming, North American porcupine

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Lagomorphs and Rodents				
12.1.2	Lack of up-to-date existing information	Establish or continue monitoring (vet surveys for some species - porcupine).	P	Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat, North American porcupine
12.1.3	Need to answer research question	Determine cause of apparent population declines and what measures are needed to ensure recovery.	P	Allegheny woodrat, southern bog lemming
12.1.3	Need to answer research question	Determine extent of gene flow between populations, dispersal behavior/capabilities, and habitat connectivity needs.	P	Appalachian cottontail, southern rock vole, Allegheny woodrat
12.1.4	Need to develop new technique	Use genetic analyses of fecal samples to differentiate between Eastern and Appalachian cottontails.	P	Appalachian cottontail
12.2.1	Need to provide technical assistance	Work with landowners and public land managers to minimize nuisance issues and need for control.	P	North American porcupine
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection, connectivity and restoration needs in public land management plans.	P	All SGCN lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	All SGCN lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Consideration of wildlife plans within stewardship forestry plans, including taking SGCN list into consideration (forest/wildlife plans -outreach).	X	All SGCN lagomorphs and rodents
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat
IUCN 15: Administrative Needs				
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	P	Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat

Conservation Actions for Carnivore SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Carnivores				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect large, contiguous and diverse forested landscapes that are connected by adequate movement/dispersal corridors.	P	ALL SGCN carnivores
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and habitats.	X	Eastern spotted skunk, bobcat
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P	Eastern spotted skunk, bobcat
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of industrial wind development on species and their habitats.	P	Eastern spotted skunk, bobcat
IUCN 12: Resource Management Needs				
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	ALL SGCN carnivores
12.1.2	Lack of up-to-date existing information	Improve understanding of species home range, dispersal and movement patterns.	P	Eastern spotted skunk, bobcat
12.1.4	Need to develop new technique	Develop more effective survey and monitoring techniques.	P	Least weasel
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection, connectivity and restoration needs in public land management plans.	P	ALL SGCN carnivores
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	X	Eastern spotted skunk, bobcat
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	Eastern spotted skunk, bobcat
IUCN 15: Administrative Needs				
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	P	Eastern spotted skunk, bobcat

Conservation Actions for Bat SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Bats				
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and habitats.	P	Big brown bat, silver-haired bat, eastern red bat, hoary bat, Seminole bat, tricolored bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat
3.3.1	Wind power	Monitor industrial wind development sites for mortality.	P	ALL SGCN bats
3.3.1	Wind power	Use mist net and acoustic surveys to determine migratory timing on the Delmarva peninsula.	P	Silver-haired bat, eastern red bat, hoary bat, Seminole bat, tricolored bat
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P	ALL SGCN bats
3.3.1	Wind power	Curtail turbine operation at low wind speeds at industrial wind development sites.	P	ALL SGCN bats
IUCN 5: Biological Resource Use				
5.3.3	Logging and wood harvesting; unintentional effects – small scale	Promote timber management practices on private lands that minimize impacts on bats.	P	ALL SGCN bats
IUCN 6: Human Intrusions and Disturbance				
6.1.4	Recreational activity: exploration of caves/mines	Protect hibernating bats from disturbance.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1.6	Invasive non-native fungal/bacterial diseases: white nose syndrome	Use acoustic surveys to monitor effect of white-nose Syndrome on summer populations.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
8.1.6	Invasive non-native fungal/bacterial diseases: white nose syndrome	Assist research related to white-nose syndrome, including potential methods for abating its effects.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
8.1.6	Invasive non-native fungal/bacterial diseases: white nose syndrome	Promote the use of roosting boxes and regularly monitor to determine bat use and track population recovery; increase education and outreach efforts.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Bats				
IUCN 9: Pollution				
9.3.3	Agricultural and forestry effluents: herbicides and pesticides	Identify the types of pesticide use (e.g., mosquito control, gypsy moth control, various forms of agricultural pest control) that are known to or could potentially impact bat populations and take measures to avoid or minimize those impacts.	P	ALL SGCN bats
IUCN 12: Resource Management Needs				
12.1.2	Lack of up-to-date existing information	Cautiously monitor populations in hibernacula.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.1.2	Lack of up-to-date existing information	Monitor maternity colonies.	P	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	P	ALL SGCN bats
12.1.2	Lack of up-to-date existing information	Use acoustic surveys, mist net surveys and other techniques to better determine status, distribution and habitat associations in MD.	P	ALL SGCN bats
12.1.3	Need to answer research question	Investigate WNS bat resistance in MD tunnels and extend knowledge to partners.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.2.1	Need to provide technical assistance	Protect maternity colonies by working with land owners and land managers.	P	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat
12.2.3	Need for fish, wildlife and/or habitat planning	Include bat conservation needs in public land management plans.	P	ALL SGCN bats
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and connectivity needs in local and county land zoning plans (e.g., Comprehensive Plans).	P	ALL SGCN bats
12.2.3	Need for fish, wildlife and/or habitat planning	Develop forest BMPs for bats.	P	ALL SGCN bats
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/ project management	Coordinate inventory, monitoring, and research across MD and surrounding states; form a Mid-Atlantic Bat Working Group.	P	ALL SGCN bats

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Bats				
15.3.3	Need for increased legal protection	Increase ability to protect habitat through application and modification, if needed, of existing laws.	P	Big brown bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat

Conservation Actions for Marine Mammal SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Marine Mammals				
IUCN 1 – 4: Urbanization/Development				
1.1-3.1	Urbanization/ Development Land conversion	Site coastal developments in a manner that avoids or minimizes impacts to important coastal and estuarine habitats.	P	Bottlenose dolphin
IUCN 2: Agriculture and Aquaculture				
2.4.2	Marine and freshwater aquaculture: industrial aquaculture	Site aquaculture facilities in a manner that avoids or minimizes impacts to important coastal and estuarine habitats.	P	Bottlenose dolphin
IUCN 3: Energy Production and Mining				
3.1.1	Oil and gas drilling and distribution of petroleum and other liquid hydrocarbons	Site oil and gas drilling to minimize impacts on marine species.	P	ALL SGCN marine mammals
3.3.1	Wind power	Site offshore wind developments so as to minimize impacts on species and their habitats.	P	ALL SGCN marine mammals
3.3.1	Wind power	Conduct research to determine how to minimize and mitigate impacts of offshore wind development on species and their habitats.	P	ALL SGCN marine mammals
IUCN 4: Transportation and Service Corridors				
4.3.1	Movement of large ships in shipping lanes	Reduce disruption of movement corridors and ship strikes.	P	North Atlantic right whale, fin whale, humpback whale, sperm whale, bottlenose dolphin

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mammals – Marine Mammals				
IUCN 5: Biological Resource Use				
5.4.4	Fishing and harvesting of aquatic resources: unintentional effects	Reduce entanglements in fishing nets.	P	Fin whale, humpback whale, sperm whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin
IUCN 6: Human Intrusions and Disturbance				
6.1.2	Recreational activities: boating	Raise awareness of boaters to reduce conflicts.	P	Sperm whale, bottlenose dolphin
6.2.1	Military exercises	Reduce impacts to marine species through military exercises.	P	ALL SGCN marine mammals
6.3.1	Work and other activities	Reduce impacts to marine species from geological and geophysical surveys.	P	ALL SGCN marine mammals
IUCN 7: Natural Systems Modification				
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Understand impacts of recent species population declines to ecosystem.	P	Bottlenose dolphin
IUCN 8: Invasive and Other Problematic Species and Genes				
8.2.2	Problematic native species/diseases: cetacean morbillivirus	Understand anthropogenic triggers for cetacean morbillivirus.	P	Bottlenose dolphin
IUCN 9: Pollution				
9.2.3	Toxic chemicals from factories, illegal dumping of chemicals, other industrial effluent, ship waste discharge	Reduce dumping of toxic chemicals in ocean.	P	ALL SGCN marine mammals
9.4.1	Plastics	Reduce garbage dumping in oceans.	P	Fin whale, sperm whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin
9.6.3	Excess energy: noise pollution	Reduce noise where possible, especially in migration corridors and other areas of known habitat use.	P	Blue whale, humpback whale, sperm whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin
IUCN 11: Climate Change and Severe Weather				
11.3.1	Temperature extremes and phenology shifts related to predator-prey ecology	Understand impacts of climate change on movements and key food resources.	P	Blue whale, fin whale, Gervais' beaked whale, True's beaked whale, Cuvier's beaked whale, bottlenose dolphin

Appendix 7h. Conservation Actions for Bird Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **bird** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a.

The actions listed move from broad to narrow in scope, with actions for the overall taxa group (**birds**) listed first, then following in this order: 1) mature upland forest birds, 2) grassland early successional birds, 3) colonial and coastal birds, 4) wetland birds, 5) aquatic birds, and 6) miscellaneous birds.

