

Appendix 6a. Species-level threats and actions (Mammals: Terrestrial)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
1.3.4	1 Development	1.3 Tourism & Recreation Areas	1.3.4 Recreational trails		Site recreational trails in a way that minimizes fragmentation of habitat.	Long-tailed shrew, southern water shrew, Allegheny woodrat	High
4.1.1	4 Transportation	4.1 Roads & Railroads	4.1.1 Roads	Roads as barriers to movement	Look into feasibility of small wildlife road crossings, especially in the context of the 2025 Wildlife Connectivity and Crossings Act.	Allegheny woodrat, eastern spotted skunk, least weasel, bobcat, gray fox	High
5.3.1	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.1 Complete removal of the forest cover	Over-logging in a short amount of time	Mitigate effects of logging such as new road development, alteration of hydrological flow regime, etc. on shrews and their habitats. Potentially set limit on logging in such areas.	Long-tailed shrew, southern water shrew, Delmarva fox squirrel, southern rock vole, Allegheny woodrat, southern bog lemming	Low
5.3.2	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.2 Partial removal of the forest cover	Drying of habitat	Protect populations on public lands through streamside and watershed-scale habitat protection and restoration, and by providing habitat connectivity between drainages.	Southern water shrew, southern rock vole, southern bog lemming	Low
5.3.2	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.2 Partial removal of the forest cover	Drying of habitat	Protect populations on public lands through protection of forest canopy cover within and around rock outcrop habitat.	Long-tailed shrew	Low
3.1.4	2 Agriculture and Aquaculture	3.1 Oil & Gas Drilling	3.1.4 Onshore natural gas development	Groundwater extraction	Avoid and minimize impacts of hydrofracturing-related groundwater extraction on stream and wetland habitats that support this species.	Southern water shrew	Low

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7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Continue to restore high elevation, red spruce-dominated forests.	Southern rock vole	High
8.2.8	8 Invasive and Problematic Species	8.2 Problematic Native Plants & Animals	8.2.8 Interspecific competition with a favored species		Use habitat protection and management practices that minimize the risk of encroachment by eastern cottontails.	Appalachian cottontail	High
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	Canine distemper	Study modes of transmission, intraguild interactions, and developing strains to determine risk to carnivores at the population level.	Eastern spotted skunk, gray fox	High
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	RHDV2	Continue monitoring of populations and communication with interstate working groups in order to track and contain Rabbit Hemorrhagic Disease Virus Type 2 (RHDV2).	Appalachian cottontail	High
8.4.4	8 Invasive and Problematic Species	8.4 Pathogens	8.4.4 Worm-induced disease	Raccoon roundworm	Identify raccoon roundworm-positive sites and treat raccoon roundworm through the use of anthelmintic baits.	Allegheny woodrat	High
8.5.1	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.1 Loss of Genetic Diversity		Reestablish populations where they have been extirpated; augment where populations have declined/become isolated.	Allegheny woodrat, eastern spotted skunk	High

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9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides		Identify the types of pesticide/herbicide use (e.g., mosquito control, spongy 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.	Least shrew, long-tailed shrew, smoky shrew, southern pygmy shrew, southeastern shrew, southern water shrew	High
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Primary and secondary poisoning from rodenticides	Increase understanding of indirect impacts of rodenticides on carnivore populations.	Bobcat, gray fox	High
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Monitor and maintain management practices for the Delmarva fox squirrel in the Chesapeake Forest Plan, updating as needed.	Delmarva fox squirrel	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Improve understanding of species distribution, status, and habitat requirements.	Least shrew, long-tailed shrew, smoky shrew, southern pygmy shrew, southeastern shrew, southern water shrew, Appalachian cottontail, Delmarva fox squirrel, southern rock vole, Allegheny woodrat, southern bog lemming, eastern spotted skunk, least weasel, American mink, gray fox	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Improve understanding of species home range, dispersal, and movement patterns.	Eastern spotted skunk, least weasel, bobcat, gray fox	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine home range, dispersal behavior/capabilities, extent of gene flow between populations, and habitat connectivity needs.	Long-tailed shrew, southern water shrew	High

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12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine reproductive ecology.	Long-tailed shrew, southern water shrew	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine cause of apparent population declines and what measures are needed to ensure recovery.	Allegheny woodrat, southern bog lemming	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue work to determine extent of gene flow between populations, dispersal behavior/capabilities, and habitat connectivity needs. (Work has not yet begun for rock voles.)	Appalachian cottontail, southern rock vole, Allegheny woodrat	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine whether water shrew populations have come back to previously acid rain-impacted or mine drainage-impacted streams.	Southern water shrew	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to develop new technique	Develop more effective survey and monitoring techniques, including live capture methods for insectivores.	Least shrew, long-tailed shrew, smoky shrew, southern pygmy shrew, southeastern shrew, southern water shrew, least weasel	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to develop new technique	Improve techniques for studying species, prioritizing no-kill and noninvasive methods.	Least shrew, long-tailed shrew, smoky shrew, southern pygmy shrew, southeastern shrew, southern water shrew, southern rock vole, Allegheny woodrat, southern bog lemming	High

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12.5	12 Other Options	12.5 State Specific Issues		Need for increased legal protection	Ensure that Delmarva fox squirrels remain a prohibited species for hunting/trapping, as over-hunting was the main cause of its original decline.	Delmarva fox squirrel	Medium

Appendix 6a. Species-level threats and actions (Mammals: Bats)

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IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Monitor industrial wind development sites for mortality.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	Medium
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Curtail turbine operation at low wind speeds at industrial wind development sites (onshore and offshore, as needed).	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Use mist net and acoustic surveys to determine migratory timing and year-round residency on the Delmarva peninsula.	Silver-haired bat, eastern red bat, hoary bat, little brown bat, northern long-eared bat, tricolored bat	High
4.1	4 Transportation	4.1 Roads & Railroads		Human-built disruptions at anthropogenic structures (roads and culverts)	Continue to promote Maryland Department of Natural Resources (MD DNR) Natural Heritage Program (NHP) and U.S. Fish and Wildlife Service (USFWS) as consultants for construction projects that may impact sensitive bat populations, including transportation infrastructure.	Silver-haired bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	Low
5.3.2	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.2 Partial removal of the forest cover		Promote timber management practices on private lands that minimize impacts on bats.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High

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PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
6	6 Human Intrusions			Bat exclusion measures and behaviors	Promote the use of roosting boxes to stabilize maternity colonies that have been excluded through human intrusions.	Little brown bat, northern long-eared bat, Indiana bat, tricolored bat	Low
6.1.3	6 Human Intrusions	6.1 Recreational Activities	6.1.3 Recreational use of cliffs and rock faces		Prevent disturbance to summer roosting sites or hibernacula sites.	Silver-haired bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
6.1.7	6 Human Intrusions	6.1 Recreational Activities	6.1.7 Caving		Protect hibernating bats from disturbance.	Silver-haired bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
6.3	6 Human Intrusions	6.3 Work & Other Activities		Human-built disruptions at anthropogenic structures (mines, tunnels, and buildings)	Continue to promote MD DNR and USFWS as consultants for construction projects that may impact sensitive bat populations, including subterranean structures such as mines and tunnels.	Silver-haired bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
6.3.3	6 Human Intrusions	6.3 Work & Other Activities	6.3.3 Vandalism	Vandalism to bat gates at hibernacula	Coordinate with Natural Resources Police (NRP) to monitor gates at bat hibernacula sites for vandalism; prosecute as needed.	Silver-haired bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	Low
8.4.3	8 Invasive and Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens	White-nose syndrome (WNS)	Use acoustic and hibernacula surveys to monitor effect of WNS on populations.	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High

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8.4.3	8 Invasive and Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens	White-nose syndrome (WNS)	Assist research related to WNS, including potential methods for abating its effects.	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
8.5.1	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.1 Loss of Genetic Diversity	White-nose syndrome (WNS)	Work with partners to monitor genetic health of populations and work to prevent additional loss by protecting WNS survivors.	Hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides		Take measures to avoid or minimize pesticide uses (e.g., mosquito control, spongy moth control, various forms of agricultural pest control) that are known to or could potentially impact bat populations, including through the promotion of organic farming practices and integrated pest management.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
9.6.1	9 Pollution	9.6 Excess Energy	9.6.1 Light pollution	Light pollution that leads to habitat loss	Work with (construction) project managers to minimize light disturbances in/near sensitive bat habitat areas.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	Low
9.6.3	9 Pollution	9.6 Excess Energy	9.6.3 Noise pollution	Noise pollution (especially transport and construction)	Work with (construction) project managers to minimize noise disturbances in/near sensitive bat habitat areas.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High

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12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife, and/or habitat planning	Include bat conservation needs in public land management plans.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife, and/or habitat planning	Finalize and promote the Maryland Bat Conservation Strategy, which contains best management practices (BMPs) for development for the purposes of human recreation, transportation, wind power, and other human intrusions.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need to provide technical assistance	Protect maternity colonies by working with landowners and land managers.	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Cautiously monitor populations in hibernacula.	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Continue and increase efforts to monitor maternity colonies.	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Use acoustic surveys, mist net surveys, and other techniques to better determine status, distribution, and habitat requirements/associations in Maryland.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High

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12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Investigate WNS bat resistance in Maryland tunnels and extend knowledge to partners.	Eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Coordinate inventory, monitoring, and research across Maryland and surrounding states.	Silver-haired bat, eastern red bat, hoary bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, tricolored bat	High

Appendix 6a. Species-level threats and actions (Mammals: Marine)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
4.3.1	4 Transportation	4.3 Shipping Lanes	4.3.1 Shipping		Reduce disruption of movement corridors and ship strikes.	Blue whale, fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, minke whale, West Indian manatee	Low
5.4	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources		Unintentional effects: entanglement	Reduce entanglements in fishing nets.	Fin whale, humpback whale, North Atlantic right whale, sperm whale, minke whale, West Indian manatee, bottlenose dolphin, harbor porpoise	Medium
6.1.4	6 Human Intrusions	6.1 Recreational Activities	6.1.4 Recreational boating		Raise awareness of boaters to reduce conflicts.	Blue whale, fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, minke whale, West Indian manatee, bottlenose dolphin, harbor porpoise	High
6.2.3	6 Human Intrusions	6.2 War, Civil Unrest & Military Exercises	6.2.3 Military exercises		Reduce impacts to marine species through military exercises.	Blue whale, fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, minke whale, West Indian manatee, bottlenose dolphin, harbor porpoise	Low
6.3.1	6 Human Intrusions	6.3 Work & Other Activities	6.3.1 Research activities		Reduce impacts to marine species from geological and geophysical surveys.	Blue whale, fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, minke whale, bottlenose dolphin, harbor porpoise	Low
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	Cetacean morbillivirus	Seek to better understand anthropogenic triggers for cetacean morbillivirus.	Bottlenose dolphin, harbor porpoise	Medium
9.4.4	9 Pollution	9.4 Garbage & Solid Waste	9.4.4 Drifting plastic and entanglement rubbish		Continue work to reduce aquatic plastic pollution, which presents a threat to many marine species via entanglement and ingestion. Pursue both supply-side tactics (i.e., reduce production of and reliance on plastics) and cleanup efforts.	Blue whale, fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, minke whale, West Indian manatee, bottlenose dolphin, harbor porpoise	Low
9.6.3	9 Pollution	9.6 Excess Energy	9.6.3 Noise pollution		Reduce noise where possible, especially in migration corridors and other areas of known habitat use.	Blue whale, fin whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, minke whale, bottlenose dolphin, harbor porpoise	Low
11.3	11 Climate Change	11.3 Changes in Temperature Regimes		Temperature extremes and phenology shifts related to predator-prey ecology	Seek to better understand impacts of climate change on movements and key food resources.	Blue whale, fin whale, West Indian manatee, bottlenose dolphin, harbor porpoise	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Seek to better understand impacts of recent species population declines to ecosystem.	Bottlenose dolphin	Medium

Appendix 6a. Species-level threats and actions (Birds)

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1 - 4				Habitat loss (from various causes)	Start a Maryland grasslands bird initiative (similar to Virginia's), which could include efforts such as paying farmers to delay haying a few weeks and asking mowers to raise their blade heights.	Working lands / grassland birds	High
1	1 Development			Use of materials that cause collision hazards	Encourage practices that minimize bird window strikes, including alternative lighting and use of glass in buildings. Evaluate and retrofit state-owned buildings with these practices as possible.	Raptors and songbirds mostly, although all birds can be impacted	High
1.1.1	1 Development	1.1 Housing & Urban Areas	1.1.1 Dense housing & urban areas		Promote use of rooftop material for flat roofs that is suitable for nesting.	Common nighthawk and least tern	Low
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	Coastal development	Encourage bird-friendly practices (such as the creation of nesting structures) by residents/landowners in coastal areas, especially the Critical Area.	Coastal birds	Low
1.2.1	1 Development	1.2 Commercial & Industrial Areas	1.2.1 Commercial & industrial areas	Data centers and other large-scale commercial development	Ensure adequate environmental review processes are in place and rare species data layers are up to date.	American barn owl, American kestrel, Henslow's sparrow, and other grassland-dependent birds	High
2.1	2 Agriculture and Aquaculture	2.1 Annual & Perennial Non-Timber Crops			Continue to work with farming community and agricultural agencies to provide breeding habitat for SGCN where appropriate via existing landowner incentive programs.	Working lands / grassland birds	Low
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Monitor industrial wind development sites for mortality.	Golden eagle and migratory birds	Medium
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Minimize and use appropriate lighting at industrial wind development sites to reduce mortality of migrating birds.	Golden eagle and migratory birds	Medium
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Conduct research to determine how to minimize and mitigate impacts of industrial wind development on breeding bird SGCN.	Breeding landbirds	Medium
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Determine potential impacts of offshore wind energy development on birds, and take measures to avoid and minimize these impacts.	Colonial and coastal birds	High
3.3.2	3 Energy Production	3.3 Renewable Energy	3.3.2 Wind farms		Continue to identify relative importance of Appalachian ridgetops as migratory corridors for golden eagles to assess risk from wind power developments.	Golden eagle	High