Overall Conservation Actions for All Bird SGCN and Habitats

IUCN Threat Code	IUCN Threat Description	Conservation Actions for ALL Birds	Action Priority Type
IUCN 1: Residential and Commercial Development			
1.1.2, 1.2.2	Residential and commercial development using materials that cause collision hazards	Encourage practices that minimize bird window strikes, including lighting and use of glass in buildings.	X
IUCN 3: Energy Production and Mining			
3.1.2	Hydraulic fracturing and other natural gas extraction and distribution processes	Site and operate hydraulic fracturing in a manner that avoids/minimizes impacts on SGCN and their habitats.	X
3.3.1	Wind power	Minimize lighting at industrial wind development sites to reduce mortality of migrating birds.	X
3.3.1	Wind power	Monitor industrial wind development sites for mortality.	X
3.3.1	Wind power	Site industrial wind development in a manner that minimizes both direct (e.g., bird strike, habitat loss) and indirect (e.g., habitat fragmentation) impacts on SGCN and their habitats.	X
IUCN 6: Human Intrusions and Disturbance			
6.1	Recreational activities	Protect information on known occurrences of sensitive SGCN birds to protect breeders from disturbance.	X

IUCN Threat Code	IUCN Threat Description	Conservation Actions for ALL Birds	Action Priority Type
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases			
8.1.4	Invasive non-native terrestrial/wetland animals	Work with county governments to determine how to address impacts of feral cats on birds.	X
8.1.5	Invasive non-native terrestrial/wetland plants	Manage invasive non-native plants impacting key wildlife habitats.	X
8.2.2	Problematic native species/diseases	Manage invasive native plants impacting key wildlife habitats.	X
IUCN 12: Resource Management Needs			
12.1.2	Lack of up-to-date existing information	Follow-up Breeding Bird Atlas project with detailed studies to investigate reasons for population decline, extirpation, and/or loss of former (county) range (for species where this is true).	X
12.1.2	Lack of up-to-date existing information	Establish a volunteer monitoring program for bald eagle nests.	X
12.1.2	Lack of up-to-date existing information	Establish volunteer monitoring programs for selected SGCN.	X
12.2.3	Need for wildlife and/or habitat planning	Develop formal species recovery plans.	X
12.2.3	Need for wildlife and/or habitat planning	Include habitat protection needs in public land management plans.	X
IUCN 14: Education/Outreach Needs			
14.2.1	Need for improved knowledge of wildlife and their habitats	Educate the public on best backyard practices to support breeding, wintering, and migrant birds.	X
14.2.2	Lack of aquatic resources and wildlife education facilities	Educate the public on impacts of feral cats on birds.	X
14.3.1	Need to develop and/or maintain a broad base of support for agency goals and objectives	Implement public outreach efforts for SGCN.	X
IUCN 15: Administrative Needs			
15.1.2	Need to maintain or improve information management systems	Begin to include uncommon (i.e., species ranked S3) birds in Natural Heritage Program database and/or develop database for SGCN not currently tracked.	X
15.3.2	Need for coordination for effective program/project management	Continue working with other states on range-wide conservation projects.	X
15.3.3	Need for increased legal protection	Increase ability to protect habitat through modification or application of existing laws.	X
15.3.3	Need for increased legal protection	Limit impacts of feral cats on bird populations by changing or establishing state and local regulations.	X
15.3.4	Need for increased enforcement of laws	Increase enforcement of poaching laws and regulations.	X

Conservation Actions for Mature Upland Forest Birds

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
5.3.2	Logging and wood harvesting; intentional use – large scale	Protect remaining old growth forest (including adequate no-cut buffers) on public and private lands, and where possible, expand these areas and promote the establishment of additional extensive tracts of old growth forest. Educate foresters in habitat/ecosystem management and sustainable development.	P	P	P	P	P
5.3.2	Logging and wood harvesting; intentional use – large scale	Work with private landowners, state forests, and industry to retain large trees, and increase presence of snags and vertical structure complexity.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Work with private landowners, state forests, and industry to maintain and promote a species composition found in natural communities.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Whenever possible, encourage timber harvesting to occur outside the nesting season to minimize impacts on nesting birds.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Determine the effects of various timber harvest practices on SGCN, including forest interior birds.	X	X	X	X	X
5.3.2	Logging and wood harvesting; intentional use – large scale	Conserve and encourage older conifer forests in three western counties.		X			
5.3.2	Logging and wood harvesting; intentional use – large scale	On lower Eastern Shore public lands and private lands, where possible, work towards the restoration of large tracts of pine-dominated old growth forest so that red-cockaded woodpecker may someday be reintroduced to the state.					X
IUCN 7: Natural Systems Modifications							
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Re-establish natural fire regimes to restore and maintain habitats.		X	X	X	X
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Develop and implement a comprehensive, holistic plan to restore high elevation, conifer-dominated forests, especially red spruce and white pine.		X			

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases							
8.1.4	Invasive non-native terrestrial/wetland animals: hemlock woolly adelgid	Determine the degree of threat and spectrum of impacts to species populations resulting from hemlock loss due to hemlock woolly adelgid. Encourage Integrated Pest Management through training and good practice.		X		X	
8.1.4	Invasive non-native terrestrial/wetland animals: hemlock woolly adelgid	Where appropriate, control hemlock-woolly adelgid infestations using methods that have minimal non-target impacts including rare species.		X		X	
8.2.2	Problematic native species/diseases: white-tailed deer	Control overabundant white-tailed deer populations to reduce impacts to forested ecosystems by partnering with medical groups regarding disease control; encouraging native predators; providing incentives for culling by hunters; and providing education programs.	P		P	P	P
IUCN 9: Pollution							
9.5.5	Air-borne pollutants: herbicides and pesticides	Limit pesticide applications that reduce food resources or could directly impact birds, such as gypsy moth control chemicals.	X	X	X	X	
IUCN 12: Resource Management Systems							
12.1.1	Lack of initial baseline inventory	Determine distribution, relative abundance, and breeding sites for rare species such as breeding and wintering long-eared owl and breeding yellow-bellied sapsucker, Swainson's thrush, olive-sided flycatcher, northern saw-whet owl, and Wayne's black-throated green warbler.		X	X	X	X
12.1.2	Lack of up-to-date existing information	Conduct long-term monitoring programs for priority SGCN and/or indicators of ecologically significant areas. Link with information from the Breeding Bird Atlas.	P	P	P	P	P
12.1.2	Lack of up-to-date existing information	Identify additional important migratory stopover sites for neotropical migrants.		X	X	X	X
12.1.3	Need to answer research question	Determine cause of apparent population declines for whip-poor-wills and other forest birds, including what measures are needed to ensure recovery.	P	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Mature Upland Forest Birds	Forest Interior Habitat	High Elevation Conifers - Natural Communities and Plantations	Other Appalachian Plateau Forests	Ridge and Valley; Piedmont Forests	Coastal Plain forests (including loblolly plantations)
12.2.1	Need to provide technical assistance	Develop habitat management guidelines for use by foresters, private land owners, and public land managers, and work with them to incorporate appropriate forest management practices into forest stewardship plans. Promote the idea of "steward foresters".	P	P	P	P	P
12.2.3	Need for fish, wildlife, and/or habitat planning	Manage state-owned forest land for conserving biodiversity.	P	P	P	P	P
12.2.3	Need for fish, wildlife, and/or habitat planning	Incorporate forest conservation actions into land planning efforts by local, state, and federal agencies.	P	P	P	P	P
IUCN 14: Education/Outreach Needs							
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Develop a private lands registry program to incentivize private landowners to maintain suitable forested habitat.	X	X	X	X	X
IUCN 15: Administrative Needs							
15.1.2	Need to maintain or improve information management systems	Regularly update GIS layer that identifies forest interior-dwelling species habitats for use in planning/zoning.	X				
15.3.3	Need for increased legal protection; updating existing laws and regulations	Modify the loblolly pine seed tree law to more easily allow for a mixed pine - hardwood forest.					P
15.3.4	Need for increased enforcement of laws	Identify additional legal needs for forest bird protection	X	X	X	X	X

Conservation Actions for Grassland Early Successional Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
IUCN 1: Residential and Commercial Development						
1.1.1	Land conversion from natural habitat to urban and other residential areas	Protect and restore natural grassland and shrubland habitats.	P			
IUCN 2: Agriculture and Aquaculture						
2.1.2; 2.1.3	Small-holder farming; agro-industry	Work with farming community and agricultural agencies to provide breeding habitat for SGCN where appropriate via existing landowner incentive programs.		P		P
IUCN 4: Transportation and Service Corridors						
4.4.1	Airplane flight paths	Work with airfields to minimize bird strikes through habitat management, monitoring, and other techniques.		X		X
IUCN 5: Biological Resource Use						
5.1.3	Hunting and collecting terrestrial animals: persecution/control	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating early successional forest habitats; do so in a manner that avoids and minimizes nuisance issues and conflicts with non-bird SGCN, unique natural communities, etc.			X	
5.3.2	Logging and wood harvesting; intentional use – large scale	Where appropriate, manage state lands on the Eastern Shore for early successional habitat for northern bobwhite.		P	P	P
IUCN 7: Natural Systems Modifications						
7.1.2	Fire and fire suppression: increase in fire frequency/intensity	Re-establish natural fire regimes to restore and maintain habitats	P		P	
7.3.2	Inappropriate timing of mowing	Implement a delayed haying scheme to protect nests from being destroyed (example - program in Vermont).		P		
IUCN 9: Pollution						
9.5.5	Air-borne pollutants: herbicides and pesticides	Avoid impacts to SGCN bird species and key food resources from the application of pesticides and herbicides, and from crops engineered for specific chemical use.		P		P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
IUCN 12: Resource Management Needs						
12.1.2	Lack of up-to-date existing information	Better assess the distribution, abundance and habitat associations of northern bobwhite, especially in current areas with stable populations and areas that historically had stable populations.	P	P	P	P
12.1.2	Lack of up-to-date existing information	Better determine extent of breeding habitat use, abundance, and distribution of SGCN on reclaimed strip mines in western Maryland.		P		P
12.1.2	Lack of up-to-date existing information	Conduct surveys for loggerhead shrike in vicinity of recent sightings and in other areas with potential habitat. Coordinate work to extent possible with neighboring states and regional efforts.	P	P		
12.1.2	Lack of up-to-date existing information	Monitor effects of management actions for one species on all SGCN present, including potential impacts on long-term habitat suitability for multiple SGCN.		X		X
12.1.2	Lack of up-to-date existing information	Monitor known breeding sites of upland sandpiper, conduct surveys to document new sites.		X		
12.1.2	Lack of up-to-date existing information	Determine current distribution and relative abundance of breeding short-eared owls.	X	X		
12.1.3	Need to answer research question	Conduct research to understand the decline of American kestrel.	X	X		
12.1.3	Need to answer research question	Determine relative importance of natural communities and anthropogenic grasslands as breeding habitat for SGCN.	X	X		
12.1.3	Need to answer research question	Determine relative importance of natural communities and managed early successional forest as breeding habitat for SGCN, including habitat created by gypsy moth damage.			X	X
12.1.3	Need to answer research question	Continue to investigate causes of decline of northern bobwhite.	X	X	X	X
12.1.4	Need to develop new technique	Determine whether managed habitats are functioning as ecological traps.		X		X
12.2.1	Need to provide technical assistance	Work with landowners to maintain suitable habitat and minimize disturbance to nesting upland sandpipers.	P	P		
12.2.1	Need to provide technical assistance	Develop BMPs that support multiple SGCN.	P	P	P	P

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
12.2.1	Need to provide technical assistance	Conduct an overall forest inventory to determine current and likely future "early successional" habitat on public lands.			P	P
12.2.1	Need to provide technical assistance	Work with utilities to manage vegetation in transmission line corridors for early successional SGCN birds such as yellow-breasted chat, golden-winged warbler, etc. Wherever possible, do so in a manner that also benefits non-bird SGCN (e.g., rare and declining butterflies, tiger beetles, bees).		P		P
12.2.1	Need to provide technical assistance	Develop BMPs for the management of reclaimed strip mines for SGCN shrubland and grassland nesting birds.		P		P
12.2.1	Need to provide technical assistance	Identify areas on public lands that could be used to demonstrate outcomes of land management techniques to aid in private land technical assistance efforts.	X	X	X	X
12.2.1	Need to provide technical assistance	Work with Department of Defense to provide and maintain existing grassland and early successional habitats.		X		X
12.2.1	Need to provide technical assistance	Work with airfields to manage vegetation for early successional SGCN birds. Wherever possible, do so in a manner that also benefits non-bird SGCN (e.g., rare and declining butterflies, bees).		X		X
12.2.1	Need to provide technical assistance	Establish a cooperative barn owl nest box program.	X	X		
12.2.3	Need for fish, wildlife and/or habitat planning	Create and maintain landscapes containing suitable habitat that are sufficiently large to sustain viable source populations of northern bobwhite; where possible, do so in a natural ecosystem context.	P	P	P	P
12.2.3	Need for fish, wildlife and/or habitat planning	Develop a comprehensive conservation plan for the restoration and management of reclaimed strip mines in a manner that provides habitat, where appropriate, for SGCN shrubland and grassland birds while minimizing long-term mining impacts on natural forest and aquatic ecosystems.		X		
IUCN 14: Education/Outreach Needs						
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Where appropriate, maintain large grasslands on reclaimed strip mines through education and outreach to private landowners.		P		

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Grassland Early Successional Birds	Natural Grasslands and Savannas (including glades and barrens)	Managed Grasslands	Natural Early Successional Forest	Managed Early Successional Forest
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Inform the public about the importance of grassland and early successional habitats.	P	P	P	P
IUCN 15: Administrative Needs						
15.3.3	Need for increased legal protection	Evaluate the need for changing mine reclamation standards to better support creation of habitat.		X		X

Conservation Actions for Colonial and Coastal Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
IUCN 3: Energy Production and Mining							
3.3.1	Wind Power	Determine potential impacts of offshore wind energy development and take measures to avoid and minimize these impacts.			X		
IUCN 5: Biological Resource Use							
5.1.1	Hunting and collecting terrestrial animals: intentional use	Continue to closely regulate take of passage peregrine falcons.			X		
IUCN 6: Human Intrusions and Disturbance							
6.1.2	Recreational activities: boating	Protect colony sites from human disturbance.	X	X			X

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
6.1.3	Recreational activities: use of beaches	Minimize off road vehicle use in sensitive habitats and at critical times of year (breeding season, seasonal migrations/movements).	X		X		
6.1.3	Recreational activities: use of beaches	Protect sandflats, mudflats and shallow tidal water habitats from human disturbance.	X		X		X
IUCN 7: Natural Systems Modifications							
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Determine the impact of the frequency and extent of winter burning practices on obligate salt marsh breeding bird species.					X
7.1.1	Fire and fire suppression: increase in fire frequency/intensity	Reduce frequency of arson fires in salt marshes.					X
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Restore tidal flows to marshes and create tidal open water flats.					P
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Determine the impact of the Open Marsh Water Management on obligate salt marsh breeding bird species.					X
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases							
8.1.5	Invasive non-native terrestrial/wetland plants: *Phragmites*	Control common reed (*Phragmites*) wherever practical in large wetland complexes. Target new invasions vs. those that are long-established and identify best locations to expend efforts and funds.					P
8.2.2	Problematic native species: nesting gulls	Manage nuisance roof top nesting gull colonies.				P	
8.2.2	Problematic native species: gulls	Manage predator pressure (gulls) in critical colonies of listed species.	P	P		P	
8.2.2	Problematic native species: foxes, crows, gulls	Manage predator pressure (fox, crow, gull) in areas of critical nesting habitat.	P	P			
8.2.2	Problematic native species/diseases: double-crested cormorant	Manage nuisance double-crested cormorant colonies.				X	

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
IUCN 9: Pollution							
9.5.5	Air-borne pollutants: herbicides and pesticides	Determine the impact of mosquito control pesticide use on obligate salt marsh breeding bird species and take measures to avoid/minimize impacts.					P
IUCN 11: Climate Change and Severe Weather							
11.1.1	Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss to predicted changes in sea level.	P	P		P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Take measures to mitigate habitat change resulting from sea-level rise.	P	P		P	P
11.1.1	Habitat shifting or alteration: sea-level rise	Prevent conversion of tidal high marsh to tidal low marsh due to sea level rise or create additional shallow marsh habitat via thin layering or similar technologies.					P
11.1.1	Habitat shifting or alteration: sea-level rise	Develop new technologies to accelerate tidal marsh accretion.					X
11.1.4	Storms and flooding	Create replacement nesting habitat for royal tern, common tern and black skimmer using dredged material.	P	P			
IUCN 12: Resource Management Needs							
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for black rails.					P
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for saltmarsh and Coastal Plain swamp sparrows.					X
12.1.2	Lack of up-to-date existing information	Monitor breeding populations of listed species and species of special conservation interest (brown pelican, double-crested cormorant) - annually.	P	P		P	
12.1.2	Lack of up-to-date existing information	Monitor breeding populations of wading birds, gulls and non-listed species - 5 year intervals (except great blue heron).		P		P	P
12.1.2	Lack of up-to-date existing information	Monitor breeding populations of great blue herons - 10 year intervals.		P		P	
12.1.2	Lack of up-to-date existing information	Use existing and new information to identify important migratory stopover sites for shorebirds.			P		P
12.1.2	Lack of up-to-date existing information	Monitor breeding population of American oystercatchers every 5 years.	P	P			

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Colonial and Coastal Birds	Beach Nesting Birds	Island Nesting Birds	Beach and Island Winter/Migration	Colonial Waterbirds –Other Habitats	Tidal Salt Marsh and Tidal Brackish Marsh
12.1.2	Lack of up-to-date existing information	Monitor breeding, migrating, and wintering shorebirds in coordination with regional surveys.	P	P			
12.1.2	Lack of up-to-date existing information	Monitor breeding distribution and relative abundance of rails, bitterns, grebes - 5 year intervals.					P
12.1.2	Lack of up-to-date existing information	Continue surveys of birds using the offshore zone during periods of migration and during winter.			X		
12.1.3	Need to answer research question	Investigate potential biological causes of population declines in common tern and black skimmer.	P	P			
12.1.3	Need to answer research question	Determine life history requirements of black rails in Chesapeake Bay marshlands.		P		P	P
12.1.3	Need to answer research question	Determine habitat requirements of Coastal Plain swamp, saltmarsh and sharptailed sparrows.					P
12.2.1	Need to provide technical assistance	Encourage management practices that maintain extensive areas of high marsh as essential habitat for black rail and other high marsh species.					P
12.2.1	Need to provide technical assistance	Manage roof top nesting least tern colonies.				X	
12.2.1	Need to provide technical assistance	Establish a cooperative barn owl nest box program in Chesapeake Bay salt marsh habitats.					X
IUCN 15: Administrative Needs							
15.3.2	Need for coordination for effective program/project management	Regularly update Critical Area information on colonial waterbird nesting colony locations.				P	P
15.3.4	Need for increased enforcement of laws	Improve enforcement of colony closures in the coastal bays.	X	X			