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3.3.4	3 Energy Production	3.3 Renewable Energy	3.3.4 Solar farms		Increase development of solar farms in a sustainable way that emphasizes building on/over sites such as landfills, parking lots, etc. rather than undeveloped land (i.e., farms and fallow fields used by grassland birds).	American barn owl, American kestrel, Henslow's sparrow, and other grassland-dependent birds	High
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines		Develop best management practices (BMPs) to maintain more bird-friendly habitats in powerline corridors.	Working lands / shrubland birds	Low
5.1.1	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.1 Hunting		Close hunting seasons on species of concern.	King rail and sora	Low
5.1.1	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.1 Hunting	Lead ammunition	Continue efforts to educate the public regarding the benefits of non-lead ammunition.	Birds of prey, especially bald eagle	Low
5.3	5 Bio Resource Use	5.3 Logging & Wood Harvesting			Whenever possible, encourage timber harvesting to occur outside the nesting season to minimize impacts on nesting birds.	Forest-dependent birds	Medium
5.3	5 Bio Resource Use	5.3 Logging & Wood Harvesting			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.	Red-cockaded woodpecker	Low
5.4	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources		Light-baiting	Look into the potential negative impacts of light-baiting on coastal breeding bird SGCN. Develop abatement measures as necessary.	Piping plover, least tern, and other coastal breeding birds	Low
6.1	6 Human Intrusions	6.1 Recreational Activities		Use of beaches	Minimize or continue to minimize off-road vehicle use in sensitive habitats and at critical times of year (e.g., breeding season, seasonal migrations/movements).	Piping plover, least tern, and other ground-nesting birds	High
6.1.3	6 Human Intrusions	6.1 Recreational Activities	6.1.3 Recreational use of cliffs and rock faces		Work with climbing clubs to minimize degradation and disturbance of important peregrine falcon nesting grounds.	Peregrine falcon	High
7.1.2	7 Natural System Modifications	7.1 Fire & Fire Suppression	7.1.2 Suppression in the fire regime		Increase the amount of prescribed burns in targeted areas to promote better habitat for scrub birds like the yellow-breasted chat and eastern towhee.	Yellow-breasted chat, eastern towhee, and other scrubland birds	Medium
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Cats	Increase efforts to raise awareness of the issues around feral cats, which threaten ground-nesting bird populations in particular.	Landbirds, especially ground-nesting birds	High

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8.2.5	8 Invasive and Problematic Species	8.2 Problematic Native Plants & Animals	8.2.5 Increased predation by mesopredators		Protect ground-nesting colonial waterbird colonies from predators.	Ground-nesting colonial waterbirds	High
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	West Nile virus (WNV)	Conduct research to determine if and how WNV may impact (or already be impacting) SGCN such as ruffed grouse.	Ruffed grouse and other susceptible SGCN	High
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	Highly pathogenic avian influenza (HPAI)	Conduct research to determine if and how HPAI may impact (or already be impacting) susceptible species. Include efforts to monitor spread of disease throughout populations.	Peregrine falcon, eagles, colonial nesting waterbirds, waterfowl	High
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Loss of invertebrate prey (moths/mosquitoes)	Better center or correlate invertebrate monitoring, study, and conservation efforts within the world of bird conservation; consider both in terms of a biomass and individual prey species.	Insectivorous birds (e.g., flycatchers, warblers)	High
9.4.4	9 Pollution	9.4 Garbage & Solid Waste	9.4.4 Drifting plastic and entanglement rubbish		Continue work to reduce aquatic plastic pollution, which presents a threat to many marine species via entanglement and ingestion. Pursue both supply-side tactics (i.e., reduce production of and reliance on plastics) and cleanup efforts.	Seabirds	Low
9.6.1	9 Pollution	9.6 Excess Energy	9.6.1 Light pollution		Encourage practices that minimize use of lighting at night to reduce disruptions of nocturnal life patterns and collisions with tall, improperly lit structures.	Owls, songbirds, and seabirds (for offshore structures) mostly, although all birds can be impacted	High
11.1	11 Climate Change	11.1 Habitat Shifting & Alteration		Sea-level rise	Manage coastal islands by "building up" sand annually to restore nesting habitat for colonial waterbirds, which are being eroded away by extreme high tides and storm surges.	Colonial waterbirds	High
11.1.2	11 Climate Change	11.1 Habitat Shifting & Alteration	11.1.2 Phenological mismatch	Changes in timing of ecological processes causing issues for long-distance migrants	Continue researching the effects of phenological mismatches and the impact to the survival of species, as well as potential habitat management practices that may mitigate these effects.	Migratory birds	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Conduct population-level surveys of species that may not have declined in distribution but may have had declines in abundance.	SGCN indicator species (e.g., wood thrush, scarlet tanager)	High

Appendix 6a. Species-level threats and actions (Birds)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species and Species Groups	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Increase inter-agency coordination to examine broader environmental conditions that may be behind waterbird declines, including potential declines in forage fish abundance and diversity.	Waterbirds	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue research into the importance of Maryland stopover habitat for migratory species of concern.	Migratory birds	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine if and/or how new/expanded range species (e.g., birds like common ravens) are impacting bird SGCN.	All birds	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Research to determine cause of decline in belted kingfisher populations, primarily on the Eastern Shore.	Belted kingfisher	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Track overwintering species to determine if declining Maryland populations may be related to loss of overwintering habitat.	Northern harrier, short-eared owl, and other grassland birds	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to develop new technique	Improve spring/fall count methodology to increase data usefulness in identifying important migratory stopover areas.	Migratory birds	High
12.3	12 Other Options	12.3 Education & Outreach	Education needs	Need for improved knowledge of fish and wildlife and their habitats	Better educate private landowners on the impacts of invasive plants on native bird populations, especially in the understory. Emphasize the importance of allowing deer hunting on their lands to help address this issue.	Landbirds, primarily	High
12.3	12 Other Options	12.3 Education & Outreach	Education needs	Need for improved knowledge of fish and wildlife and their habitats	Increase public outreach and education regarding what habitats and management practices are beneficial for birds.	Landbirds, primarily	High
12.3	12 Other Options	12.3 Education & Outreach	Outreach needs		Continue to utilize apps such as Merlin to promote public interest in birds and bird-related conservation issues.	All birds	Low
12.3	12 Other Options	12.3 Education & Outreach	Outreach needs	Need to maintain and/or increase constituent base	Explore ways to get more adult volunteers involved in the Young Birders (YMOS) subgroup of the Maryland Ornithological Society (MOS).	All birds	High
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Approach soil and water conservation districts to discuss bird conservation cooperation.	Landbirds, primarily	Low

Appendix 6a. Species-level threats and actions (Birds)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species and Species Groups	Action Priority (Threat Impact x Action Urgency)
12.4	12 Other Options	12.4 Administrative Needs	Infrastructure needs	Need to maintain or improve information management systems	Continue to incorporate migratory stopover sites/corridors into BioNet.	Migratory birds	High
12.5	12 Other Options	12.5 State Specific Issues		Need for increased legal protection	Pass Maryland-specific law akin to the Migratory Bird Treaty Act (MBTA) to protect migratory birds from incidental take, especially since the federal law may be in jeopardy.	Migratory birds	Low

Appendix 6a. Species-level threats and actions (ALL Herps)

PART 1: THREATS					PART 2: ACTIONS	
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Action Priority (Threat Impact x Action Urgency)
1 - 4				Habitat loss (from various causes)	Protect known occupied habitat, or largest/best populations.	High
1 - 4				Habitat loss (from various causes)	Create new vernal pools and other wetland habitats for aquatic SGCN.	Low
1 - 4				Habitat fragmentation (from various causes)	Develop site conservation design to better connect core populations into functioning metapopulations, especially on state and non-governmental organization (NGO) lands.	Low
1 - 4				Habitat fragmentation (from various causes)	Minimize and reduce habitat fragmentation.	Low
3.1.4	3 Energy Production	3.1 Oil & Gas Drilling	3.1.4 Onshore natural gas development		Minimize direct and indirect impacts of energy development to SGCN.	Low
4.1.1	4 Transportation	4.1 Roads & Railroads	4.1.1 Roads		Identify potential high roadkill crossing areas statewide by conducting a geographic information system (GIS)-based "causeway" study similar to New York/Cornell effort (i.e., considering wetlands within 100 meters of both sides of road) followed by field verification. These would then be areas to focus mitigation efforts.	Low
4.1.1	4 Transportation	4.1 Roads & Railroads	4.1.1 Roads		Improve connectivity of habitat by addressing conservation of movement corridors between breeding areas, including improved road crossings, low-rise curbing, wildlife passage tunnels/culverts, wildlife crossing signage, and temporary closure of park roads (during seasonal migrations), especially on roads within or bisecting state and NGO lands.	Low
5.1	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals		Collection of wild animals, especially turtles	Limit collection through education and regulation changes.	Medium

Appendix 6a. Species-level threats and actions (ALL Herps)

PART 1: THREATS					PART 2: ACTIONS	
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Action Priority (Threat Impact x Action Urgency)
5.3	5 Bio Resource Use	5.3 Logging & Wood Harvesting			Manage public and private conservation lands to benefit SGCN found in specific, limited microhabitats.	Low
5.3	5 Bio Resource Use	5.3 Logging & Wood Harvesting			Manage state lands for native forest communities where herpetofauna are found (i.e., limit extent of loblolly pine plantations).	Low
5.3	5 Bio Resource Use	5.3 Logging & Wood Harvesting			Consider time-of-year restrictions for timber harvests and identify no-cut zones as needed to minimize impacts on SGCN on state lands.	Low
6.1	6 Human Intrusions	6.1 Recreational Activities			Implement additional protection measures for populations on public lands (e.g., rerouting hiking trails, educational signs).	Low
6.1.1	6 Human Intrusions	6.1 Recreational Activities	6.1.1 Motor vehicles		Minimize or continue to minimize off-road vehicle use in sensitive habitats and at critical times of year (e.g., breeding season, seasonal migrations/movements).	Low
7	7 Natural System Modifications				Implement appropriate habitat management practices.	Low
7.2	7 Natural System Modifications	7.2 Dams & Water Management / Use			Restore known occupied habitat of aquatic species, especially in areas where populations are declining.	Low
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Removal of coarse woody debris	Retain coarse woody debris in all natural areas.	Low
7.2.4	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.4 Drainage in agricultural environments		Maintain or increase water quality and wetland hydrology through improved best management practices (BMPs), including improved sediment and erosion control.	Low
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	Ranavirus	Distribute Northeast Partners in Amphibian and Reptile Conservation (NE PARC) Disease Working Group educational materials regarding Ranavirus management to public properties; especially those known to have the disease present.	Low
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	Ranavirus	Promote NE PARC decontamination protocols; include these protocols in permit reviews for wetland activities.	Low

Appendix 6a. Species-level threats and actions (ALL Herps)

PART 1: THREATS					PART 2: ACTIONS	
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Action Priority (Threat Impact x Action Urgency)
9	9 Pollution				Determine impacts of environmental pollutants (such as per- and polyfluoroalkyl substances [PFAS]) on SGCN populations.	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Develop formal species conservation plans for SGCN as needed.	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need to provide technical assistance	Provide technical assistance to Natural Resources Police (NRP) to support enforcement actions of state and federal laws and regulations.	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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.	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Conduct eDNA surveys in subwatersheds to determine presence/absence of certain species, including eastern hellbender and rainbow snake.	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Develop protocols and conduct population monitoring (e.g., abundance, demographics, reproduction, etc.) for SGCN.	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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).	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Assess feasibility of population augmentation or reintroduction.	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine impacts of emerging pathogens.	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Study impacts of sea-level rise and climate change on coastal SGCN.	Low

Appendix 6a. Species-level threats and actions (ALL Herps)

PART 1: THREATS					PART 2: ACTIONS	
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Assessing methodologies for pathogen surveillance (e.g., eDNA)	Low
12.3	12 Other Options	12.3 Education & Outreach	Education needs		Increase decontamination protocol education to address known and emerging diseases.	Low
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Continue working with other states on existing collaborative range-wide conservation projects and develop new projects.	Low
12.4	12 Other Options	12.4 Administrative Needs	Infrastructure needs	Need to maintain or improve information management systems	Begin to include uncommon (i.e., species ranked S3) herpetofauna in Natural Heritage Program (NHP) database and/or develop database for SGCN not currently tracked. Database would also be used for Environmental Review (ER) project screening.	Low
12.5	12 Other Options	12.5 State Specific Issues		Need for increased legal protection	Re-evaluate state legal status for many herpetofauna SGCN.	Low

Appendix 6a. Species-level threats and actions (Herps: Amphibians)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
3.2	3 Energy Production	3.2 Mining & Quarrying			Use Environmental Review (ER) process to ensure that mining actions won't be detrimental to populations of SGCN.	Eastern tiger salamander, green salamander, eastern hellbender, common mudpuppy, barking treefrog, carpenter frog	Low
3.3.1	3 Energy Production	3.3 Renewable Energy	3.3.1 Hydroelectric dams	Water releases from Deep Creek Dam	Study impact of water releases from Deep Creek on hellbenders in the Youghiogheny.	Eastern hellbender, common mudpuppy	Medium
7.2.1	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.1 Water level management using dams		Maintain/improve aquatic hydrology by working with Deep Creek for proper water flow for species needs.	Eastern hellbender, common mudpuppy	Medium
7.2.3	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.3 Water management using culverts		Maintain/improve aquatic hydrology by retrofitting culverts, etc. Maintain and enhance stream buffers through environmentally sensitive designs.	Eastern hellbender, seal salamander, spring salamander, common mudpuppy, mud salamander, red salamander, mountain dusky salamander, longtail salamander	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Restore known occupied habitat, especially in areas where populations are declining, by removal of encroaching trees/saplings.	Eastern tiger salamander, barking treefrog, carpenter frog	High
9.2.2	9 Pollution	9.2 Industrial & Military Effluents	9.2.2 Acid mine drainage		Monitor and address acid mine drainage as issues arise. Work with Pennsylvania on acid mine drainage issues separating Maryland and Pennsylvania hellbender populations.	Eastern hellbender, common mudpuppy	High

Appendix 6a. Species-level threats and actions (Herps: Amphibians)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Conduct regular chorus surveys and/or acoustic monitoring to inform status and distribution.	Eastern narrow-mouthed toad, barking treefrog, carpenter frog, mountain chorus frog, upland chorus frog, eastern spadefoot	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Develop population augmentation protocols and begin implementation of head-starting, translocation, and repatriation as needed. Ensure that protocols are site- and species-specific.	Eastern tiger salamander, eastern hellbender, common mudpuppy, eastern narrow-mouthed toad, mountain chorus frog	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Determine reasons for apparent population decline/extirpation in the state (disease, contaminants, siltation, acidification).	Eastern hellbender, mountain chorus frog, upland chorus frog	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Study canopy use of Maryland populations to incorporate into habitat protection measures.	Green salamander	Low