Conservation Actions for Wetland Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Wetlands Birds	Bogs, Fens, Seepage Swamps (higher elevation)	Swamps, Floodplain Wetlands, and Tidal Forests	Tidal Freshwater Marsh	Wetlands in Impoundments
IUCN 5: Biological Resource Use						
5.1.3	Hunting and collecting terrestrial animals: persecution/control	Maintain beaver populations and encourage their re-establishment in areas where they are lacking as one means of creating SGCN habitat; do so in a manner that avoids and minimizes nuisance issues and conflicts with non-bird SGCN, unique natural communities, etc.	X	X		
5.3.2	Logging and wood harvesting; intentional use – large scale	Restore floodplain forests including reestablishment of old growth, natural hydrology, and improved water quality.		P		
5.3.2	Logging and wood harvesting; intentional use – large scale	Promote retention of, or creation of snags for nesting habitat in floodplain areas.	X	X	X	X
IUCN 7: Natural Systems Modification						
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Restore tidal flows to marshes and create tidal open water flats.			P	
7.2.1	Dams and water management/use: abstraction of surface water (domestic use)	Protect known wetland breeding sites for alder flycatcher.	X			
7.2.3	Dams and water management/use: abstraction of surface water (agricultural use)	Develop and implement methods to restore hydrology to wetlands degraded by ditching.		X	X	
7.2.3	Dams and water management/use: abstraction of groundwater (commercial use)	Minimize impacts of hydraulic fracturing on hydrology and wetlands.	X	X		

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Wetlands Birds	Bogs, Fens, Seepage Swamps (higher elevation)	Swamps, Floodplain Wetlands, and Tidal Forests	Tidal Freshwater Marsh	Wetlands in Impoundments
7.2.9	Dams and water management/use: small dams	Work with landowners to encourage retention of emergent wetlands rather than impounding them.	X	X	X	
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases						
8.1.5	Invasive non-native terrestrial/wetland plants: *Phragmites*	Control common reed (*Phragmites*) and other invasive plants wherever practical in large wetland complexes.			P	P
IUCN 9: Pollution						
9.1.2	Domestic and urban wastewater: run-off	Improve storm water management practices and sediment erosion control measures to avoid/minimize development impacts to forested wetland areas.		X		
9.2.2	Industrial and military effluents: seepage from mining	Restore wetlands affected by acid mine drainage.	X	X		
9.3.1	Agricultural and forestry effluents: nutrient loads	Minimize inputs of point and non-point nutrients to maintain water quality.		X	X	X
IUCN 12: Resource Management Needs						
12.1.1	Lack of initial baseline inventory	Identify key wintering areas for rusty blackbird.		X	X	
12.1.1	Lack of initial baseline inventory	Identify important breeding sites for uncommon species of rails (king and sora).	X		X	X
12.1.2	Lack of up-to-date info	Monitor changes in relative breeding population level and distribution for common gallinule.			X	X
12.1.2	Lack of up-to-date info	Monitor breeding, migrating, and wintering shorebirds in coordination with regional surveys.		X	X	X
12.1.2	Lack of up-to-date info	Monitor change in relative breeding population level and distribution of pied-billed grebe.			X	X
12.1.2	Lack of up-to-date info	Monitor populations of alder flycatcher, Nashville warbler, and northern waterthrush and document additional breeding sites.	X	X		
12.1.3	Need to answer research question	Understand critical resource needs for different parts of the life cycle for American black duck.		X	X	X
12.1.3	Need to answer research question	Determine relative importance of Appalachian Plateau wetlands for golden-winged warbler.	X			

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

Conservation Actions for Aquatic Birds

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

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

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

Conservation Actions for Miscellaneous Birds

IUCN Threat Code	IUCN Threat Description	Conservation Actions For Other Miscellaneous Birds	Ridgetops	Cliffs	Banks	Artificial Structures (buildings, bridges, etc.)
IUCN 1: Residential and Commercial Development						
1.1.1	Land conversion from natural habitat to urban and other residential areas	Protect important migratory stopover sites on ridgetops from development.	X			
IUCN 3: Energy Production and Mining						
3.2.2	Surface mining - rock quarry	Work with mining interests to protect or create nesting habitat for bank swallows.			X	
3.3.1	Wind power	Site industrial wind development in a manner that avoids or minimizes species and habitat impacts.	P	P		

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

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

Appendix 7i. Conservation Actions for Reptile and Amphibian Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **reptile and amphibian** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a.

The actions listed move from broad to narrow in scope, with actions for the overall taxa group (**reptiles and amphibians**) listed first, then following in this order: 1) salamanders, 2) frogs and toads, 3) sea turtles, 4) turtles, 5) lizards, and 6) snakes. Individual species for which the action applies are listed in the rightmost Species of Greatest Conservation Need column.

Conservation Actions for ALL Reptile and Amphibian SGCN

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

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

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

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

Conservation Actions for Salamander SGCN

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

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

Conservation Actions for Frog and Toad SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Frogs and Toads				
IUCN 7: Natural Systems Modifications				
7.3	Dams and water management/use	Restore known occupied habitat, especially in areas where populations are declining, by removal of encroaching trees/saplings.	P	Barking treefrog, carpenter frog
IUCN 9: Pollution				
9.1.2	Domestic waste water: run-off	Assess impacts from road salt and develop abatement measures.	X	Mountain chorus frog, upland chorus frog
IUCN 11: Climate Change				
11.1.1	Habitat shifting or alteration: sea-level rise	Assist marsh migration due to sea-level rise impacts.	X	Eastern narrow-mouthed toad, Atlantic coast leopard frog, carpenter frog
IUCN 12: Resource Management Needs				
12.1.1	Lack of baseline data	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	P	ALL frogs and toads SGCN
12.1.1	Lack of baseline data	Conduct road-side chorus surveys and monitor annually.	P	Eastern narrow-mouthed toad,

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

Conservation Actions for Sea Turtle SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Sea Turtles				
IUCN 5: Biological Resource Use				
5.4.3	Fishing and harvesting of aquatic resources: unintentional effects (subsistence/small scale)	Implement effective regulations related to bycatch in fishing/crabbing gear.	X	Loggerhead sea turtle
IUCN 6: Human Intrusions and Disturbance				
6.1.2	Recreational activities: boating	Implement effective methods to reduce mortality from boat strikes.	X	Loggerhead sea turtle, Kemp's Ridley sea turtle
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Continue efforts to gather and centrally compile sightings data to determine important areas for conservation.	P	ALL SGCN sea turtles

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Sea Turtles				
12.1.2	Lack of up-to-date existing information	Create a system to report propeller strikes.	X	Loggerhead sea turtle
12.1.2	Lack of up-to-date existing information	Partner with watermen to collect demographic data on sea turtles (live & dead) captured in gear.	X	ALL SGCN sea turtles
12.1.2	Lack of up-to-date existing information	Continue surveys for nests and protecting nest locations from humans and predators.	P	Loggerhead sea turtle
12.1.3	Need to answer research question	Determine if nesting females are just laying late-term eggs or if they are unique individuals reacting to climate change.	X	Loggerhead sea turtle
12.1.3	Need to answer research question	Determine potential impacts from offshore wind energy development through research and survey means.	X	ALL SGCN sea turtles
12.1.3	Need to answer research question	Continue system for reporting of dead sea turtles and getting them necropsied to determine cause of death.	P	ALL SGCN sea turtles
12.1.3	Need to answer research question	Conduct a satellite transmitter study of juvenile movements and habitat use in Chesapeake Bay.	X	Kemp's Ridley sea turtle

Conservation Actions for Turtle SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Turtles				
IUCN 1: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect and restore nesting and/or basking habitat.	P	Bog turtle, wood turtle, northern map turtle, northern diamond-backed terrapin
1 - 4	Habitat loss (from various causes)	Protect breeding beach habitat by limiting rip-rap and bulkheads along shorelines.	P	Northern diamond-backed terrapin
IUCN 5: Biological Resource Use				
5.1.2	Hunting and collecting terrestrial animals: unintentional effects	Promote the use of cull rings and Turtle Exclusion Devices on all recreational pots to avoid bycatch.	X	Northern diamond-backed terrapin

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Turtles				
5.3.2	Logging and wood harvesting; intentional use (large scale)	Manage State lands for native forest communities (i.e. limit extent of loblolly pine plantations).	X	Spotted turtle, eastern box turtle
5.4.3	Fishing and harvesting of aquatic resources: unintentional effects (subsistence/small scale)	Reduce mortality (as bycatch) in recreational and commercial crab pots.	P	Northern diamond-backed terrapin
IUCN 7: Natural Systems Modifications				
7.2	Dams and water management/use	Monitor changes in hydrology at most important known locations to inform future management of these areas.	X	Bog turtle
7.3.4	Lack of natural disturbance patterns or ecosystem functions due to species loss	Manage vegetation at most important known locations.	X	Bog turtle
7.3.5	Imbalanced predator/prey dynamics	Control predators at known nesting sites.	P	Bog turtle, northern map turtle
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.5.2	Viral disease: Ranavirus	Prohibit use of wild turtles in Turtle Derbies.	P	Spotted turtle, wood turtle, eastern box turtle
IUCN 9: Pollution				
9.1.2	Domestic and urban waste water: run-off	Maintain and increase water quality through various methods, including improved sediment and erosion control.	X	Bog turtle, wood turtle
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	X	ALL SGCN turtles
12.1.2	Lack of up-to-date existing information	Monitor population health (e.g., abundance, reproduction, etc.) at known locations.	P	Wood turtle
12.1.2	Lack of up-to-date existing information	Piedmont populations should be studied and conserved; study outside of core range.	X	Eastern box turtle
12.1.3	Need to answer research question	Monitor spread of individuals infected with Ranavirus; determine impact of emerging pathogens.	X	Northern diamond-backed terrapin
12.1.3	Need to answer research question	Determine efficacy of head-starting.	X	Northern diamond-backed terrapin
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Continue to coordinate efforts of MD Terrapin Working Group.	P	Northern diamond-backed terrapin
15.3.2	Need for coordination for	Continue working with other states on range-wide conservation	P	Bog turtle, wood turtle, northern

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Turtles				
	effective program/project management	projects.		diamond-backed terrapin

Conservation Actions for Lizard SGCN

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

Conservation Actions for Snake SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Snakes				
IUCN 1: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect known occupied habitat, or largest/best populations.	X	Northern scarletsnake, timber rattlesnake, rainbow snake, mole kingsnake, coastal plain milksnake, plain-bellied watersnake, red cornsnake, mountain earthsnake,
IUCN 1: Residential and Commercial Development				
1.3	Tourism and recreational areas	Implement additional protection measures for populations on public	P	Timber rattlesnake

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Snakes				
		lands (e.g., rerouting hiking trails, educational signs).		
IUCN 5: Biological Resource Use				
5.1.1	Hunting and collection terrestrial animals: intentional use	Ensure species is included on Natural Heritage Program's Vulnerable Species list and implement exemption to Public Information Act.	P	Timber rattlesnake, coastal plain milksnake, red cornsnake
5.3.2	Logging and wood harvesting; intentional use (large scale)	Develop time-of-year restrictions for timber harvests and identify no-cut zones (if any).	P	Timber rattlesnake, rainbow snake
5.3.2	Logging and wood harvesting; intentional use (large scale)	Manage State lands for native forest communities (i.e., limit extent of loblolly pine plantations).	X	Coastal plain milksnake, eastern ribbonsnake
IUCN 7: Natural Systems Modifications				
7.1.2	Fire and fire suppression: suppression of fire frequency/ intensity	Prevent shading of specific rookeries by canopy closure.	X	Timber rattlesnake
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Conduct targeted, intensive surveys to determine species distribution and status (de novo surveys).	P	ALL SGCN snakes
12.1.2	Lack of up-to-date existing information	Monitor population health (e.g., abundance, reproduction, etc.) at known locations.	P	ALL SGCN snakes
12.1.2	Lack of up-to-date existing information	Follow-up MARA project with detailed study to evaluate whether range contraction and population declines are occurring.	X	Northern scarletsnake, smooth green snake, eastern ribbonsnake
12.1.3	Need to answer research question	Determine impact of poaching.	X	Timber rattlesnake, red cornsnake, eastern kingsnake
12.1.3	Need to answer research question	Conduct radio telemetry study to determine extent of area required for protection, microhabitats used, behavior, etc.	X	Rainbow snake
12.2.3	Need for fish, wildlife, and/or habitat planning	Consider threats on a mountain-by-mountain basis to preserve current range.	X	Timber rattlesnake
12.2.3	Need for fish, wildlife, and/or habitat planning	Consider management plan for Southern Frederick County location, which may be at a critically low population level.	X	Timber rattlesnake
IUCN 14: Education/Outreach Needs				
14.3.1	Outreach needs: need to develop and/or maintain a broad base of support for agency goals and objectives	Implement public outreach effort on snakes, including signage on venomous and Rare, Threatened, and Endangered species in parks.	X	Timber rattlesnake
IUCN 15: Administrative Needs				
15.3.4	Need for increased enforcement	Increase enforcement of poaching laws & regulations.	P	Northern scarletsnake, timber

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Snakes				
	of laws			rattlesnake, coastal plain milksnake, red cornsnake, eastern kingsnake

Appendix 7j. Conservation Actions for Fish Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **fish** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a.

The actions listed move from broad to narrow in scope, with actions for the overall taxa group (**fishes**) listed first, then following in this order: 1) estuarine/large river fishes, 2) piedmont/coastal plain fishes, and 3) highland fishes. Individual species for which the action applies are listed in the rightmost Species of Greatest Conservation Need column.

Conservation Actions for ALL Fish SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes – ALL				
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Assess population strongholds and identify areas with successful/feasible restoration and prioritize for biological recovery.	X	ALL SGCN fishes
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient; restore and protect these areas that are most vulnerable and most resilient.	X	ALL SGCN fishes
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Ensure that the conservation requirements of SGCN fishes are met in all management projects (e.g., timber harvest plans) on state lands. As part of this, establish general set of land and water management principles for living resources benefit such as limiting impervious surfaces to watershed, limiting (or removing if possible) migration barriers, etc.	P	ALL SGCN fishes

Conservation Actions for Estuarine/Large River Fish SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes – Estuarine/Large River				
IUCN 5: Biological Resource Use				
5.4.1	Fishing and harvesting of aquatic resources: intentional use (small scale)	Establish sustainable harvest levels.	X	Horseshoe crab
IUCN 6: Human Intrusions and Disturbance				
6.1.3	Recreational activities: use of beaches	Identify spawning and nursery habitat and implement a spawning survey.	P	Horseshoe crab
IUCN 8: Invasive and Other Problematic Species, Genes and Diseases				
8.1.2	Invasive non-native aquatic animals	Assess impacts from invasive fishes (e.g., blue catfish).	P	White catfish
8.1.2	Invasive non-native aquatic animals	Ban importation and use of Asian horseshoe crabs.	P	Horseshoe crab
8.1.3	Invasive non-native aquatic animals	Limit/prevent the spread of invasive fish.	X	Bowfin, white catfish
IUCN 12: Resource Management Needs				
12.2	Resource management decision needs	Re-evaluate the species' state rank/status using all recent data available.	X	Bowfin, white catfish
12.1.1	Lack of initial baseline inventory	Document tributaries with spawning populations.	X	Atlantic sturgeon
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from MD and adjacent states when possible) to focus survey efforts.	X	Bowfin, spotfin killifish, thorny skate, barndoor skate, smooth skate
12.1.2	Lack of up-to-date existing information	Compile all recent distribution records.	X	Bowfin, spotfin killifish, white catfish, thorny skate, barndoor skate, smooth skate
12.1.3	Need to answer research question	Evaluate efficacy of sampling gears and identify most appropriate sampling gear and study design to use for targeted status assessment surveys.	P	Bowfin, spotfin killifish
12.1.3	Answer research question	Design and conduct radio telemetry study to determine extent of area required for protection, habitats used, etc.	X	Bowfin
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient.	X	ALL SGCN estuarine/large river fishes

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes – Estuarine/Large River				
12.2.3	Need for fish, wildlife, and/or habitat planning	Implement and promote conservation actions outlined in Federal and State fisheries management plans.	P	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, white catfish, horseshoe crab
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Hickory shad, American shad

Conservation Actions for Piedmont/Coastal Plain Fish SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes – Piedmont/Coastal Plain				
IUCN 12: Resource Management Needs				
12.2	Resource management decision needs	Re-evaluate the species' state rank/status using all recent data available.	X	Swamp darter, banded sunfish
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from MD and adjacent states when possible) to focus survey efforts.	X	American brook lamprey, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, Maryland darter, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish
12.1.2	Lack of up-to-date existing information	Conduct annual surveys to detect trends in population size, size structure, etc. in watersheds under threat of development, resource extraction, etc.	X	American brook lamprey, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Maryland darter, glassy darter, mud sunfish, flier, banded sunfish
12.1.3	Need to answer research question	Evaluate need for and feasibility of propagation, population augmentation, translocation, and/or reintroduction (and, if needed, establish fish propagation program to meet these needs); Consider "experimental/non-essential" population status.	X	Bridle shiner, stripeback darter, blackbanded sunfish
12.1.3	Need to answer research question	Assess connectivity among populations - metapopulation; understand gene flow among populations.	P	

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes – Piedmont/Coastal Plain				
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	P	Stripeback darter, Chesapeake logperch, blackbanded sunfish
12.1.3	Need to answer research question	Complete genetic assessment to determine intra- and inter-population genetic variation of MD and Delaware populations.	X	American brook lamprey, ironcolor shiner, stripeback darter, glassy darter, mud sunfish, flier, blackbanded sunfish
12.1.3	Need to answer research question	Seek funding to develop mitochondrial and/or nuclear DNA primers for targeted eDNA surveys.	X	Blackbanded sunfish
12.1.3	Need to answer research question	Identify populations most threatened based on county development plans, etc.	X	Blackbanded sunfish, Maryland darter
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts.	X	American brook lamprey, bridle shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish
12.2.3	Need for species/ habitat planning	Evaluate feasibility of re-introduction of species into historical locations; consider "experimental/non-essential" population status reintroduction via translocation from Pennsylvania stock.	X	Bridle shiner
12.2.3	Need for fish, wildlife, and/or habitat planning	Implement and promote conservation actions outlined in federal and state fisheries management/recovery plans.	P	Maryland darter
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Chesapeake logperch, blackbanded sunfish

Conservation Actions for Highland Fish SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes - Highland				
IUCN 3: Energy Production and Mining				
3.2.3	Mining and quarrying; deep mining	Monitor population size and age structure in Casselman River to assess impacts from recently permitted coal deep mine.	X	Stonecat
IUCN 11: Climate Change and Severe Weather				
11.3	Temperature extremes	Evaluate habitat change and loss predicted due to changes in thermal regime and precipitation patterns.	P	Brook trout
IUCN 12: Resource Management Needs				
12.2	Resource management decision needs	Re-evaluate the species' state rank/status using all recent data available.	X	Brook trout, checkered sculpin
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from MD and adjacent states when possible) to focus survey efforts.	X	Striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter
12.1.2	Lack of up-to-date existing information	Conduct annual surveys to detect trends in population size, size structure, etc. in watersheds under threat of development, resource extraction, etc.; use this knowledge to support sustainable harvests.	X	Stonecat, brook trout, striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter
12.1.2	Lack of up-to-date existing information	Develop methods of volunteer recreational harvest sampling (e.g. logbooks and online surveys).	X	
12.1.3	Need to answer research question	Identify at risk populations using current data and prioritize list of populations to be protected.	X	Brook trout
12.1.3	Need to answer research question	Evaluate need for and feasibility of propagation, population augmentation, translocation, and/or reintroduction (and, if needed, establish fish propagation program to meet these needs); Consider "experimental/non-essential" population status.	X	Stonecat, longnose sucker
12.1.3	Need to answer research question	Identify suitable habitats for reintroduction.	X	Brook trout, stonecat
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	P	Stonecat, striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter
12.1.3	Need to answer research question	Identify populations most threatened based on county development plans, etc.	X	

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Fishes - Highland				
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	P	Stonecat, brook trout, striped shiner, pearl dace, mottled sculpin, checkered sculpin, Johnny darter

Appendix 7k. Conservation Actions for Insect Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **insect** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a.