Appendix 6a. Species-level threats and actions (Herps: Turtles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
1 - 4				Habitat loss (from various causes)	Study, protect, and restore nesting and/or basking habitat.	Eastern spiny softshell, spotted turtle, bog turtle, wood turtle, northern map turtle, diamond-backed terrapin, eastern box turtle, striped mud turtle, eastern mud turtle, eastern musk turtle	High
5.1.4	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.4 Poaching/persecution of terrestrial animals		Develop repatriation protocols and begin implementation as needed for placement of turtles illegally collected and traded.	Spotted turtle, bog turtle, wood turtle, diamond-backed terrapin, eastern box turtle	High
5.4.1	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.1 Recreational or subsistence fishing		Promote the use and enforcement Turtle Reduction Devices (TRDs) on all recreational pots to avoid bycatch.	Diamond-backed terrapin	Low
5.4.2	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.2 Commercial fishing		Reduce mortality (as bycatch) in recreational and commercial crab pots, catfish traps, fyke nets, and other larger-scale fishing gear.	Diamond-backed terrapin	Low
7.2	7 Natural System Modifications	7.2 Dams & Water Management / Use			Continue to monitor changes in hydrology at most important known locations to inform future management of these areas.	Spotted turtle, bog turtle, wood turtle, northern map turtle	Low
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Lack of natural disturbance patterns or ecosystem functions due to species loss	Continue to manage vegetation at most important known locations.	Spotted turtle, bog turtle, wood turtle, northern map turtle, diamond-backed terrapin, eastern box turtle	High
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Imbalanced predator/prey dynamics	Control and/or exclude predators at known nesting sites and habitats.	Eastern spiny softshell, spotted turtle, bog turtle, wood turtle, northern map turtle, diamond-backed terrapin, eastern box turtle	High

Appendix 6a. Species-level threats and actions (Herps: Turtles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
7.3.1	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.1 Shoreline alteration		Protect, maintain, and restore access to nesting beach habitat by limiting hardened or altered shorelines, such as riprap or bulkheads. Encourage living shoreline methods of shoreline protection.	Eastern spiny softshell, wood turtle, northern map turtle, diamond-backed terrapin	High
8.4	8 Invasive and Problematic Species	8.4 Pathogens			Monitor spread of individuals infected with Ranavirus, Herpesvirus, Mycoplasma, Adenovirus, Emydomyces; determine impact of emerging pathogens.	Eastern spiny softshell, spotted turtle, bog turtle, wood turtle, northern map turtle, diamond-backed terrapin, eastern box turtle, striped mud turtle, eastern mud turtle, eastern musk turtle	Medium
8.4	8 Invasive and Problematic Species	8.4 Pathogens		Disease surveillance and monitoring	Implement landscape-level surveys to determine abundance and severity of existing and emerging diseases.	Eastern spiny softshell, spotted turtle, bog turtle, wood turtle, northern map turtle, diamond-backed terrapin, eastern box turtle, striped mud turtle, eastern mud turtle, eastern musk turtle	Low
8.4.2	8 Invasive and Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens	Ranavirus	Educate the public on and enforce the prohibition of native turtles in Turtle Derbies.	Spotted turtle, wood turtle, eastern box turtle	Low
11.1	11 Climate Change	11.1 Habitat Shifting & Alteration		Sea level rise	Monitor impacts of sea level rise on coastal turtle SGCN.	Spotted turtle, diamond-backed terrapin	Medium
11.4.1	11 Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.1 Overabundant Rains	Increase in amount and severity of storms	Create nesting habitat through various methods including vegetation control, tree removal, and substrate enhancement.	Eastern spiny softshell, wood turtle, northern map turtle, diamond-backed terrapin	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Monitor changes in sex ratios of populations.	Spotted turtle, northern map turtle, diamond-backed terrapin, eastern box turtle, striped mud turtle, eastern mud turtle, eastern musk turtle	Low

Appendix 6a. Species-level threats and actions (Herps: Turtles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Look into impacts of crayfish trapping on freshwater turtles.	Spotted turtle, striped mud turtle, eastern mud turtle, eastern musk turtle	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to develop new technique	Develop population augmentation protocols and begin implementation of head-starting and translocation as needed. Ensure that protocols are site- and species-specific.	Eastern spiny softshell, spotted turtle, bog turtle, wood turtle, northern map turtle, diamond-backed terrapin, eastern box turtle	Low

Appendix 6a. Species-level threats and actions (Herps: Snakes & Lizards)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
5.1	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals			Ensure species are included on Natural Heritage Program (NHP)'s Vulnerable Species list and implement exemption to Public Information Act (PIA).	Scarletsnake, northern mole kingsnake, eastern milksnake, red cornsnake	Low
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Prevent shading of specific hibernacula and gestation sites by canopy closure.	Timber rattlesnake, copperhead	Low
8.4.3	8 Invasive and Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens	Snake Fungal Disease (SFD)	Develop and implement surveillance protocols for SFD.	Timber rattlesnake, rainbow snake, plain-bellied watersnake, eastern kingsnake, copperhead, queensnake	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Implement conservation actions identified for Maryland populations in the Timber Rattlesnake Conservation Action Plan (TRCAP).	Timber rattlesnake	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Monitor population health (e.g., abundance, reproduction, etc.) at known locations.	Scarletsnake, timber rattlesnake, rainbow snake, northern mole kingsnake, eastern milksnake, plain-bellied watersnake, smooth greensnake, red cornsnake, eastern ribbonsnake, mountain earthsnake, eastern kingsnake	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Assess potential impacts of human disturbance including poaching, harm, and harassment.	Timber rattlesnake, eastern milksnake, red cornsnake, eastern kingsnake	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Conduct radio telemetry study to determine extent of area required for protection, microhabitats used, behavior, etc.	Timber rattlesnake, rainbow snake, northern mole kingsnake, eastern kingsnake	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Evaluate effects of shale barren habitat restoration projects on populations.	Six-lined racerunner, northern coal skink	Low

Appendix 6a. Species-level threats and actions (Herps: Snakes & Lizards)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.3	12 Other Options	12.3 Education & Outreach	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 (RTE) species in parks.	Timber rattlesnake, copperhead	Low

Appendix 6a. Species-level threats and actions (Herps: Sea Turtles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
5.4.1	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.1 Recreational or subsistence fishing	Unintentional effects: bycatch	Partner with watermen to collect demographic data on sea turtles (both live and dead) captured in gear.	Loggerhead sea turtle, Kemp's ridley sea turtle, green sea turtle, leatherback sea turtle	Low
5.4.1	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.1 Recreational or subsistence fishing	Unintentional effects: bycatch	Implement effective regulations related to bycatch in fishing/crabbing gear.	Loggerhead sea turtle, Kemp's ridley sea turtle, leatherback sea turtle	Low
6.1	6 Human Intrusions	6.1 Recreational Activities		Beach disturbance by humans and their pets	Continue surveys for nests and protecting these nest locations from humans and predators.	Loggerhead sea turtle	High
6.1.4	6 Human Intrusions	6.1 Recreational Activities	6.1.4 Recreational boating	Unintentional effects: propeller strikes	Create a system to report propeller strikes.	Loggerhead sea turtle	Low
6.1.4	6 Human Intrusions	6.1 Recreational Activities	6.1.4 Recreational boating	Unintentional effects: propeller strikes	Implement effective methods to reduce mortality from boat strikes.	Loggerhead sea turtle, Kemp's ridley sea turtle, green sea turtle, leatherback sea turtle	Low
9.4.4	9 Pollution	9.4 Garbage & Solid Waste	9.4.4 Drifting plastic and entanglement rubbish		Continue work to reduce aquatic plastic pollution, which presents a threat to many marine species via entanglement and ingestion. Pursue both supply-side tactics (i.e., reduce production of and reliance on plastics) and cleanup efforts.	Loggerhead sea turtle, Kemp's ridley sea turtle, green sea turtle, leatherback sea turtle	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Continue efforts to gather and centrally compile sightings data to determine important areas for conservation.	Loggerhead sea turtle, Kemp's ridley sea turtle, green sea turtle, leatherback sea turtle	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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.	Loggerhead sea turtle	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue system for reporting of dead sea turtles and getting them necropsied to determine cause of death.	Loggerhead sea turtle, Kemp's ridley sea turtle, green sea turtle, leatherback sea turtle	High

Appendix 6a. Species-level threats and actions (Fish: Freshwater)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
1 - 4				Habitat loss (from various causes)	Continue efforts to identify populations most threatened based on county and other development plans, particularly for state-listed species.	American brook lamprey, bridle shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
3	3 Energy Production			Natural resource extraction	Monitor population size and age structure in western Maryland to assess impacts from natural resource extraction; especially important for stonecat.	Stonecat, striped shiner, mottled sculpin, johnny darter	Medium
11.3	11 Climate Change	11.3 Changes in Temperature Regimes			Evaluate predicted habitat change and loss due to changes in thermal regime and precipitation patterns.	Stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Medium
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Re-evaluate state conservation status (i.e., S-ranks) using all recent data available; especially important for brook trout.	American brook lamprey, bridle shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Implement and promote conservation actions outlined in federal and state fisheries management/recovery plans.	Chesapeake logperch, blackbanded sunfish, brook trout	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Develop state fisheries management/recovery plans for species that do not yet have them.	Stripeback darter, stonecat	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Continue conducting 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.	American brook lamprey, bridle shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low

Appendix 6a. Species-level threats and actions (Fish: Freshwater)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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.	American brook lamprey, bridge shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Continue periodic survey efforts on prevalence of microfishing.	American brook lamprey, bridge shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to identify at-risk populations using current data, then prioritize list of populations to be protected.	Brook trout	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue work to identify suitable habitats for reintroduction.	Chesapeake logperch, blackbanded sunfish, stonecat, brook trout, longnose sucker, striped shiner, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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.	Bridge shiner, stripeback darter, Chesapeake logperch, blackbanded sunfish, stonecat, brook trout, longnose sucker, striped shiner, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Evaluate feasibility of re-introduction of species into historical locations. Consider "experimental/nonessential" population status reintroduction via translocation from Pennsylvania stock.	Bridge shiner, stonecat	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Assess metapopulation connectivity among seemingly disconnected populations of these species. Understand gene flow among populations to better determine those most vulnerable to isolation and extirpation.	Stripeback darter, Chesapeake logperch, blackbanded sunfish, brook trout, Allegheny pearl dace, checkered sculpin	Low

Appendix 6a. Species-level threats and actions (Fish: Freshwater)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review (ER).	American brook lamprey, bridge shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to monitor populations to understand intra- and inter-population genetic variation (as a result of genetic augmentation) of Maryland and Delaware populations.	Blackbanded sunfish	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to seek funding to further develop DNA primers for targeted eDNA surveys.	American brook lamprey, bridge shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Utilize recent sea-level rise models to identify populations most vulnerable to sea-level rise impacts.	Ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to develop new technique	Develop methods of volunteer recreational harvest sampling (e.g., logbooks and online surveys).	Brook trout	Low
12.3	12 Other Options	12.3 Education & Outreach	Education needs		Educate microfishers on safe handling practices and species to avoid.	American brook lamprey, bridge shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Continue to coordinate conservation actions with surrounding states in shared drainages where these species occur.	Chesapeake logperch, blackbanded sunfish, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low

Appendix 6a. Species-level threats and actions (Fish: Freshwater)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Coordinate with county stream assessment surveys to ensure distribution data, etc. for fish are included in statewide databases, plans, and initiatives.	American brook lamprey, bridge shiner, comely shiner, ironcolor shiner, swamp darter, stripeback darter, Chesapeake logperch, glassy darter, mud sunfish, flier, blackbanded sunfish, banded sunfish, shield darter, stonecat, brook trout, longnose sucker, striped shiner, Allegheny pearl dace, mottled sculpin, checkered sculpin, johnny darter	Low

Appendix 6a. Species-level threats and actions (Fish: Bay/Ocean)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
4.3.1	4 Transportation	4.3 Shipping Lanes	4.3.1 Shipping	Increased noise / disturbance from increased shipping traffic and larger ships	Research the effects of noise and other effects from ships on aquatic animals.	Whale shark	Low
5.4.2	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.2 Commercial fishing		Establish sustainable harvest levels, as appropriate, based on stock assessment findings.	Sandbar shark	High
5.4.2	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.2 Commercial fishing	Commercial fisheries bycatch	Develop, implement, and enforce fishing practices that reduce bycatch and/or increase post-release survival.	Hickory shad, American shad, blueback herring, alewife, dusky shark, sandbar shark, sand tiger shark, white shark, Atlantic angel shark	Low
5.4.3	5 Bio Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.3 Poaching/persecution of aquatic species	Deliberate and illegal harvesting or persecution, harassment, abuse or to cause deliberate harm	Develop and implement effective methods to monitor for illegal harvesting or persecution.	Hickory shad, American shad, horeshoe crab, blueback herring, alewife	Medium
6.1	6 Human Intrusions	6.1 Recreational Activities		Use of beaches	Identify spawning and nursery habitat and implement a spawning survey.	Horeshoe crab	High
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals		Assess impacts from invasive aquatic animals (e.g., blue catfish).	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife	High
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals		Limit/prevent the spread of invasive fish.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife	High
11.2.1	11 Climate Change	11.2 Changes in Geochemical Regimes	11.2.1 Changes in pH of habitats	Ocean acidification	Mitigate impacts from climate change through management of fossil fuels and reductions of emissions.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Document tributaries and other areas with spawning and nursery habitat and populations.	Shortnose sturgeon, Atlantic sturgeon, dusky shark, sandbar shark, sand tiger shark, Atlantic angel shark	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Conduct targeted surveys to fill data gaps on distribution; use landscape, water chemistry, and habitat data (from Maryland and adjacent states when possible) to focus survey efforts.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	Low

Appendix 6a. Species-level threats and actions (Fish: Bay/Ocean)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Compile all recent distribution records.	Shortnose sturgeon, hickory shad, horeshoe crab, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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.	Shortnose sturgeon, Atlantic sturgeon	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Support research on the impacts of climate change, such as ocean acidification, on aquatic species.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Design and conduct acoustic and other studies to determine extent of area required for protection, habitats used, etc.	Shortnose sturgeon, Atlantic sturgeon	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Identify populations most vulnerable to sea-level rise impacts, and identify which are not resilient.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Research the various effects of offshore wind development (e.g., vibrations, noise, electromagnetic field disruptions, and placement related to occupancy) on aquatic animals.	Horeshoe crab, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	Medium
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Lack of current status assessment	Evaluate the species' current state rank/status using all recent data available.	Horeshoe crab, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Implement and promote conservation actions outlined in Federal and State fisheries management plans.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	Low
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Coordinate conservation actions with surrounding states in shared drainages where this species occurs.	Shortnose sturgeon, Atlantic sturgeon, hickory shad, American shad, horeshoe crab, blueback herring, alewife, dusky shark, sandbar shark, sand tiger shark, white shark, longfin mako, whale shark, Atlantic angel shark	High