The actions listed move from broad to narrow in scope, with actions for the overall taxa group (**insects**) listed first, then following in this order: 1) ash-dependent insects, 2) tiger beetles, 3) other beetles, 4) bees, 5) ants, 6) moths, 7) butterflies (skippers), 8) butterflies (lycaenids), 9) butterflies (other), 10) dragonflies and damselflies, 11) stoneflies, and 12) other insects. Individual species for which the action applies are listed in the rightmost Species of Greatest Conservation Need column.

Conservation Actions for ALL Insect SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects - ALL				
IUCN 1 - 4: Urbanization/Development				
1 - 4	Habitat loss (from various sources)	Protect and manage high quality habitat through land acquisition and conservation easements.	P	ALL SGCN insects
IUCN 7: Natural Systems Modifications				
7.1.2	Fire and fire suppression: suppression of fire frequency/intensity	Restore areas of known, occupied habitat, especially where populations are declining; monitor population response.	P	ALL SGCN insects
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1	Invasive non-native/alien species/diseases	Assess threats from invasive species and control invasives when feasible.	P	ALL SGCN insects
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to determine or refine species distribution.	P	ALL SGCN insects
12.1.2	Lack of up-to-date existing information	Improve understanding of species distribution, abundance, status, and habitat requirements through monitoring and research.	P	ALL SGCN insects

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects - ALL				
12.1.2	Lack of up-to-date existing information	Increase knowledge of population dynamics and dispersal.	P	ALL SGCN insects
12.1.3.	Need to answer research question	Estimate population size and evaluate trends.	P	ALL SGCN insects
12.1.3.	Need to answer research question	Assess threats that may be contributing to population declines or negatively impacting sites.	P	ALL SGCN insects
IUCN 14: Education/Outreach Needs				
14.2.1	Need for improved knowledge of fish and wildlife and their habitats	Engage in efforts and develop new public education and outreach to the general public, students, etc. about insect conservation issues and incentives for training new taxonomists.	P	ALL SGCN insects

Conservation Actions for Ash-dependent Insect SGCN

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

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Ash-dependent Insects				
8.1.4	Invasive non-native terrestrial/wetland animals: emerald ash borer	Maintain small groves/fields of ash seedlings (<1 inch in diameter) that are too small for EAB but might be hosts for our natives.	X	Ashleaf gall mite, ashleaf flowergall mite, ash bullet gall midge, ash midrib gall midge, ash plant bug, Eastern ash bark beetle, northern ash bark beetle, white-banded ash bark beetle, ash seed weevil, blackheaded ash sawfly, brownheaded ash sawfly, Grote's swallow, ash pyralid, purple plagodis, banded ash clearwing moth

Conservation Actions for Tiger Beetle SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Tiger Beetles				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect known occupied habitat, or largest/best populations.	X	Eastern Pinebarrens tiger beetle, northeastern beach tiger beetle, white tiger beetle, Northern Barrens tiger beetle, Puritan tiger beetle
1 - 4	Habitat loss (from various causes)	Protect habitat by working with the regulatory process through the modification or application of existing laws, specifically with mitigation project policies.	P	Northeastern beach tiger beetle, Puritan tiger beetle
1-4	Habitat loss (from various causes)	Protect shoreline habitat through pursuing land acquisition and conservation easements.	P	Northeastern beach tiger beetle, Puritan tiger beetle
IUCN 6: Human Intrusions and Disturbance				
6	Human Intrusions and Disturbance	Limit disturbance of occupied, suitable habitat.	X	White tiger beetle, ghost tiger beetle
IUCN 7: Natural Systems Modification				
7.3.1	Shoreline stabilization	Restore areas of known, occupied shoreline habitat, especially where populations are declining; monitor population response.	P	Northeastern beach tiger beetle, white tiger beetle, ghost tiger beetle, Puritan tiger beetle
7.3.1	Shoreline stabilization	Evaluate impacts of shoreline erosion control structures.	P	Northeastern beach tiger beetle, Puritan tiger beetle

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Tiger Beetles				
IUCN 12: Resource Management Needs				
12.1.2	Lack of up-to-date existing information	Refine understanding of larval habitat requirements so that sections of shoreline cliffs most important to protect can be identified	X	Eastern Pinebarrens tiger beetle, Appalachian tiger beetle, Northern Barrens tiger beetle
12.1.2	Lack of up-to-date existing information	Conduct population viability analyses to help guide habitat protection and restoration efforts	X	Eastern Pinebarrens tiger beetle, northeastern beach tiger beetle, Appalachian tiger beetle, Northern Barrens tiger beetle, Puritan tiger beetle
12.1.3.	Need to answer research question	Determine reasons for population decline on Western shore.	X	Northeastern beach tiger beetle, Northern Barrens tiger beetle
12.1.3.	Need to answer research question	Resolve taxonomic issues regarding subspecies.	X	Northeastern beach tiger beetle, white tiger beetle
12.1.3.	Need to answer research question	Evaluate impacts of climate change.	X	Northeastern beach tiger beetle, white tiger beetle, Northern Barrens tiger beetle, Puritan tiger beetle
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate watershed habitat conservation efforts with neighboring states.	X	Appalachian tiger beetle

Conservation Actions for Other Beetle SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Other Beetles				
IUCN 12: Resource Management Needs				
12.1.3	Need to answer research question	Determine if species is extant in MD.	X	Bethany Beach firefly
12.1.3.	Need to answer research question	Seek taxonomist assistance to describe new species.	X	A cave beetle *(Pseudanophthalmus sp 15)*

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Other Beetles				
12.2.3	Need for wildlife and habitat planning	Determine habitat protection needs.	X	Six-banded longhorn beetle, a tenebrionid beetle *(Helops cisteloides)*, Seth Forest water scavenger beetle, Bethany Beach firefly, a tenebrionid beetle (*Schoenicus puberulus)*

Conservation Actions for Bee SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Bees				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Create bee habitat along roads and highways.	P	ALL SGCN bees (pollinators)
IUCN 2: Agriculture and Aquaculture				
2	Agriculture and Aquaculture	Create lists of plants that native bees will pollinate and create seed mixes for various habitats that Maryland Department of Transportation (MDOT) or utility companies can use.	P	ALL SGCN bees (pollinators)
IUCN 4: Transportation and Service Corridors				
4.2.1	Utility and service lines: land conversion from natural habitat to utility and other service lines	Manage utility (powerline) rights of way as bee habitat.	P	ALL SGCN bees (pollinators)
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.4	Problematic species/diseases of unknown origin	Ensure that commercial bumble bee colonies are pathogen free.	P	Bumblebees *(Bombus* spp.*)*
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Target survey work for spring deciduous forest species (*Osmia*, *Andrena*, *Nomada*) before leaf out.	P	Mining bees *(Andrena* spp.*)*, a cuckoo bee *(Nomada rubicunda)*, a mason bee *(Osmia chalybea)*
12.1.1	Lack of initial baseline inventory	Target survey work for specialists (on a specific genus or species of plant) when those plants are in flower.	P	Oil-collecting bees *(Macropis* spp.*)*

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Bees				
12.1.1	Lack of initial baseline inventory	Target survey work to collect wetland habitat specialists.	P	ALL SGCN bees
12.1.2	Lack of up to date existing information	Develop and implement citizen science program monitoring.	X	ALL SGCN bees
12.1.3.	Need to answer research question	Determine if still extant in Maryland.	X	Macropis cuckoo bee
12.2.2	Need for fish, wildlife, and/or habitat planning	Create bee habitat refugia adjacent to croplands.	P	ALL SGCN bees (pollinators)

Conservation Actions for Ant SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Ants				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect pitcher plant bogs on private and public lands.	X	ALL SGCN ants
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Conduct initial surveys to collect baseline data; distribution data and habitat associations data is necessary.	P	ALL SGCN ants
12.1.1	Lack of initial baseline inventory	Focus surveys and protection on isolated pockets of habitats (bogs, barrens, dunes, etc.) for specialist species.	P	ALL SGCN ants
12.1.1	Lack of initial baseline inventory	Focus attention on parasitic ants as this is the most data deficient group of ants.	X	ALL SGCN ants