Appendix 6a. Species-level threats and actions (Inverts: Crayfish)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
1 - 4				Habitat loss (from various causes)	Continue efforts to identify populations most threatened based on county and other development plans, particularly for state-listed species.	<i>Cambarus</i> sp. C	Low
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals		Assess impacts from invasive crayfishes, including range restrictions, downward population trends, and hybridization.	<i>Cambarus</i> sp. C, Allegheny crayfish, rock crayfish	Low
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals		Limit/prevent the spread of invasive crayfishes via anglers by banning or restricting their possession/use as bait.	<i>Cambarus</i> sp. C, Allegheny crayfish, rock crayfish	Medium
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 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.	<i>Cambarus</i> sp. C, Allegheny crayfish, rock crayfish	Low
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals	Hybridization	Use historical/museum data to assess genetically polluted population in the Northwest Branch, which has hybridized with an introduced species of southern crayfish.	<i>Cambarus</i> sp. C	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning	Reassess state rank and listing once species is properly described and global rank has changed.	<i>Cambarus</i> sp. C	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Continue conducting 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.	<i>Cambarus</i> sp. C	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Conduct regular surveys to detect trends in population size in watersheds under threat of development, resource extraction, etc.	<i>Cambarus</i> sp. C, Allegheny crayfish, rock crayfish	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Set up long-term monitoring sites in order to assess population trends.	<i>Cambarus</i> sp. C	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to identify at-risk populations using current data, then prioritize list of populations to be protected.	<i>Cambarus</i> sp. C, Allegheny crayfish, rock crayfish	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to acquire data from adjacent states to assess abiotic associations and refine/define protection guidelines for use in Environmental Review (ER).	<i>Cambarus</i> sp. C	Low

Appendix 6a. Species-level threats and actions (Inverts: Crayfish)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Applicable Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	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.	<i>Cambarus</i> sp. C	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Seek funding to develop mitochondrial and/or nuclear DNA primers for targeted eDNA surveys for historic watersheds.	<i>Cambarus</i> sp. C	Low
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management	Continue to coordinate conservation actions with surrounding states in shared drainages where these species occur.	<i>Cambarus</i> sp. C, Allegheny crayfish, rock crayfish	Low

Appendix 6a. Species-level threats and actions (Inverts: Freshwater Mussels)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	Conversion of agricultural and forested lands to suburban areas	Encourage proactive protection of the highest quality mussel habitat through data sharing and outreach with county planning agencies. Seek long-term watershed scale protection of priority streams via local planning, easements and land acquisition.	Dwarf wedgemussel, triangle floater, brook floater, northern lance, yellow lance, green floater, creeper	High
2.1.1	2 Agriculture and Aquaculture	2.1 Annual & Perennial Non-Timber Crops	2.1.1 Annual cropping systems (field crops)	Nutrient and sediment laden run-off, and other impacts to stream hydrology, habitat quality, etc. from field crop agriculture	Restore ecological integrity of streams through best management practice (BMP) implementation, revegetation, and cooperative landowner agreements to reduce effects from agricultural practices (e.g., fertilizers, pesticides, and herbicides).	Dwarf wedgemussel, triangle floater, northern lance, creeper	High
3.2.1	3 Energy Production	3.2 Mining & Quarrying	3.2.1 Underground mines	Coal mine permitted to operate underneath and discharge mine water into the Casselman River circa 2010	Conduct population monitoring in Casselman River to assess potential impacts from permitted coal deep mine.	Creeper	High
3.2.3	3 Energy Production	3.2 Mining & Quarrying	3.2.3 Quarries & sand pits	Sand and gravel mining, particularly on the Eastern Shore and in southern Maryland	Evaluate potential impacts of sand mining and work with appropriate regulatory agencies to avoid impacts.	Dwarf wedgemussel, triangle floater, northern lance, creeper	Low
3.3.1	3 Energy Production	3.3 Renewable Energy	3.3.1 Hydroelectric dams	Hydroelectric dam operation alters habitat quantity and quality	Use existing regulatory mechanisms (e.g., Federal Energy Regulatory Commission [FERC] licensing, Section 401 Clean Water Act [CWA]) to ensure flow-regime is supportive of mussel life history and habitat requirements.	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel	Low
4.1.3	4 Transportation	4.1 Roads & Railroads	4.1.3 Bridges	Bridge repair or construction projects (e.g., Wilson Bridge over Potomac River, railroad bridge over Susquehanna River) cause the temporary and permanent loss of mussel habitat	Advocate for mussel-friendly stream construction practices during transportation construction projects.	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, creeper	Low
4.3.2	4 Transportation	4.3 Shipping Lanes	4.3.2 Dredging of shipping lands	Dredging of large, tidal rivers for navigational channels	Evaluate potential impacts of coastal river dredging and work with appropriate regulatory agencies to avoid impacts.	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel	Low
5.3	5 Bio Resource Use	5.3 Logging and Wood Harvesting		Timber harvesting impacts to streams via increased runoff, sediment, bank erosion, increased stream water temperatures, altered stream hydrology.	Work with Maryland Forest Service (MFS) to develop timber harvest BMPs on private and public lands where state and federally listed mussel species may be impacted.	Dwarf wedgemussel, triangle floater, brook floater, yellow lance, green floater, creeper	Low

Appendix 6a. Species-level threats and actions (Inverts: Freshwater Mussels)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
7.2.1	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.1 Water level management using dams	Dam removal may cause mussel displacement or stranding if dewatering is not managed	Advocate for mussel-friendly in stream construction practices during dam removal.	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel	Low
7.2.2	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.2 Beaver dam management	Beaver dams can further disrupt the dynamics of already fragmented populations	Advocate for improved beaver management, which can help create or degrade mussel habitat.	Dwarf wedgemussel	Low
7.2.3	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.3 Water level management using culverts	Blockages prevent migratory host-fish from accessing habitat	Improve habitat connectivity in streams with migratory fish hosts via blockage removal, culvert retrofit, and transportation BMPs.	Alewife floater, eastern lampmussel, tidewater mucket, eastern pondmussel	Low
7.2.3	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.3 Water management using culverts	Fragmentation of habitat due to undersized or failing culverts	Improve connectivity of suitable habitat within streams for mussels and host fishes by addressing poorly designed or failing culverts.	Dwarf wedgemussel, triangle floater, northern lance, creeper	High
7.2.4	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.4 Drainage in agricultural environments	Drainage ditches in agricultural environments can impact mussel habitat quality	Evaluate potential impacts of agricultural drainages and work with appropriate regulatory agencies to mitigate impacts.	Dwarf wedgemussel, triangle floater, northern lance, creeper	Medium
7.3.1	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.1 Shoreline alteration	Specific in-channel stream restoration techniques can be detrimental to mussels and their habitat	Advocate for mussel-friendly aquatic habitat restoration practices.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper	Low
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals	Non-native and invasive mollusks	To extent possible, prevent/minimize further introduction and spread of non-native mollusks.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper	Medium
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals	Non-native and invasive mussel predators	Determine risk of potential impacts from non-native predators.	Alewife floater, tidewater mucket, eastern pondmussel	High

Appendix 6a. Species-level threats and actions (Inverts: Freshwater Mussels)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
8.3.3	8 Invasive and Problematic Species	8.3 Introduced Genetic Material	8.3.3 Genetic material from aquaculture	Potential negative genetic effects of captive breeding efforts	Establish genetic management protocols in propagation; follow best scientific practices in conservation genetic management as it relates to propagation.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper	Low
8.4	8 Invasive and Problematic Species	8.4 Pathogens		Novel mussel parasites & disease	Develop a histological atlas for a healthy freshwater mussel.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper, paper pondshell	High
8.4.1	8 Invasive and Problematic Species	8.4 Pathogens	8.4.1 Bacterial pathogens	Fish and shellfish pathogens from mussel aquaculture	Establish and follow biosecurity and aquatic animal health protocols to minimize the risk of introduction or spread of a fish or shellfish pathogen.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper	High
8.5.1	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.1 Loss of Genetic Diversity	Loss of genetic diversity due to multiple stressors that caused declines in abundance and distribution	Develop species-specific conservation genetics management plan(s) to ensure no loss of (and potentially bolster) genetic diversity.	Dwarf wedgemussel, brook floater, yellow lance, green floater	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined		Based on known fish-host relationships, determine the extent to which fish host needs may be limiting mussel reproduction; propose conservation measures needed to re-establish the host-affiliate relationship.	Alewife floater, yellow lance, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel	Low
9.1.1	9 Pollution	9.1 Domestic & Urban waste water	9.1.1 Domestic wastewater	Biosolid spread to agricultural fields (Three Bridges Branch)	Work with appropriate regulatory agencies to understand the potential magnitude of the threat and propose the use of alternative or reduced practices.	Dwarf wedgemussel	Medium
9.2.2	9 Pollution	9.2 Industrial & Military Effluents	9.2.2 Acid mine drainage	Acid mine drainage in tributaries of the North Branch Potomac River affecting downstream water quality	Evaluate existing water quality data in the watershed to evaluate the extent and magnitude of acid mine drainage as a potentially limiting factor to mussel occupancy.	Triangle floater, brook floater, northern lance, green floater, creeper	Low
9.3.1	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.1 Nutrient loads	Groundwater pumped irrigation transfers nitrate pollution to surface waters	Encourage buffer expansion and improved nutrient management in and around mussel habitat.	Dwarf wedgemussel, triangle floater, northern lance, creeper	Low

Appendix 6a. Species-level threats and actions (Inverts: Freshwater Mussels)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
11.1	11 Climate Change	11.1 Habitat Shifting & Alteration		Sea-level rise	Improve understanding of where sea-level rise poses the greatest threat to mussel habitat and to what species.	Dwarf wedgemussel, alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel	Low
11.1.2	11 Climate Change	11.1 Habitat Shifting & Alteration	11.1.2 Phenological mismatch		Conduct expansive studies or literature reviews to evaluate the potential effects of phenological mismatch on recruitment.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper, paper pondshell	High
11.2.1	11 Climate Change	11.2 Changes in Geochemical Regimes	11.2.1 Changes in pH of habitats	Streams in the Mid-Atlantic are becoming more alkaline	Conduct expansive studies or evaluate existing datasets to understand the potential threat to state and federally listed species.	Dwarf wedgemussel, triangle floater, brook floater, northern lance, yellow lance, green floater, creeper	High
11.3.1	11 Climate Change	11.3 Changes in Temperature Regimes	11.3.1 Heat waves	Heat waves could cause mussel die-offs	Conduct expansive studies to evaluate potential effects on population dynamics.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper, paper pondshell	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning: Susquehanna River drainage	Evaluate the need for reintroduction and/or augmentation into Maryland's portion of Susquehanna River drainage and implement if found to be warranted.	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket	Low
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need for fish, wildlife and/or habitat planning: watershed planning	Develop holistic watershed conservation and restoration plans to protect or rehabilitate habitat of extant populations.	Dwarf wedgemussel, brook floater, yellow lance, green floater	High
12.2	12 Other Options	12.2 Resource Needs	Management decision needs	Need to conduct environmental reviews: transportation projects	Ensure that future transportation-related activities of state and local jurisdictions do no further harm to listed mussel species and their habitat. Develop cooperative agreement between agencies to proactively address potential conflicts and avoid impacts, establish standard survey protocols and methods, and develop project screening layers for freshwater mussels.	Dwarf wedgemussel, triangle floater, brook floater, yellow lance, green floater, creeper	Low

Appendix 6a. Species-level threats and actions (Inverts: Freshwater Mussels)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory: unsurveyed habitats can limit the effectiveness of environmental review, conservation planning, and species status assessments	Continue surveys to document new populations. To help target surveys, use Maryland Biological Stream Survey (MBSS) stream monitoring records, recent and historical mussel distribution data, Species Distribution Models (SDMs), and eDNA sampling, when appropriate.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, northern lance, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper, paper pondshell	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Re-evaluate species' status in Maryland in order to ensure appropriate and effective protection and conservation actions are being taken.	Triangle floater, northern lance, yellow lampmussel, eastern lampmussel, creeper	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Monitor extant populations and stream conditions. Re-evaluate goals, methods, efficacy, and scheduling of recent efforts and make improvements where needed.	Dwarf wedgemussel, brook floater, yellow lance, green floater	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Determine species' status in streams/watersheds where its continued presence is in question. Employ a combination of eDNA techniques and traditional survey methods.	Dwarf wedgemussel, yellow lance	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information: old data can limit the effectiveness of environmental review and species status assessments	Survey element occurrence (EO) source features for tracked (S1-S3) species that are more than 15 years old.	Triangle floater, brook floater, alewife floater, yellow lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information: undersurveyed habitats can limit the effectiveness of environmental review, conservation planning, and species status assessments	Conduct surveys and monitoring in under-surveyed lentic habitats, including tidal-freshwater, millponds, and other small impoundments in order to help evaluate status and conservation needs. Determine species occupancy, population demographics, and habitat associations.	Alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel, paper pondshell	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information: undersurveyed habitats can limit the effectiveness of environmental review, conservation planning, and species status assessments	Complete an inventory of the Potomac River (initially focusing on the Ridge and Valley) to better determine the species' distribution and abundance and establish a baseline for future monitoring. Upon completion, inventory the Blue Ridge and Piedmont.	Triangle floater, brook floater, northern lance, yellow lampmussel, green floater, creeper	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Continue to use river and stream monitoring data to determine ecological requirements of mussels in order to guide protection guidelines and restoration planning.	Dwarf wedgemussel, brook floater, yellow lance, green floater	Medium