Conservation Actions for Moths

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Moths				
IUCN 1 – 4: Urbanization/Development				
1 - 4	Habitat loss (from various causes)	Protect pitcher plant bogs on private and public lands.	X	ALL SGCN moths
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.2.1	Invasive non-native diseases: chestnut blight	Plant blight-resistant chestnut trees to restore chestnut as a forest component.	X	ALL SGCN moths
8.2.2	Problematic native species/diseases: white-tailed deer	Increase efforts to control deer including targeting specific areas for controlled hunts, creating deer exclusion areas, and creating incentives to increase hunting efforts.	X	ALL SGCN moths
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Target rare communities for initial survey focal areas: in the following key wildlife habitats: (1) coastal plain oak-pine forests (2) coastal plain seepage bogs and fens (3) tidal and nontidal shrub wetlands (4) grasslands (5) barrens and glades (6) coastal beaches and dunes (7) maritime forests and shrublands. Follow-up surveys by ranking habitat/communities by threats/rarity and look for common patterns between different taxa groups, such as bees and moths.	P	ALL SGCN moths
12.1.2	Lack of up to date information	Assess quality and results of existing baseline data and consolidate to inform survey and monitoring efforts. Suggestions for implementation include: mapping existing element occurrence data and overlay with habitat maps and physiographic province/soil maps; rank habitats/communities by SGCN abundance; add Glaser et al. data to moth database; try to assess collection years; etc. Use Glaser et al., Smithsonian database and, Bryant Books for reference.	P	ALL SGCN moths
12.1.3	Need to answer research question	Research and evaluate the impacts of Broadcast spray programs (mosquito control, gypsy moth, cankerworm, etc.). Evaluate the impacts of target host pesticide programs (emerald ash borer and Hemlock woolly adelgid). If current research is inadequate, partner with academics to design and implement an effective, measurable study that could lead to a regulatory change in pesticide/herbicide application practices.	P	ALL SGCN moths (pollinators)

Conservation Actions for Butterfly (skipper) SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Butterflies (skippers)				
IUCN 4: Transportation and Service Corridors				
4.2.1	Utility and service lines: land conversion	Work with energy companies to restrict herbicide use on powerlines rights of way and transmission lines, and create a management regime for seasonal mowing and successional stage planning (e.g. mowing back).	P	Cobweb skipper, southern grizzled skipper (pollinators)
IUCN 7: Natural Systems Modifications				
7.3.2	Inappropriate timing of mowing	Work with state highways and county road crews to alter mowing regimes use along roads and medians to benefit pollinators.	P	Chermock's mulberry wing, Delaware skipper (pollinators)
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.2.2	Problematic native species: white-tailed deer	Protect host plant from deer browse with fencing.	X	Mottled duskywing
IUCN 9: Pollutants				
9.5.5	Air-borne pollutants: herbicides and pesticides	Increase ability to protect habitat and species through modification or application of existing laws that will better regulate broadcast spray programs regulations to avoid impacts to non-target Lepidoptera.	P	ALL SGCN skippers (pollinators)
IUCN 12: Resource Management Needs				
12.1	Resource information collection needs	Coordinate with Delaware Natural Heritage Program to conduct inventory, monitoring, and survey projects and protect habitat in both states.	X	Chermock's mulberry wing, mottled duskywing
12.1.1	Lack of initial baseline inventory	Collect data on habitat requirements.	X	Chermock's mulberry wing, mottled duskywing, mulberry wing
12.1.2	Lack of up-to-date existing information	As this species is likely extirpated, change conservation rank to SH (historically known from Maryland).	X	Chermock's mulberry wing, mottled duskywing, southern grizzled skipper
12.1.3	Need to answer research question	Determine if species is extant in Maryland.	P	Chermock's mulberry wing, mottled duskywing, southern grizzled skipper, two-spotted skipper
12.1.3	Need to answer research question	Research and evaluate the impacts of broadcast spray programs (mosquito control, gypsy moth, cankerworm, etc.). Evaluate the impacts of target host pesticide programs (emerald ash borer and hemlock woolly adelgid). If current research is inadequate, partner with academics to design and implement an effective, measurable study that could lead to a regulatory change in pesticide/herbicide application practices.	P	Rare skipper (pollinators)

Conservation Actions for Butterfly (lycaenid) SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Butterflies (lycaenids)				
IUCN 4: Transportation and Service Lines				
4.2.1	Utility and service lines: land conversion	Work with energy companies to restrict herbicide use on powerlines rights of way and transmission lines, and create a management regime for seasonal mowing and successional stage planning (e.g. mowing back).	P	All SGCN lycaenids (pollinators)
IUCN 6: Human Intrusions and Disturbance				
6.1.1	Recreation: off-road vehicles	Determine potential impacts of recent bike park proposal in Frederick County watershed.	X	Edward's hairstreak
IUCN 7: Natural Systems Modifications				
7.3.2	Inappropriate timing of mowing	Work with state highways and county road crews to alter mowing regimes use along roads and medians to benefit pollinators.	P	Bronze copper, frosted elfin, great purple hairstreak, hickory hairstreak, northern hairstreak, silvery blue (pollinators)
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.2.2	Problematic native species: white-tailed deer	Protect host plant from deer browse with fencing or deer control.	P	Appalachian blue, frosted elfin, northern hairstreak
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Note occurrence data when doing inventory and monitoring work for other higher priority species.	X	Appalachian blue
12.1.2	Lack of up-to-date existing information	Monitor habitat for successional changes.	X	Hoary elfin
12.1.2	Lack of up-to-date existing information	Encourage and partner with citizen scientist groups to initiate and participate in counts with the North American Butterfly Association (NABA); or conduct other rigorous census work annually.	P	Great purple hairstreak
12.1.3.	Need to answer research question	Determine density of larval host plant required to support a viable population.	X	Great purple hairstreak
12.1.3.	Need to answer research question	Evaluate measures to promote population revival and maintenance.	X	Bronze copper
12.1.3.	Need to answer research question	Determine if still extant in Maryland.	X	Hessel's hairstreak, hickory hairstreak

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

Conservation Actions for Butterfly (other) SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Butterflies (other)				
IUCN 1 - 4: Urbanization/Development				
1 - 4	Habitat loss (from various sources)	Protect habitat through conservation easements and other means, coordinating with neighboring states as needed.	X	Baltimore checkerspot
IUCN 4: Transportation and Service Corridors				
4.2.1	Utility and service lines: land conversion	Work with energy companies to restrict herbicide use on powerlines rights of way and transmission lines, and create a management regime for seasonal mowing and successional stage planning (e.g. mowing back).	P	Atlantis fritillary, Baltimore checkerspot, monarch, northern metalmark, Olympia marble (pollinators)
IUCN 7: Natural Systems Modifications				
7.3.2	Inappropriate timing of mowing	Work with state highways and county road crews to alter mowing regimes use along roads and medians to benefit pollinators.	P	Atlantis fritillary, monarch, northern metalmark (pollinators)
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1	Invasive non-native/alien species/diseases: garlic mustard	Control garlic mustard in Potomac Garrett State Forest.	X	West Virginia white
8.2.2	Problematic native species: white-tailed deer	Manage deer population due to overbrowse.	X	Baltimore Checkerspot, giant swallowtail

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Butterflies (other)				
IUCN 9: Pollutants				
9.5.5	Air-borne pollutants: herbicides and pesticides	Work with state highways and county road crews to limit pesticide use along roads and medians.	P	Monarch (pollinators)
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Note occurrence data when doing inventory and monitoring work for other higher priority species.	X	Compton tortoiseshell, grey comma, northern metalmark
12.1.1	Lack of initial baseline inventory	Evaluate host plant distribution and habitat.	X	Olympia marble
12.1.2	Lack of up-to-date existing information	Note and monitor important migration stopover areas.	X	Monarch
12.1.3.	Need to answer research question	Determine if still extant in Maryland.	X	Pink-edged sulphur
IUCN 15: Administrative Needs				
15.3.3	Need for increased legal protection	Increase ability to protect habitat and species through modification or application of existing laws that will better regulate broadcast spray programs regulations to avoid impacts to non-target Lepidoptera.	P	Olympia marble (pollinators)

Conservation Actions for Dragonfly and Damselfly SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Dragonflies and Damselflies				
IUCN 1-4: Urbanization/Development				
1-4	Habitat loss (from various causes)	Work with watershed groups, watershed-based initiatives, landowners, and state and federal programs to protect and restore stream and wetland habitats.	P	ALL SGCN dragonflies and damselflies
1-4	Habitat loss (from various causes)	Protect high priority streams and wetlands through land acquisition and conservation easements.	P	ALL SGCN dragonflies and damselflies

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Dragonflies and Damselflies				
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	ALL SGCN dragonflies and damselflies
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Monitor biological (including benthic macroinvertebrate populations), chemical and physical stream parameters to assess potential impacts of hydraulic fracturing on stream and wetland habitats.	P	ALL SGCN dragonflies and damselflies
3.2.3	Mining and quarrying; deep mining	Monitor rare odonate populations in the Casselman River to help assess potential coal mining impacts.	P	ALL SGCN dragonflies and damselflies
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Continue surveys to better assess odonate status, distribution and conservation needs, focusing on taxa that are currently or potentially state (S1-S2S3, SH, SX) or globally rare (G1-G3G4).	P	ALL SGCN dragonflies and damselflies
12.1.2	Lack of up to date existing information	Improve understanding of life history, dispersal, ecological requirements and threats/stressors.	P	ALL SGCN dragonflies and damselflies
12.1.3	Need to answer research question	Complete genetic and morphometric analyses to help determine the taxonomic status of St. Croix Clubtail populations in the Potomac River and elsewhere.	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and restoration needs in public land management plans.	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate stream and wetland protection measures in local, county and state land planning efforts.	P	ALL SGCN dragonflies and damselflies
12.2.3	Need for fish, wildlife and/or habitat planning	Use odonate inventory and monitoring data to help identify high priority wetlands, streams and watersheds for conservation.	P	ALL SGCN dragonflies and damselflies
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate watershed-scale stream and wetland conservation efforts with neighboring states.	P	ALL SGCN dragonflies and damselflies