Appendix 6a. Species-level threats and actions (Inverts: Freshwater Mussels)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	To extent possible, determine population-specific causes of population decline and major threats (ongoing and future) in order to guide protection guidelines and restoration planning.	Brook floater, yellow lance, yellow lampmussel, green floater	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question: need to determine species and streams to implement conservation actions	Develop and implement restoration plans for species and streams identified by MD DNR as priorities (e.g., Town Creek, upper Potomac River, etc.), which may include the need for restoration suitability studies.	Brook floater, northern lance, creeper	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question: need to evaluate the need for active conservation measures	Evaluate need for population augmentation or reintroduction via propagation or translocation.	Triangle floater, brook floater, alewife floater, yellow lampmussel, eastern lampmussel, tidewater mucket, eastern pondmussel, creeper	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question: need to evaluate the need for active conservation measures	Evaluate the need for mussel propagation to meet population restoration goals via augmentation or reintroduction.	Dwarf wedgemussel, yellow lance, green floater	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question: taxonomic confusion can limit the effectiveness of environmental review, conservation planning, and species status assessments	Resolve taxonomic confusion regarding this and other lanceolate <i>Elliptio</i> species.	Northern lance, yellow lance	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question: taxonomic confusion can limit the effectiveness of environmental review, conservation planning, and species status assessments	Resolve taxonomic confusion; refine techniques to identify, distinguish from non-native <i>Lampsilis</i> spp.	Yellow lampmussel	Low
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management: interstate coordination	Coordinate conservation actions with surrounding states where these mussel species occur through species workgroups and collaborative grants.	Dwarf wedgemussel, triangle floater, brook floater, alewife floater, yellow lance, yellow lampmussel, eastern lampmussel, green floater, tidewater mucket, eastern pondmussel, creeper	Low
12.4	12 Other Options	12.4 Administrative Needs	Coordination/administration needs	Need for coordination for effective program/project management: use of existing regulatory authority	Encourage the development and implementation of Tier III Clean Water Act Anti-Degradation policy within MD DNR and Maryland Department of the Environment (MDE).	Dwarf wedgemussel	Low

Appendix 6a. Species-level threats and actions (Inverts: Snails)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
5.3.5	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.5 Management of cutting areas		Protect and maintain forest canopy around limestone cliffs and outcrops.	Cherrystone drop	Medium
9.3	9 Pollution	9.3 Agricultural & Forestry Effluents			Restore, protect, and maintain riparian and wetland buffers at Cranesville Swamp to block siltation, pesticide, and fertilizer runoff to wetlands	Striped whitelip	Medium
11.1.1	11 Climate Change	11.1 Habitat Shifting & Alteration	11.1.1 Changes in vegetation communities	Habitat loss/degradation	Take measures to mitigate habitat change resulting from changes in thermal regime and precipitation patterns, including limiting impervious surfaces, surface and groundwater abstraction, and buffer encroachment in wetlands with sensitive species.	Striped whitelip	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of initial baseline inventory	Conduct targeted surveys to determine or refine species distribution.	Angular disc snail, Blue Ridge springsnail, spruce knob threetooth, striped whitelip, Appalachian springsnail, cherrystone drop	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of up-to-date existing information	Improve understanding of species distribution, abundance, status, and habitat requirements through monitoring and research.	Angular disc snail, Blue Ridge springsnail, spruce knob threetooth, striped whitelip, Appalachian springsnail, cherrystone drop	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Estimate population size and evaluate trends.	Angular disc snail, Blue Ridge springsnail, spruce knob threetooth, striped whitelip, Appalachian springsnail, cherrystone drop	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Need to answer research question	Assess threats that may be contributing to population declines or negatively impacting sites.	Angular disc snail, Blue Ridge springsnail, spruce knob threetooth, striped whitelip, Appalachian springsnail, cherrystone drop	Low

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1 - 4				Loss of oak forests (various causes)	Engage appropriate departments and agencies in discussions about the ecological value of oak forests.	Northern oak hairstreak	Low
1	1 Development	1. Residential & Commercial Development		Development of wetlands or nearby areas	Purchase swamp and surrounding area.	Harris's checkerspot, two-spotted skipper	Medium
1	1 Development	1. Residential & Commercial Development		Some habitat in unprotected areas	Educate and encourage landowners to conserve habitat where this butterfly occurs.	Baltimore checkerspot	High
1	1 Development	1. Residential & Commercial Development		Some habitat in unprotected areas	Work with landowners to conserve floral resources.	King's hairstreak	Low
1	1 Development	1. Residential & Commercial Development		Loss of grasslands, due in part to using strip mine land for development	Engage departments and agencies in discussions about the ecological value of grasslands over forests in Maryland.	Frosted elfin, Leonard's skipper, cobweb skipper, Indian skipper	Medium
3.3.4	3 Energy Production	3.3 Renewable Energy	3.3.4 Solar farms		Work with solar development companies to create grassland habitat and wildlife management plans. Provide oversight on seed mixes and mowing timing. Provide increased incentives for Solar Pollinator-Friendly Designation.	Frosted elfin	Low
4.1.1	4 Transportation	4.1 Roads & Railroads	4.1.1 Roads	Grading of dirt roadsides harming host plant	Outline best management practices (BMPs) for roadside grading.	Silvery blue	High
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Maintenance and expansion of power line rights-of-way (ROWS)	Create a conservation agreement regarding mowing and herbicide use.	Northern metalmark, Olympia marble, silvery blue, cobweb skipper	Medium
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Maintenance and expansion of power line rights-of-way (ROWS)	Carefully guide the placement of new transmission line projects.	Baltimore checkerspot	High
5.1.4	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.4 Poaching/persecution of terrestrial animals		Since this is the charismatic state butterfly, there is greater risk for collection. Need to educate the public on the rarity of this species to discourage collection. List for state protection as well.	Baltimore checkerspot	Low

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
5.1.4	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.4 Poaching/persecution of terrestrial animals	Well-known and only location is poaching threat	Better monitor visits to site to be sure of lawful behavior.	Olympia marble, Edwards' hairstreak	Low
5.2.4	5 Bio Resource Use	5.2 Gathering Terrestrial Plants or Fungi	5.2.4 Poaching/eradication of terrestrial plants or fungi	Possible future eradication to control pine blister rust	Maintain communication with the Maryland Department of Agriculture (MDA) regarding any possibilities of ban or eradication.	Gray comma	Low
5.3.1	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.1 Complete removal of the forest cover	Sediment filling wetland from nearby logging	Purchase surrounding areas.	Two-spotted skipper	Medium
5.3.2	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.2 Partial removal of the forest cover	Logging in Chesapeake forest land	Outline conservation areas to avoid logging activities.	King's hairstreak	Low
6.1.1	6 Human Intrusions	6.1 Recreational Activities	6.1.1 Motor vehicles	Mowing to create all-terrain vehicle (ATV) trails	Educate neighbors on the policies of access/use and prosecute trespassers.	Hoary elfin	Medium
6.1.2	6 Human Intrusions	6.1 Recreational Activities	6.1.2 Hiking	Overuse of site could introduce invasive plants or harm host plants	Reroute trails to avoid sensitive location(s).	Edwards' hairstreak	Low
6.1.3	6 Human Intrusions	6.1 Recreational Activities	6.1.3 Recreational use of cliffs and rock faces		Prevent erosion by fencing off shale barren at public site.	Olympia marble	Low
7.1	7 Natural System Modifications	7.1 Fire & Fire Suppression		Poor timing and subdividing of prescribed fire	Better time prescribed fire so as to not kill adult individuals or completely burn host plant during mating period. Create burn block rotations so as not to burn population area all at once. Low priority for frosted elfin, high priority for King's hairstreak.	Frosted elfin	Medium
7.2.2	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.2 Beaver dam management	Loss of marshland	Assess trapping regulations in western Maryland.	Silver-bordered fritillary, black dash, long dash	Low
7.2.4	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.4 Drainage in agricultural environments		Assess causes for drying of bogs and wetlands.	Bog copper	Low
7.2.4	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.4 Drainage in agricultural environments	Draining and ditching of marshes	Educate landowners, offer conservation opportunities, and enforce existing regulations.	Black dash, long dash, bronze copper, mulberry wing	Low
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Non-rotational vegetation control	Create management plan for small site that outlines timing and details of vegetation control.	Edwards' hairstreak	High

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Roadside mowing of host plants	Educate landowners, offer conservation opportunities, and enforce existing regulations.	Bronze copper	Medium
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Roadside mowing of nectaring plants	Create a conservation agreement regarding mowing and herbicide use. Low priority for cobweb skipper, high priority for Leonard's skipper.	Leonard's skipper, cobweb skipper	Medium
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Roadside mowing of nectaring plants	Create signage and mowing recommendations for nearby pollinator areas. Especially important for buttonbush / rare skipper.	Great purple hairstreak, northern metalmark, Palamedes swallowtail, rare skipper	High
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Remove other woody species in order to protect bear oak.	Edwards' hairstreak	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession	Canopy closure	Selectively remove trees, shrubs, and other vegetation in order to (re-)open the tree canopy in important habitat areas. Priority varies from low to high depending on SGCN/habitat in question.	Cobweb skipper, hoary elfin, Leonard's skipper, Indian skipper, pepper and salt skipper, northern metalmark, Olympia marble, silvery blue, frosted elfin, bog copper, Harris's checkerspot, two-spotted skipper. silver-bordered fritillary, black dash, long dash, mulberry wing	Medium
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Lack of prescribed fire, especially in/on shale barrens	Begin and/or increase fire management in targeted habitat areas. Priority varies from low to high depending on SGCN/habitat in question.	Hoary elfin, cobweb skipper, Leonard's skipper, northern metalmark, Olympia marble, silvery blue	Medium
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Redbay ambrosia beetle	Monitor swamp red bay (the plant) for pest introduction.	Palamedes swallowtail	Low
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Garlic mustard	Study whether garlic mustard is actually an ecological trap. Remove garlic mustard and other invasive plants in priority areas.	West Virginia white	High
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive plants competing with spring flowers	Locate spring flowers and remove competing invasive plants.	Olympia marble	Low
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive woody plants (e.g., autumn olive)	Cut and treat woody invasives.	Frosted elfin	High
8.1.4	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.4 Aquatic plants	Common reed (<i>Phragmites australis</i>)	Remove <i>Phragmites</i> and replace with wild rice.	Rare skipper	Medium

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
8.2.2	8 Invasive and Problematic Species	8.2 Problematic Native Plants & Animals	8.2.2 Increased grazing by vertebrates	White-tailed deer	Protect host plant(s) from deer browse with fencing. Low priority for big copper and frosted elfin, high priority for Baltimore checkerspot.	Bog copper, frosted elfin, Baltimore checkerspot.	Medium
8.2.2	8 Invasive and Problematic Species	8.2 Problematic Native Plants & Animals	8.2.2 Increased grazing by vertebrates	White-tailed deer	Encourage more hunting in targeted area to decrease white-tailed deer feeding on nectaring resources.	Hoary elfin	Medium
8.2.2	8 Invasive and Problematic Species	8.2 Problematic Native Plants & Animals	8.2.2 Increased grazing by vertebrates	White-tailed deer	Encourage more hunting in targeted areas to decrease white-tailed deer feeding on oak saplings. Prioritize existing forests with low recruitment for oak tree plantings.	Northern oak hairstreak	Medium
8.5	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations		Lack of connectivity between populations means local extirpations could lead to larger declines	Move elfin caterpillars from thriving populations to unoccupied, protected baptisia locations.	Frosted elfin	Medium
8.5	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations		Lack of connectivity between populations means local extirpations could lead to larger declines	Survey surrounding wetlands for cranberry plants and butterflies.	Bog copper	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on swamp red bay	Protect host plant (swamp red bay) from maintenance threats and deer browse.	Palamedes swallowtail	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on gooseberry species	Search surrounding areas for host plants (gooseberry). Reduce plant competition around host plants.	Gray comma	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on large amount of trailing arbutus or bearberry	Search surrounding areas for host plants (trailing arbutus or bearberry). Reduce plant competition around host plants.	Hoary elfin	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on common sweetleaf	Survey for host plant locations.	King's hairstreak	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on Carolina vetch	Locate Carolina vetch and assess threats.	Silvery blue	Low

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on smooth rockcress	Locate rockcress and assess threats.	Olympia marble	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on bear oak	Augment bear oak near current hairstreak population; plant in previous site as well.	Edwards' hairstreak	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on cranberry	Promote and augment the growth and reproduction of cranberries.	Bog copper	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on toothworts (mainly <i>Cardamine diphylla</i>)	Promote and augment the growth and reproduction of toothworts.	West Virginia white	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on flat-topped white aster	Augment host plant (flat-topped white aster) populations.	Harris's checkerspot	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on turtlehead	Augment turtlehead populations.	Baltimore checkerspot	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Utilizes <i>Packera obovata</i> as host plant and woodland sunflowers as nectaring resource	Augment plant species with local seed(s).	Northern metalmark	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on lupine or baptisia	Plant <i>Baptisia tinctoria</i> seeds or plugs.	Frosted elfin	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on purple flowers	Plant native purple nectaring resources.	Leonard's skipper	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Unknown ant species tends larvae	Identify ant tender species.	Edwards' hairstreak	Medium
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Herbicide spraying of drainage ditches and field edges	Educate landowners, offer conservation opportunities, and enforce existing regulations.	Bronze copper	Low

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Spongy moth spraying	Outline conservation areas to avoid pesticide use.	Pepper and salt skipper, Atlantis fritillary, great purple hairstreak, silver-bordered fritillary, northern metalmark, Harris's checkerspot, Olympia marble, silvery blue, Leonard's skipper, cobweb skipper, Indian skipper, gray comma, northern oak hairstreak, King's hairstreak, West Virginia white	High
11.1.2	11 Climate Change	11.1 Habitat Shifting & Alteration	11.1.2 Phenological mismatch	Out of sync with <i>Liatris</i>	Study phenological mismatch to determine if it is actually an issue.	Leonard's skipper	Low
11.2.2	11 Climate Change	11.2 Changes in Geochemical Regimes	11.2.2 Changes in salinity	Saltwater intrusion	Protect swamps from storm surges	Rare skipper, Palamedes swallowtail	Medium
11.3.4	11 Climate Change	11.3 Changes in Temperature Regimes	11.3.4 Increase in temperature fluctuations	Species distribution models (SDMs) show declines due to increased annual temperatures	Assess the impact(s) of climate change on these populations. Medium priority for Baltimore checkerspot.	Two-spotted skipper, black dash, mulberry wing, silver-bordered fritillary, Harris's checkerspot, bog copper, Atlantis fritillary, Baltimore checkerspot	Low
11.4.2	11 Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.2 Droughts	Droughts affect nectaring resources in/on shale barrens	Monitor precipitation, plant health, and metalmark populations each year.	Northern metalmark	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Better understand elfin feeding preferences	Identify differences between lupine- and baptisia-feeding populations. Is there interbreeding?	Frosted elfin	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of records, perhaps due to difficulty of ID	Revisit iNaturalist records and conduct focused surveys to compare population numbers with other fritillaries.	Atlantis fritillary	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Conduct surveys in isolated wetlands.	Silver-bordered fritillary, Harris's checkerspot	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Conduct extensive surveys of the region for host plant and butterfly.	Hoary elfin	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Conduct habitat modeling and field surveys to locate additional populations.	Edwards' hairstreak	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Locate additional populations and assess threats.	Baltimore checkerspot	High

Appendix 6a. Species-level threats and actions (Inverts: Butterflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys, questions about hostplant	Monitor elfin population at Furnace every year.	Frosted elfin	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Surveying difficulties	Provide trainings on hairstreak identification.	Northern oak hairstreak	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Surveying difficulties	Provide trainings on skipper identification.	Black dash, cobweb skipper, Indian skipper, long dash, mulberry wing, pepper and salt skipper	High

Appendix 6a. Species-level threats and actions (Inverts: Moths)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
5.2.4	5 Bio Resource Use	5.2 Gathering Terrestrial Plants or Fungi	5.2.4 Poaching/eradication of terrestrial plants or fungi	Collection of pitcher plants	Monitor The Nature Conservancy (TNC) site for pitcher plant poachers.	<i>Exyra fax</i>	High
5.2.4	5 Bio Resource Use	5.2 Gathering Terrestrial Plants or Fungi	5.2.4 Poaching/eradication of terrestrial plants or fungi	Possible future eradication to control pine blister rust	Maintain communication with the Maryland Department of Agriculture (MDA) regarding any possibilities of ban or eradication.	<i>Macaria subcessaria</i>	Low
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession	Conversion of open marsh wetlands into closed canopy	Remove overgrown vegetation in targeted marshy habitat areas.	<i>Nemoria tuscarora</i>	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Remove other woody species and conduct prescribed burns in areas where bear oak is extensive.	<i>Zale lunifera</i>	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Remove woody species and conduct prescribed burns to encourage cacti growth in targeted areas.	<i>Melitara prodenialis</i>	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Remove woody species and conduct prescribed burns as necessary to preserve barren habitat.	<i>Chytonix sensilis, Cynia inopinatus, Eucloptocnemis fimbriaris, Feltia manifesta, Virbia laeta, Zanclognatha martha</i>	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession		Conduct prescribed burns as necessary. (Re)plant bear oak in burned areas to support this specialist species.	<i>Cicinnus melsheimeri</i>	Medium
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Emerald ash borer (EAB)	Assess threat of EAB to these species. Can these species survive off of ash resprouts? Survey ash for these species.	<i>Caloptilia fraxinella, Copivaleria grotei, Manduca jasminearum, Marmara fraxinicola, Olceclostera angelica, Palpita illibalis, Palpita magniferalis, Papaipema furcata, Plagodis kuetzingi, Podosesia aureocincta, Podosesia syringae, Sphinx chersis, Sphinx franckii</i>	Medium
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Hemlock wooly adelgid (HWA)	Continue release of <i>Laricobius nigrinus</i> in targeted areas.	<i>Feralia comstocki</i>	High
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Low possibility of nutria reinvasion	Continue nutria eradication program.	<i>Coleotechnites variella, Cutina albopunctella, Cutina distincta, Dioryctria pygmaeella, Iridopsis pergracilis, Isoparce cupressi, Lithophane abita, Nemoria elfa</i>	Low

Appendix 6a. Species-level threats and actions (Inverts: Moths)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Depends on <i>Phacelia</i> , which are threatened by invasives	Remove invasive species threatening large populations of <i>Phacelia</i> .	<i>Ethmia macelhosiella</i> , <i>Ethmia zelleriella</i>	Medium
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Common reed (<i>Phragmites</i>)	Remove <i>Phragmites</i> from high-quality wetlands in the Coastal Plain.	<i>Meropleon titan</i>	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on gooseberry species as host plant	Search surrounding areas for host plants (i.e., gooseberries). Reduce plant competition around host plants.	<i>Macaria subcessaria</i>	High
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on Rattlebox (<i>Crotalaria</i>)	Augment and protect <i>Crotalaria</i> populations as needed.	<i>Utetheisa ornatatrix</i>	Medium
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Nearby mosquito spraying	Outline conservation areas to avoid pesticide use and educate landowners.	<i>Coleotechnites variella</i> , <i>Cutina albopunctella</i> , <i>Cutina distincta</i> , <i>Dioryctria pygmaeella</i> , <i>Feralia comstocki</i> , <i>Iridopsis pergracilis</i> , <i>Isoparce cupressi</i> , <i>Lithophane abita</i> , <i>Meropleon titan</i> , <i>Nemoria elfa</i>	Medium
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Powerline herbicide application	Outline conservation areas to avoid herbicide use, especially in powerline rights-of-way (ROWs).	<i>Exyra fax</i>	High
11.5.2	11 Climate Change	11.5 Storms & Severe Weather	11.5.2 Storm surges	Erosion of coastal dunes	Engage land managers at Assateague regarding dune preservation.	<i>Apamea lintneri</i> , <i>Drasteria graphica</i> , <i>Eucrotopcnemis fimbriaris</i> , <i>Melipotis jucunda</i> , <i>Papaipema duovata</i> , <i>Schinia saturata</i>	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Set out lights in cypress swamps in order to better survey for these species.	<i>Coleotechnites variella</i> , <i>Cutina albopunctella</i> , <i>Cutina distincta</i> , <i>Dioryctria pygmaeella</i> , <i>Iridopsis pergracilis</i> , <i>Isoparce cupressi</i> , <i>Lithophane abita</i> , <i>Nemoria elfa</i>	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Set out lights in pitcher plant bogs in order to better survey for this species. Examine pitcher plants for caterpillars and damage.	<i>Exyra fax</i>	High

Appendix 6a. Species-level threats and actions (Inverts: Odonates)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	Fifteen-Mile Creek Watershed at risk from possible development	Acquire property directly or through easement(s). Conduct surveys to locate any rare species in the area.	Appalachian jewelwing, green-faced clubtail, pygmy snaketail, rusty snaketail, spine-crowned clubtail, Uhler's sundragon	Medium
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas		Increase surveys in urban areas to better guide Environmental Review (ER).	Appalachian snaketail, black-tipped damer, Laura's clubtail, rapids clubtail, Selys' sundragon	Medium
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	Destruction of seeps for development	Increase surveys in urban areas to better guide ER.	Seepage dancer	High
1.2.1	1 Development	1.2 Commercial & Industrial Areas	1.2.1 Commercial & industrial areas	Development of wetland at known species location	Update <i>Odonata</i> and other invertebrate records in Biotics so that records can be used for ER. Work with developer to ensure protection of wetland.	Green-striped damer, little blue dragonlet, northern bluet	High
3.2.1	3 Energy Production	3.2 Mining & Quarrying	3.2.1 Underground mines	Possible future coal mines	Discourage additional coal operations near known populations.	Crimson-ringed whiteface, Hudsonian whiteface	Low
3.2.2	3 Energy Production	3.2 Mining & Quarrying	3.2.2 Open-pit mines	Refilling of borrow pit	Work with landfill to ensure protection of borrow pit.	Atlantic bluet	Low
5.1.2	5 Bio Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.2 Trapping	Loss of beaver dams	Clarify landowner permit requirements for nuisance wildlife removal (i.e., beavers). Discuss adjusting bag limits for beavers in western Maryland. Priority is low for southern sprite and northern bluet, medium for all other species.	American emerald, beaverpond baskettail, crimson-ringed whiteface, frosted whiteface, Hudsonian whiteface, northern bluet, southern sprite, spatterdock damer	Medium
5.3.2	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.2 Partial removal of the forest cover	Logging in areas surrounding bogs	Work with landowners to identify sensitive wetland habitat within their logging operations.	American emerald, crimson-ringed whiteface, Hudsonian whiteface	Low
6.1.1	6 Human Intrusions	6.1 Recreational Activities	6.1.1 Motor vehicles	Use of all-terrain vehicles (ATVs) on and around sensitive habitat	Post signs and prosecute trespassers.	Coppery emerald, elfin skimmer, fine-lined emerald, pale bluet, ski-tailed emerald, southern pygmy clubtail, superb jewelwing, treetop emerald	Low
7.2.3	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.3 Water management using culverts	Disruption of stream flow	Avoid culvert use whenever possible and utilize bridges that do not restrict waterflow.	Appalachian snaketail, banded spiketail, Laura's clubtail, rapids clubtail, seepage dancer	Low
7.2.5	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.5 Drainage in forest environments	Ditches that drain natural water features	Plug ditches that drain temporary pools (i.e., vernal pools).	Blackwater bluet, coppery emerald, royal river cruiser, sparkling jewelwing, treetop emerald	Low
7.3.1	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.1 Shoreline alteration	Disruption of lake edge near element occurrence (EO)	More strictly assess buffer strip permits around lake in particular habitat area.	Rainbow bluet	Medium
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive plants overrunning bogs	Remove invasive plants from bogs.	Sphagnum sprite	Low

Appendix 6a. Species-level threats and actions (Inverts: Odonates)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals	Illegal stocking of ponds with fish	Assess risk of stocked ponds to this species. Conduct outreach to limit stocking.	Spatterdock darner	Low
8.1.3	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.3 Aquatic animals	Stocking of particular creek with rainbow trout	Assess risk of stocked trout to this species. Adjust stocking areas if necessary.	Zebra clubtail	Low
9.1.2	9 Pollution	9.1 Domestic & Urban waste water	9.1.2 Runoff		Work with various counties to target runoff reductions in and around important habitat area(s). Priority varies from low to high depending on SGCN/habitat in question.	Appalachian snaketail, black-tipped darner, Laura's clubtail, rainbow bluet, rapids clubtail, seepage dancer, southern sprite, sphagnum sprite	Medium
9.1.2	9 Pollution	9.1 Domestic & Urban waste water	9.1.2 Runoff	Runoff from nearby golf course	Work with golf course to reduce runoff entering impoundment where this species is known to occur.	Atlantic bluet	Low
9.2.2	9 Pollution	9.2 Industrial & Military Effluents	9.2.2 Acid mine drainage		Restore acid mine drainage locations. Ensure operating mines abide by regulations. High priority for mustached clubtail, medium priority for other species.	Harpoon clubtail, Maine snaketail, mustached clubtail, ski-tailed emerald	Medium
9.3	9 Pollution	9.3 Agricultural & Forestry Effluents		Agricultural runoff near stream	Work with farmers to reduce runoff entering nearby stream(s).	Appalachian jewelwing, blackwater bluet, burgundy bluet, pale bluet, royal river cruiser, southern pygmy clubtail, sparkling jewelwing, spine-crowned clubtail, splendid clubtail, superb jewelwing	Low
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Mosquito control	Engage local communities on ecologically safe mosquito reduction tactics. Encourage the use of <i>Bacillus thuringiensis</i> (BT) instead of broad adulticides.	Appalachian snaketail, black-tipped darner, fine-lined emerald, Laura's clubtail, little blue dragonlet, midland clubtail, rainbow bluet, rapids clubtail, royal river cruiser, seepage dancer, Selys' sundragon, southern sprite, sphagnum sprite, St. Croix snaketail, Uhler's sundragon, white corporal	Medium
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Powerline herbicide application killing bog plants	Outline conservation areas to avoid herbicide use, especially in powerline rights-of-way (ROWs).	Sphagnum sprite	Low
11.2.2	11 Climate Change	11.2 Changes in Geochemical Regimes	11.2.2 Changes in salinity	Sea-level rise changing salinity of pond(s)	Manage shoreline erosion in locations where this species is known to occur.	Atlantic bluet	Low

Appendix 6a. Species-level threats and actions (Inverts: Odonates)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
11.3.3	11 Climate Change	11.3 Changes in Temperature Regimes	11.3.3 Gradual temperature change	Climate change may push this species out of Maryland	Assess impacts of climate change (e.g., range shifts) for these species.	Beaverpond baskettail, Canada darner, green-striped darner	Low

Appendix 6a. Species-level threats and actions (Inverts: Bees)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1.1	1 Development	1. Residential & Commercial Development		Capping of sand mine land for development	Engage appropriate agencies in discussion regarding the ecological value of artificial barrens (e.g., sand pits). Advocate for protection and/or acquisition. Priority varies from low to high depending on SGCN/habitat in question.	<i>Andrena accepta</i> , <i>Andrena fulvipennis</i> , <i>Colletes americanus</i> , <i>Dieunomia heteropoda</i> , <i>Dieunomia nevadensis</i> , <i>Epimelissodes comptus</i> , <i>Protandrena aestivalis</i>	Medium
1.1	1 Development	1. Residential & Commercial Development		Important occurrence on private property	Educate and encourage landowner to set aside space for sand-nesting bees. High priority for <i>Cemolobus</i> , low priority for <i>Epeolus</i> .	<i>Cemolobus ipomoeae</i> , <i>Epeolus howardi</i>	Medium
3.2.3	3 Energy Production	3.2 Mining & Quarrying	3.2.3 Quarries & sand pits	Important occurrence on private property	Educate and encourage businesses to set aside space for sand-nesting bees. Priority varies from low to high depending on SGCN/habitat in question.	<i>Andrena accepta</i> , <i>Andrena fulvipennis</i> , <i>Coelioxys immaculatus</i> , <i>Colletes americanus</i> , <i>Dieunomia heteropoda</i> , <i>Dieunomia nevadensis</i> , <i>Epeolus howardi</i> , <i>Epeolus pusillus</i> , <i>Epimelissodes comptus</i> , <i>Lasioglossum sopinci</i> , <i>Protandrena aestivalis</i>	Medium
4.2.1	3 Energy Production	4.2 Utility & Service Lines	4.2.1 Power and service lines	Maintenance rights-of-way (ROWs) could harm host plants	Educate and encourage power company to reduce maintenance activities in specific area where bee was found.	<i>Macropis ciliata</i>	Medium
5.2.4	5 Bio Resource Use	5.2 Gathering Terrestrial Plants or Fungi	5.2.4 Poaching/eradication of terrestrial plants or fungi	Depend on plants often thought of as weeds	Advocate for leaving "weeds" (native thistles, <i>Ipomoea</i>) in areas where these bees are known to occur.	<i>Cemolobus ipomoeae</i> , <i>Osmia chalybea</i> , <i>Osmia texana</i>	Low
6.1.2	6 Human Intrusions	6.1 Recreational Activities	6.1.2 Hiking	Trampling on Erythronium (trout lilies)	Fence off large patches of trout lily where this bee species is known to occur.	<i>Andrena erythronii</i>	Low
7.3	7 Natural System Modifications	7.3 Other Ecosystem Modifications		Roadside mowing of nectaring and host plants	Create signage and mowing recommendations for nearby pollinator areas. Plant roadside wildflowers in certain areas to supplement pollinator habitat.	<i>Andrena helianthi</i> , <i>Andrena ziziae</i> , <i>Bombus affinis</i> , <i>Bombus terricola</i> , <i>Colletes nudus</i> , <i>Osmia texana</i> , <i>Paranthidium jugatorium</i>	High
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of (sandy) barren habitat due to vegetation succession	Conduct prescribed burns in targeted habitat areas, especially sandy coastal plain forests. Priority varies from low to high depending on SGCN/habitat in question, though it is high for most species.	<i>Lasioglossum arantium</i> , <i>Lasioglossum floridanum</i> , <i>Lasioglossum nymphale</i> , <i>Lasioglossum raleighense</i> , <i>Melissodes apicatus</i> , <i>Nomada rubicunda</i> , <i>Nomia maneei</i> , <i>Osmia felti</i> , <i>Perdita bradleyi</i> , <i>Protandrena abdominalis</i>	High
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of (sandy) barren habitat due to vegetation succession	Remove trees to open canopy in targeted habitat areas. Priority varies from low to medium depending on SGCN/habitat in question.	<i>Andrena accepta</i> , <i>Andrena fulvipennis</i> , <i>Colletes americanus</i> , <i>Dieunomia heteropoda</i> , <i>Dieunomia nevadensis</i> , <i>Epeolus howardi</i> , <i>Epeolus pusillus</i> , <i>Epimelissodes comptus</i> , <i>Protandrena aestivalis</i>	Medium