Conservation Actions for Stonefly SGCN

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Insects – Stoneflies				
IUCN 1-4: Urbanization/Development				
1-4	Habitat loss (from various causes)	Work with watershed groups, watershed-based initiatives, landowners, and state and federal programs to protect and restore stream and wetland habitats.	P	ALL SGCN stoneflies
1-4	Habitat loss (from various causes)	Protect high priority streams and wetlands through land acquisition and conservation easements.	P	ALL SGCN stoneflies
IUCN 3: Energy Production and Mining				
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Site hydraulic fracturing development in a manner that avoids or minimizes impacts on species and their habitats.	P	ALL SGCN stoneflies
3.1.2	Hydraulic fracturing and other natural gas extraction processes	Monitor biological (including benthic macroinvertebrate populations), chemical and physical stream parameters to assess potential impacts of hydraulic fracturing on stream and wetland habitats.	P	ALL SGCN stoneflies
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Determine status and distribution of stoneflies in Maryland.	P	ALL SGCN stoneflies
12.1.2	Lack of up to date existing information	Improve understanding of life history, dispersal, ecological requirements and threats/stressors.	P	ALL SGCN stoneflies
12.1.3	Need to answer research question	Improve understanding of the role stoneflies may play in helping to assess stream biotic integrity and identify priority streams for protection and restoration.	X	ALL SGCN stoneflies
12.2.3	Need for fish, wildlife and/or habitat planning	Include habitat protection and restoration needs in public land management plans.	P	ALL SGCN stoneflies
12.2.3	Need for fish, wildlife and/or habitat planning	Protect and restore habitat on private lands through appropriate landowner assistance and conservation programs (e.g., forest stewardship plans).	P	ALL SGCN stoneflies
12.2.3	Need for fish, wildlife and/or habitat planning	Incorporate stream and wetland protection measures in local, county and state land planning efforts.	P	ALL SGCN stoneflies
12.2.3	Need for fish, wildlife and/or habitat planning	Use odonate inventory and monitoring data to help identify high priority wetlands, streams and watersheds for conservation.	P	ALL SGCN stoneflies
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate watershed-scale stream and wetland conservation efforts with neighboring states.	P	ALL SGCN stoneflies

Conservation Actions for Other Insect SGCN

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

Appendix 7l. Conservation Actions for Crayfish Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **crayfish** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a. Individual species for which the action applies are listed in the rightmost Species of Greatest Conservation Need column.

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Crayfish				
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1.2	Invasive non-native aquatic animals	Assess impacts from invasive crayfishes.	P	ALL SGCN crayfish
8.1.2	Invasive non-native aquatic animals	Limit/prevent the spread of invasive crayfishes via anglers by banning or restricting their possession/use as bait.	P	ALL SGCN crayfish
8.1.2	Invasive non-native aquatic animals	Address the pathways of invasive crayfishes including pet, bait, biological supply, and live seafood industries using education/outreach and other vector management techniques.	P	ALL SGCN crayfish
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution of the species; use landscape, water chemistry, and habitat data (from Maryland and adjacent states when possible) to focus survey efforts.	P	Digger crayfish, acuminate crayfish
12.1.2	Lack of up-to-date existing information	Conduct annual surveys to detect trends in population size in watersheds under threat of development, resource extraction, etc.	P	Acuminate crayfish, Allegheny crayfish, rock crawfish
12.1.3	Need to answer research question	Identify at risk populations using current data and prioritize list of populations to be protected.	P	ALL SGCN crayfish
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	X	ALL SGCN crayfish
12.1.3	Need to answer research question	Identify populations most threatened based on county development plans, etc.	P	ALL SGCN crayfish

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Crayfish				
12.1.3	Need to answer research question	Evaluate efficacy of sampling gears and identify most appropriate sampling gear and study design to use for targeted status assessment surveys.	P	Digger crayfish
12.1.3	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient.	X	Digger crayfish, acuminate crayfish
12.1.3	Need to answer research question	Acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review.	X	ALL SGCN crayfish
12.1.3	Need to answer research question	Complete genetic assessment to determine intra-population variation within Maryland populations and inter-population similarity to populations in Virginia, Pennsylvania, and North Carolina.	P	Acuminate crayfish
12.1.3	Need to answer research question	Seek funding to develop mitochondrial and/or nuclear DNA primers for targeted eDNA surveys.	X	Digger crayfish, acuminate crayfish
IUCN 15: Administrative Needs				
15.3.2	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	X	ALL SGCN crayfish

Appendix 7m. Conservation Actions for Mussel Species of Greatest Conservation Need

Appendices 7g-7m list conservation actions recommended for Species of Greatest Conservation Need (SGCN) in a format intended to allow readers to efficiently find specific threats and conservation actions cross-referenced to species. This appendix lists conservation actions specific to **mussel** Species of Greatest Conservation Need. This appendix includes both **priority (P)** and **non-priority (X)** actions for implementation. Urgency, cost, chance of success, benefit, collateral benefit to other species/habitat, feasibility/likelihood of implementation, and public support were considered in the selection of priority actions for implementation. Further details regarding prioritization are presented in Chapter 7 and Appendix 7a. An action designated as "priority" for a group of species is not necessarily a priority for every Species of Greatest Conservation Need included in the group. Complete IUCN threat codes are defined in Appendix 5a. Individual species for which the action applies are listed in the rightmost Species of Greatest Conservation Need column.

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mussels				
IUCN 2: Agriculture and Aquaculture				
2	Agriculture and Aquaculture	Protect and restore ecological integrity of streams where species is extant through prioritized land acquisition, revegetation, and cooperative landowner agreements to reduce effects from agricultural practices (fertilizer, pesticides/herbicides), development (storm water run-off), and climate change (thermal and hydrologic alteration).	P	Dwarf wedgemussel, triangle floater, creeper
IUCN 3: Energy Production and Mixing				
3.2.3	Mining and quarrying; deep mining	Continue population monitoring in Casselman River to assess impacts from recently permitted coal deep mine.	P	Creeper
IUCN 4: Transportation and Service Corridors				
4.3.2	Shipping lanes; dredging impacts	Evaluate potential impacts of coastal river dredging and work with appropriate regulatory agencies to avoid impacts.	X	Tidewater mucket, eastern pondmussel
IUCN 7: Natural Systems Modifications				
7.2	Dams and water management/use	Improve habitat connectivity with migratory fish hosts in streams via blockage removal, culvert retrofit, and transportation BMPs.	X	Alewife floater, eastern lampmussel, tidewater mucket, eastern pondmussel
7.2.12	Dams and water management/use: culverts	Improve connectivity of habitat within streams for mussels and host fishes by addressing poorly designed or failing culverts with State Highway Administration and the U.S. Fish and Wildlife Service. Conduct a new culvert assessment in entire Northeast to prioritize culvert work by North Atlantic Landscape Conservation Cooperative – University of Massachusetts-The Nature Conservancy (connectivity assessment).	P	Dwarf wedgemussel

IUCN Threat Code	IUCN Threat Description	Conservation Actions	Action Priority Type	Species of Greatest Conservation Need
Mussels				
IUCN 8: Invasive and Other Problematic Species, Genes, and Diseases				
8.1.2	Invasive non-native aquatic animals: zebra mussels	To extent possible, prevent/minimize further spread of zebra mussels in Susquehanna River drainage and other watersheds.	P	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel
8.1.2	Invasive non-native aquatic animals	Determine impacts from non-native predators (e.g., blue catfish).	X	Tidewater mucket, eastern pondmussel, alewife floater
IUCN 12: Resource Management Needs				
12.1.1	Lack of initial baseline inventory	Continue surveys to document new populations. To help target surveys, use recent eDNA findings (via Environmental Protection Agency study), MD Biological Stream Survey (MBSS) stream monitoring data, recent/historical mussel distribution data (as compiled by Natural Heritage Program, MBSS) and eDNA techniques if possible.	P	Tidewater mucket, eastern pondmussel, green floater, alewife floater, brook floater, dwarf wedgemussel
12.1.2	Lack of up-to-date existing information	Monitor extant populations and stream conditions. Re-evaluate goals, methods, efficacy, and scheduling, of recent population and habitat monitoring efforts and make improvements where needed.	P	Green floater, brook floater, dwarf wedgemussel
12.1.2	Lack of up-to-date existing information	Determine species' status in streams/watersheds where its continued presence is in question. Employ combination of eDNA techniques and traditional survey methods.	P	Dwarf wedgemussel
12.1.2	Lack of up-to-date existing information	Re-evaluate species' status in Maryland; resurvey recent/historical locations and potential habitat. Employ combination of eDNA techniques, if possible, and traditional survey methods.	P	Triangle floater, yellow lance, creeper, eastern lampmussel
12.1.2	Lack of up-to-date existing information	Complete a detailed inventory in the Potomac River, initially focusing on the upper Ridge and Valley portion, to better determine the species' distribution and abundance and establish a baseline for future monitoring.	X	Green floater, brook floater
12.1.2	Lack of up-to-date existing information	Conduct surveys and monitoring as needed to re-evaluate status, distribution and conservation needs.	X	Alewife floater, northern lance, Atlantic spice, yellow lampmussel
12.1.2	Lack of up-to-date existing information	Monitor known populations as needed to help re-evaluate status, distribution and conservation needs.	P	Tidewater mucket, eastern pondmussel
12.1.2	Lack of up-to-date existing information	Conduct surveys and monitoring as needed to re-evaluate status, distribution and conservation needs; focus on lentic habitats such as millponds and other small impoundments which are under-surveyed.	X	Paper pondshell
12.1.3	Need to answer research question	Confirm fish host requirements for Maryland populations, extent to which to which fish host needs are limiting populations, and conservation measures needed to maintain this life history link.	X	Dwarf wedgemussel

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

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