Appendix 6a. Species-level threats and actions (Inverts: Bees)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of (sandy) barren habitat due to vegetation succession	Where feasible, conduct prescribed burns in sandy coastal plain forests. Where burning is unfeasible, remove trees to open canopy instead. Priority is medium for <i>Coelioxys</i> and <i>Lasioglossum</i> , low for <i>Perdita</i> and <i>Sphecodes</i> .	<i>Coelioxys immaculatus</i> , <i>Lasioglossum sopinci</i> , <i>Perdita boltoniae</i> , <i>Sphecodes brachycephalus</i>	Medium
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Nonnative species out compete the hostplant <i>Geranium maculatum</i> .	Remove invasive species that threaten host and nectaring plants in important habitat areas. Priority varies from low to high depending on SGCN/habitat in question.	<i>Andrena distans</i> , <i>Andrena erythronii</i> , <i>Andrena geranii</i> , <i>Andrena lamelliterga</i> , <i>Andrena phaceliae</i> , <i>Bombus affinis</i> , <i>Bombus terricola</i> , <i>Colletes aestivalis</i> , <i>Macropis ciliata</i>	Medium
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive species are threats to <i>Zizia</i>	Augment existing populations of <i>Zizia</i> and encourage garden plantings.	<i>Andrena ziziae</i>	High
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive species compete with spring ephemerals	Remove invasive species (e.g., garlic mustard, lesser celandine, and other spring non-natives) where native wildflowers (e.g., <i>Arabis</i> , <i>Cardamine</i> , and <i>Dentaria</i>) are abundant. Survey garlic mustard for this bee; does its presence cause a population sink for this species?	<i>Andrena arabis</i>	Medium
8.2.2	8 Invasive and Problematic Species	8.2 Problematic Native Plants & Animals	8.2.2 Increased grazing by vertebrates	White-tailed deer	Locate native azaleas where this bee is known to occur and protect from deer browse with fencing.	<i>Andrena cornelli</i>	Medium
8.4.3	8 Invasive and Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens		Survey for non-native <i>Osmias</i> near native populations. Assess fungal threats from non-native <i>Osmias</i> .	<i>Osmia chalybea</i> , <i>Osmia felti</i> , <i>Osmia texana</i>	Low
8.4.3	8 Invasive and Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens	Pathogen spillover from domesticated bumblebees (<i>Nosema bombi</i>)	Increase regulations on shipment and screening of commercially reared bees.	<i>Bombus affinis</i> , <i>Bombus terricola</i>	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on <i>Oenothera</i>	Augment <i>Oenothera</i> in areas where this bee is known to occur.	<i>Epimelissodes comptus</i>	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on <i>Andrena gardineri</i> , which in turn depends on <i>Packera</i>	Augment <i>Packera</i> flowers in areas where this bee is known to occur.	<i>Nomada seneciophila</i>	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on vining beans like <i>Strophostyles</i>	Augment climbing beans in areas where this bee is known to occur.	<i>Nomia maneei</i>	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on <i>Monarda punctata</i>	Augment <i>Monarda punctata</i> populations and create signage and mowing recommendations for areas with <i>Monarda punctata</i> .	<i>Protandrena abdominalis</i>	Low
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on <i>Heuchera</i>	Augment existing populations of <i>Heuchera</i> and encourage garden plantings of non-cultivars.	<i>Colletes aestivalis</i>	Low

Appendix 6a. Species-level threats and actions (Inverts: Bees)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Depends on <i>Geranium maculatum</i>	Encourage garden plantings of non-cultivars of <i>Geranium maculatum</i> .	<i>Andrena distans</i>	Medium
9.3.1	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.1 Nutrient loads	Depends on extensive <i>Pontederia cordata</i> beds in healthy wetlands	Establish and advocate for larger wetland buffers.	<i>Melissodes apicatus</i>	Low
11.3.3	11 Climate Change	11.3 Changes in Temperature Regimes	11.3.3 Gradual temperature change	Range retraction likely due to increased temperatures	Remove invasive species threatening large populations of spring wildflowers.	<i>Bombus vagans</i>	Low
11.5.2	11 Climate Change	11.5 Storms & Severe Weather	11.5.2 Storm surges	Erosion of coastal dunes	Engage land managers in discussion regarding dune preservation. Priority is medium for <i>Lasioglossum georgeickworti</i> , low for all others.	<i>Andrena braccata</i> , <i>Colletes speculiferus</i> , <i>Epeolus pusillus</i> , <i>Lasioglossum georgeickworti</i> , <i>Lasioglossum nymphae</i>	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys for <i>Heuchera</i>	Survey for <i>Huchera</i> and this rare bee.	<i>Colletes aestivalis</i>	Low

Appendix 6a. Species-level threats and actions (Inverts: Tiger Beetles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Maintenance and expansion of power line rights-of-way (ROWs)	Work with ROW users on ways to mitigate disturbance.	Cow path tiger beetle, splendid tiger beetle	Low
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Utility traffic, herbicide application, rock blasting, and mowing on ROWs and utility roads.	Work with ROW users on ways to mitigate disturbance.	Common claybank tiger beetle, northern barrens tiger beetle	High
6.1.1	6 Human Intrusions	6.1 Recreational Activities	6.1.1 Motor vehicles	Use of all-terrain vehicles (ATVs) on sandy forest roads	Post signs and prosecute trespassers.	Eastern pinebarrens tiger beetle	Low
6.1.1	6 Human Intrusions	6.1 Recreational Activities	6.1.1 Motor vehicles	Use of ATVs on stream banks	Post signs and prosecute ATV use on the wrong trails.	Appalachian tiger beetle	Low
6.1.1	6 Human Intrusions	6.1 Recreational Activities	6.1.1 Motor vehicles	Vehicles on beach in southern Assateague Island National Seashore	Limit access to dunes for vehicles using fencing and signage.	Ghost tiger beetle, white tiger beetle	Low
6.1.2	6 Human Intrusions	6.1 Recreational Activities	6.1.2 Hiking	Mountain biking on trails damages nesting habitat	Expand habitat area away from trails.	Common claybank tiger beetle, cow path tiger beetle, northern barrens tiger beetle	High
6.1.3	6 Human Intrusions	6.1 Recreational Activities	6.1.3 Recreational use of cliffs and rock faces	Rock climbing in non-designated locations	Post signs and prosecute trespassers. Work with climbing groups to self-monitor. Discuss possibility of acquiring Haystack Mountain.	Common claybank tiger beetle, cow path tiger beetle, northern barrens tiger beetle	High
6.1.4	6 Human Intrusions	6.1 Recreational Activities	6.1.4 Recreational boating	Trampling of beaches from boaters	Post signage at boat ramps encouraging boaters to reduce disturbance of beaches. Conduct outreach to boating organizations.	Eastern beach tiger beetle, Puritan tiger beetle	Medium
7.3.1	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.1 Shoreline alteration	Shoreline hardening that destroys sand beaches and promotes the growth of vegetation on exposed cliff faces	Monitor shoreline hardening projects in Environmental Review (ER) closely. Do not let projects undergo development without Natural Heritage Program (NHP) involvement.	Eastern beach tiger beetle, Puritan tiger beetle	High
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of barren habitat due to vegetation succession	Conduct prescribed burns in targeted habitat areas.	Common claybank tiger beetle, cow path tiger beetle, eastern pinebarrens tiger beetle, northern barrens tiger beetle, splendid tiger beetle	High

Appendix 6a. Species-level threats and actions (Inverts: Tiger Beetles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of barrens habitat due to vegetation succession	Remove trees to open canopy in targeted habitat areas.	Common claybank tiger beetle, cow path tiger beetle, eastern pinebarrens tiger beetle, northern barrens tiger beetle	High
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Feral horse trampling and feeding in swales and dunes	Continue sterilization work to manage herd size at Assateague.	Ghost tiger beetle, white tiger beetle	Low
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive species along streams	Remove invasive plant species (e.g., Japanese knot weed and stiltgrass) along streams where this species is known to occur.	Appalachian tiger beetle	High
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive species covering cliffs	Spray herbicides on cliff faces where this species is known to occur.	Puritan tiger beetle	High
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive plant species along beaches	Remove invasive species (e.g., common reed [<i>Phragmites</i>]) along beaches with tiger beetle records.	Eastern beach tiger beetle	Medium
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Common reed (<i>Phragmites</i>)	Remove invasive species within swales behind dunes at Assateague.	Ghost tiger beetle, white tiger beetle	Low
8.5	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations		Lack of connectivity between populations means local extirpations could lead to larger declines	Move tiger beetles to adjacent habitat to increase the number of populations.	Eastern pinebarrens tiger beetle	Medium
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Application of mosquito adulticides	Work with the Maryland Department of Agriculture (MDA) to set guidelines for the use of mosquito control funds. Make mosquito control on private property opt-in instead of opt-out. Switch from adulticides to <i>Bacillus thuringiensis</i> (BT).	Eastern beach tiger beetle	Medium
11.4.1	11 Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.1 Overabundant rains	Increased floods causing washouts of silt bars	Consider trapping sediment in locations with extant populations.	Appalachian tiger beetle	Medium
11.5.2	11 Climate Change	11.5 Storms & Severe Weather	11.5.2 Storm surges	Beach erosion from sea-level rise and storm surges	Assess risks of sea-level rise and develop management plan for Assateague.	Ghost tiger beetle, white tiger beetle	High
11.5.2	11 Climate Change	11.5 Storms & Severe Weather	11.5.2 Storm surges	Beach erosion from sea-level rise and storm surges	Assess risks of sea-level rise and develop management plan to conserve beaches without harming habitat.	Eastern beach tiger beetle, Puritan tiger beetle	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Assess Severn River populations after the shoreline hardening event from 2021.	Puritan tiger beetle	High

Appendix 6a. Species-level threats and actions (Inverts: Tiger Beetles)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Conduct surveys around current known locations in order to locate additional populations.	Appalachian tiger beetle, eastern beach tiger beetle, eastern pinebarrens tiger beetle	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	(Continue to) conduct surveys on lands with known populations.	Common claybank tiger beetle, ghost tiger beetle, white tiger beetle	Low

Appendix 6a. Species-level threats and actions (Inverts: Fireflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1.3.2	1 Development	1.3 Tourism & Recreation Areas	1.3.2 Campgrounds	Assateague campground abutting swales with large numbers of fireflies	Fence off swales near campground at Assateague.	Bethany Beach firefly	Low
7.2.1	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.1 Water level management using dams	Reduced or increased flow rates across scour areas	Engage with dam managers to discuss outflow and other conservation possibilities.	Potomac firefly	Medium
7.2.5	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.5 Drainage in forest environments	Ditching impeding natural hydrology	Remove ditches from areas near Atlantic white cedar in order to restore natural hydrology.	Mysterious lantern firefly	Medium
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Feral horse trampling and feeding in swales	Fence off high-quality swales with firefly occurrences. Continue sterilization work to manage herd size at Assateague.	Bethany Beach firefly	Low
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive plants in high-quality forested peatland habitats	Remove invasive species within forested peatlands at Assateague.	Mysterious lantern firefly	Low
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Invasive species on river scour ecosystems	Remove invasive species along river scour islands.	Potomac firefly	High
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Common reed (<i>Phragmites</i>)	Remove <i>Phragmites</i> in high-quality saltmarsh areas.	Keel-necked firefly, salt marsh firefly	Medium
8.1.2	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.2 Terrestrial plants	Common reed (<i>Phragmites</i>)	Remove invasive species (especially <i>Phragmites</i>) within swales at Assateague.	Bethany Beach firefly	Low
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Potential future use of adulticide pesticides to control mosquitoes	Advocate for no use of pesticides in sensitive habitat areas.	Keel-necked firefly, mysterious lantern firefly, salt marsh firefly	Low
9.6.1	9 Pollution	9.6 Excess Energy	9.6.1 Light pollution	Light pollution around campsite and roads	Advocate for reduced lighting near swales at Assateague.	Bethany Beach firefly	Low
11.1.1	11 Climate Change	11.1 Habitat Shifting & Alteration	11.1.1 Changes in vegetation communities	Loss of ice scour allows for increased tree growth and canopy closure	Cut river scour trees that are becoming overgrown at targeted locations (e.g., maples and sycamores).	Potomac firefly	High
11.5.1	11 Climate Change	11.5 Storms & Severe Weather	11.5.1 Storms & severe weather	Open canopy due to storm felled trees	Replant felled trees in targeted areas, especially Atlantic white cedar.	Mysterious lantern firefly	Low

Appendix 6a. Species-level threats and actions (Inverts: Fireflies)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
11.5.2	11 Climate Change	11.5 Storms & Severe Weather	11.5.2 Storm surges	Beach erosion from sea-level rise and storm surges	Assess risks of sea-level rise and develop management plan, especially for Assateague.	Bethany Beach firefly, keel-necked firefly, salt marsh firefly	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Train biologists on firefly identification.	Keel-necked firefly, mysterious lantern firefly, salt marsh firefly	High

Appendix 6a. Species-level threats and actions (Inverts: Aquatic Orders, or EPT)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1.1.1	1 Development	1.1 Housing & Urban Areas	1.1.1 Dense housing & urban areas	Expansion of apartments near habitat	Ensure that construction near water avoids harming stream through silt or chemical runoff. Avoid cutting trees in order to help with this.	Lobed stone	Low
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	15-Mile Creek Watershed at risk from possible development	Acquire property directly or through easement(s). Conduct surveys to locate any rare species in the area.	Dusky sallfly, lash springfly, Shenandoah sallfly	Low
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Maintenance and expansion of power line rights-of-way (ROWs)	Create a conservation agreement regarding mowing and herbicide use.	Variable needelfly	Medium
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Maintenance and expansion of power line rights-of-way (ROWs)	Work with power companies to avoid impacts to small streams that cross ROWs.	Shenandoah sallfly	High
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Construction of transmission corridors in western Maryland wildlands affecting hydrology	Challenge improper land use in court. Work with developers to site transmission lines outside of vulnerable drainage basins.	Lash springfly, Shenandoah needelfly	Medium
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession	Woody plant encroachment reducing size of open bog	Remove encroaching woody plants in sensitive habitat areas.	Variable needelfly	High
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Hemlock wooly adelgid (HWA)	Continue release of <i>Laricobius nigrinus</i> in targeted areas.	Pocahontas sallfly, Shenandoah needelfly	Low
9.1.2	9 Pollution	9.1 Domestic & Urban waste water	9.1.2 Runoff		Work with Prince George's County to target runoff reductions in and around important habitat area(s).	Variable needelfly	Medium
9.3	9 Pollution	9.3 Agricultural & Forestry Effluents		Agricultural runoff near streams	Work with farmers to reduce runoff entering nearby stream(s).	Lobed stone, vernal springfly	Low
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Use of mosquito adulticides	Engage neighborhood near known location(s) regarding ecologically safe mosquito reduction tactics.	Variable needelfly	Medium

Appendix 6a. Species-level threats and actions (Inverts: Cave and Groundwater)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	Development in catchment basin(s)	Acquire springs and surrounding areas where these species are known to occur. Prevent runoff from entering springs. Medium priority for <i>Stygobromus paxillus</i> , low for all others.	<i>Paraplanaria dactyligera</i> , <i>Stygobromus caecilius</i> , <i>Stygobromus felleri</i> , <i>Stygobromus foliatus</i> , <i>Stygobromus gracilipes</i> , <i>Stygobromus indentatus</i> , <i>Stygobromus paxillus</i>	Low
3.2.3	3 Energy Production	3.2 Mining & Quarrying	3.2.3 Quarries & sand pits	Sand and silt filling up spring from nearby mine	Communicate with landowner regarding threat. Work to prevent the flow of silt into spring.	<i>Paraplanaria dactyligera</i> , <i>Stygobromus caecilius</i>	Medium
4.2.1	4 Transportation	4.2 Utility & Service Lines	4.2.1 Power and service lines	Construction of transmission corridors in western Maryland wildlands affecting hydrology	Challenge improper land use in court. Work with developers to site transmission lines outside of vulnerable drainage basins.	<i>Caecidotea franzi</i> , <i>Sphalloplana buchanani</i> , <i>Stygobromus amicus</i>	Medium
8.5.2	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Species may rely on waste from declining mammal species	Assess threat of declining mammals and their waste.	<i>Caecidotea alleghenyensis</i> , <i>Caecidotea franzi</i> , <i>Crangonyx dearolfi</i> , <i>Pseudobaicalasellus holsingeri</i> , <i>Sphalloplana buchanani</i> , <i>Stygobromus amicus</i> , <i>Stygobromus emarginatus</i>	Low
9.1.2	9 Pollution	9.1 Domestic & Urban waste water	9.1.2 Runoff	Yard chemicals, road salt, pet waste	Work to reduce runoff entering spring(s).	<i>Stygobromus kenki</i> , <i>Stygobromus sextarius</i>	High
9.3.1	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.1 Nutrient loads	Nutrient pollution from agriculture in drainage basins	Acquire vulnerable locations in drainage basins. Protect springs and caves by filtering drainage basin through techniques such as increasing vegetation and structural elements.	<i>Caecidotea alleghenyensis</i> , <i>Conasellus pricei</i> , <i>Crangonyx dearolfi</i> , <i>Proctyla typhlops</i> , <i>Pseudobaicalasellus holsingeri</i> , <i>Sphalloplana hoffmasteri</i> , <i>Sphalloplana pricei</i> , <i>Stygobromus amicus</i> , <i>Stygobromus biggersi</i> , <i>Stygobromus emarginatus</i> , <i>Stygobromus pizzinii</i>	Low
9.3.2	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.2 Soil erosion, sedimentation	Sediment pollution	Reforest around particular spring edge to reduce sedimentation in the spring.	<i>Stygobromus gracilipes</i>	Medium
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Hemlock wooly adelgid (HWA) pesticides near springs	Advise on where trunk application should be used (instead of drenching) for HWA.	<i>Proctyla typhlops</i> , <i>Sphalloplana buchanani</i> , <i>Stygobromus amicus</i>	High
9.4.1	9 Pollution	9.4 Garbage & Solid Waste	9.4.1 Garbage	Littering of mine shaft	Post signage to prevent littering in sensitive habitat areas.	<i>Caecidotea franzi</i>	High
9.4.1	9 Pollution	9.4 Garbage & Solid Waste	9.4.1 Garbage	Littering of mine shaft	Remove existing trash and post signage to prevent further littering in/around particular habitat area. Maintain gate to prevent entry. Priority varies from low to high depending on SGCN.	<i>Conasellus pricei</i> , <i>Pseudobaicalasellus mausi</i> , <i>Pseudobaicalasellus vandeli</i> , <i>Sphalloplana hoffmasteri</i> , <i>Stygobromus pizzinii</i>	Medium

Appendix 6a. Species-level threats and actions (Inverts: Cave and Groundwater)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
11.4.1	11 Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.1 Overabundant rains	Silt backing up into mine pool from Potomac	Work with National Park Service (NPS) to prevent flooding of the mine where this species is known to occur.	<i>Pseudobaicalasellus mausi</i>	Medium

Appendix 6a. Species-level threats and actions (Inverts: Other)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
1	1 Development	1. Residential & Commercial Development		Important occurrence on private property	Educate and encourage landowner to set aside space for reindeer lichen.	A tenebrionid beetle (<i>Schoenicus puberulus</i>)	High
1.1.1	1 Development	1.1 Housing & Urban Areas	1.1.1 Dense housing & urban areas	Many occurrences in unprotected forest remnants near development	Establish environmental easements in unprotected forest pockets where this species is found.	Painted wood fly (<i>Blera pictipes</i>)	Low
1.1.2	1 Development	1.1 Housing & Urban Areas	1.1.2 Low-density housing areas	Chance of expanding adjacent residential neighborhood	Acquire land or establish easment(s) where this species is found.	Seth Forest water scavenger beetle (<i>Hydrochus spangleri</i>)	Medium
1.2.1	1 Development	1.2 Commercial & Industrial Areas	1.2.1 Commercial & industrial areas	Development in/near known habitat	Rank and possibly list this species	Riley's 13-year cicada (<i>Magicicada tredecim</i>)	High
5.2.4	5 Bio Resource Use	5.2 Gathering Terrestrial Plants or Fungi	5.2.4 Poaching/eradication of terrestrial plants or fungi	Collection of pitcher plants	Monitor The Nature Conservancy (TNC) site for pitcher plant poachers.	Purple pitcher plant flesh fly (<i>Fletcherimyia fletcheri</i>), pitcher plant midge (<i>Metriocnemus knabi</i>), pitcher plant mosquito (<i>Wyeomyia smithii</i>), pitcher plant mite (<i>Sarraceniopus gibsoni</i>)	High
5.3.1	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.1 Complete removal of the forest cover	Removal of tree cover around vernal pools	Locate and map vernal pools and delmarva bays so that they can be protected and surveyed. Prevent Chesapeake forest land logging adjacent to vernal pools.	A dytiscid beetle (<i>Hoperius planatus</i>), Seth Forest water scavenger beetle (<i>Hydrochus spangleri</i>)	Medium
5.3.2	5 Bio Resource Use	5.3 Logging & Wood Harvesting	5.3.2 Partial removal of the forest cover	Harvesting forest stands with known occurrences using heavy equipment compacts soil	Consult Maryland Forest Service about circumventing dunes at Pocomoke site to enter logging area.	A tenebrionid beetle (<i>Helops cisteloides</i>)	High
6.1.2	6 Human Intrusions	6.1 Recreational Activities	6.1.2 Hiking	Disturbance of the thin soil layer supporting <i>Eleocharis</i> harmed by foot traffic	Place fences preventing access to <i>Limotettix</i> areas.	Eastern sedge barrens leafhopper (<i>Limotettix minuendus</i>)	High
7.1.1	7 Natural System Modifications	7.1 Fire & Fire Suppression	7.1.1 Increase in the fire regime	Burn blocks that are too large threaten leafhoppers	Create burn block rotations so as to avoid burning population area all at once.	Eastern sedge barrens leafhopper (<i>Limotettix minuendus</i>)	Medium
7.2.5	7 Natural System Modifications	7.2 Dams & Water Management / Use	7.2.5 Drainage in forest environments	Draining of vernal pools and Delmarva bays with ditches	Plug ditches that drain temporary pools.	A dytiscid beetle (<i>Hoperius planatus</i>), Seth Forest water scavenger beetle (<i>Hydrochus spangleri</i>)	High
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession	Virginia pine and <i>Smilax</i> covering fields	Open up canopy with selective tree removal and prescribed burns, as appropriate.	Eastern sedge barrens leafhopper (<i>Limotettix minuendus</i>)	High

Appendix 6a. Species-level threats and actions (Inverts: Other)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
7.3.2	7 Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.2 Vegetation succession	Woody plant encroachment reducing size of open bog	Remove encroaching woody plants from important habitat areas.	Pitcher plant mite (<i>Sarraceniopus gibsoni</i>)	High
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of barrens habitat due to vegetation succession	Conduct prescribed burns in important dune and barren habitat areas.	A tenebrionid beetle (<i>Helops cisteloides</i>), a tenebrionid beetle (<i>Schoenicus puberulus</i>)	High
7.4.1	7 Natural System Modifications	7.4 Removing / Reducing Human Maintenance	7.4.1 Reducing or ceasing vegetation control	Loss of barrens habitat due to vegetation succession	Conduct targeted removal of trees at important habitat area.	A tenebrionid beetle (<i>Schoenicus puberulus</i>)	High
8.1.1	8 Invasive and Problematic Species	8.1 Invasive Non-Native / Alien Plants & Animals	8.1.1 Terrestrial animals	Emerald ash borer (EAB)	Assess threat of EAB to these species. Can these species survive off of ash resprouts? Survey ash for these species. Priority is high for <i>Colobopsis</i> , medium for all others.	A carpenter ant (<i>Colobopsis mississippiensis</i>), ash bullet gall midge (<i>Dasineura pellex</i>), swollen ash gall midge (<i>Dasineura tumidosae</i>), fringetree lace bug (<i>Leptopypha mutica</i>), a sh leaf gall mite (<i>Aceria fraxini</i>), ash flower gall mite (<i>Aceria fraxiniflora</i>), ash key gall mite (<i>Aceria fraxinivora</i>), blackheaded ash sawfly (<i>Tethida barda</i>), encircled borer (<i>Agrilus subcinctus</i>), Charlie Brown's flea beetle (<i>Capraita sexmaculata</i>), eastern ash bark beetle (<i>Hylesinus aculeatus</i>), an ash seed weevil (<i>Lignyodes bischoffi</i>), an ash seed weevil (<i>Lignyodes fraxini</i>), an ash seed weevil (<i>Lignyodes helvolus</i>), an ash seed weevil (<i>Lignyodes horridulus</i>)	Medium
8.5	8 Invasive and Problematic Species	8.5 Intrinsic Biological Limitations		Lack of connectivity between populations means local extirpations could lead to larger declines	Relocate leafhoppers from high population areas to low population areas.	Eastern sedge barrens leafhopper (<i>Limotettix minuendus</i>)	Medium
9.1.2	9 Pollution	9.1 Domestic & Urban waste water	9.1.2 Runoff		Work with Prince George's County to target runoff reductions in and around important habitat area(s).	Pitcher plant mite (<i>Sarraceniopus gibsoni</i>)	Medium

Appendix 6a. Species-level threats and actions (Inverts: Other)

PART 1: THREATS					PART 2: ACTIONS		
IUCN Code	IUCN Level 1	IUCN Level 2	IUCN Level 3	Further Threat Description (if needed)	Conservation Action (WHAT)	Associated Species	Action Priority (Threat Impact x Action Urgency)
9.3.3	9 Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Herbicide use in power line rights-of-way (ROWs)	Outline conservation areas to avoid herbicide use.	Purple pitcher plant flesh fly (<i>Fletcherimyia fletcheri</i>), pitcher plant midge (<i>Metriocnemus knabi</i>), pitcher plant mosquito (<i>Wyeomyia smithii</i>), pitcher plant mite (<i>Sarraceniopus gibsoni</i>)	High
11.1.1	11 Climate Change	11.1 Habitat Shifting & Alteration	11.1.1 Changes in vegetation communities	Replacement of hardwoods with loblolly pine in eastern Maryland	Selectively log/remove loblollies in order to promote hardwood reestablishment.	A dytiscid beetle (<i>Hoperius planatus</i>)	Medium
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Survey pitcher plant contents for these species.	Purple pitcher plant flesh fly (<i>Fletcherimyia fletcheri</i>), pitcher plant midge (<i>Metriocnemus knabi</i>), pitcher plant mosquito (<i>Wyeomyia smithii</i>)	High
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys	Conduct blacklight surveys at other locations with reindeer lichen in order to survey for this species.	A tenebrionid beetle (<i>Schoenicus puberulus</i>)	Low
12.2	12 Other Options	12.2 Resource Needs	Resource information collection needs	Lack of surveys in other possible occurrence areas	Conduct surveys in other serpentine barrens.	Eastern sedge barrens leafhopper (<i>Limotettix minuendus</i>)	High