



Chapter 5

Threats to Maryland's Species and Their Habitats





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Introduction

Many challenges confront our native fish, wildlife, and plant populations and the places they need to survive. Threats to these populations can be local, statewide, regional, national, or global in scale. They may be direct, affecting a species or habitat directly, or indirect, affecting a species or habitat through one or more intermediary actors or processes. Some threats are the direct result of human activities; others take the form of more natural processes. Threats can also manifest in the absence of something rather than its presence. For example, lack of sufficient legal protection for a vulnerable species or habitat can be just as damaging as more “traditional” threats such as pollution, resource extraction, and climate change. The same can be said for other “scarcities,” including inadequate or ineffective coordination between agencies, insufficient data for many species and their habitats, and inadequate funding to deal with the numerous threats.

This chapter identifies these threats to Maryland’s Species of Greatest Conservation Need (SGCN) and their associated key wildlife habitats (KWHs), whether they be local or global in scale, direct or indirect, natural or artificial, or problematic in presence or absence. This chapter provides information about key threats (**Element #3**) identified by the Maryland Department of Natural Resources (MD DNR) and its partners. The subsequent chapter then describes conservation actions (**Element #4**) to address these threats in Maryland and the other states of the Northeast region. The content of these two chapters was co-developed throughout the State Wildlife Action Plan (SWAP or Plan) revision process, as Maryland developed its SWAP so that every threat has a specific associated action. However, they have been split into separate chapters for the sake of organization.

The chapter begins with a brief explanation as to how Maryland updated its list of threats and actions for the 2025 SWAP revision. Then, the comprehensive threat classification system used by all 14 Northeast states is explained. Finally, state and regional priority threats are highlighted at the end of the chapter. In the interest of saving space, species- and habitat-specific threats are not included in the text of this chapter. The full list of threats and their associated actions can be found in Appendices 6a and 6b. An overview of species group-specific threats and actions can also be found in the text of Chapter 3.

Threats in the 2025 SWAP Revision

After updating the SGCN list, one of the first steps in revising Maryland’s SWAP was reviewing, editing, and adding to the list of threats and actions from the previous 2015 SWAP revision. This needed to be done for both SGCN-specific and KWH-specific threats and actions. Throughout 2025, nearly 150 people contributed to the SGCN-specific list and 100 to the KWH-specific list, though there is some overlap between the two groups. These groups included MD DNR staff, other government organization staff, partner organization staff, academics, community scientists, and more. For a more comprehensive overview of partner participation in the SWAP revision process, please see Chapter 8. For a full list of which organizations participated in Maryland’s 2025 SWAP revision, see Appendix 8a.

MD DNR and its partners combed through every threat and associated action listed in the 2015 SWAP revision, flagging those that were completed, in need of revision, or no longer appropriate. After needed updates and removals were made, staff and partners worked together to “fill in the gaps” by referring to various resources that have been made available since the



2015 SWAP revision. This included academic literature, non-governmental organization (NGO) and government reports, datasets and data analysis results, recent regulations, and much more. Staff and partners then worked to incorporate these emerging or previously overlooked concerns into the 2025 SWAP, either by combining them with existing threat–action pairs or creating new line items. This resulted in two updated sets of threats and actions—one for SGCN, one for KWHs—that can be found in Appendices 6a and 6b, respectively.

Though spearheaded by MD DNR, the Department made efforts to conduct these updates in a collaborative manner. Threats and actions in the 2025 SWAP revision are therefore the result of many hours of discussion involving both partners and staff. Although much of the resulting work can be found in Appendices 6a and 6b, these frequent meetings, workshops, and other forms of contact between MD DNR and its partners highlighted a number of topics that came up repeatedly over the course of the revision process. This chapter therefore pays special attention to these topics; they are further discussed in the “Priority Threats for Maryland” section.

Threat Classification System

Following the development of the 2015 SWAPs, the *Northeast State Wildlife Action Plan Synthesis: Regional Conservation Priorities* report synthesized the threats to both species and habitats identified in the 14 individual SWAPs (TCI & NEFWDC 2017). The Conservation Measures Partnership (CMP) and the International Union for Conservation of Nature (IUCN) have developed several threat classification systems, which were advanced by Lamarre et al. (2021) for use in Quebec. The classification system used in the Northeast states’ 2025 SWAP revisions is heavily based upon these works, with some modifications that include relevant threats for the Northeast.

Maryland uses this classification system to categorize threats facing its species and habitats. When possible, all threats are categorized using a three-level approach. The first, Level 1, broadly categorizes the threat into one of 12 categories. The second, Level 2, is slightly more specific, breaking the broad Level 1 category into more specific sub-categories. The third, Level 3, allows for an even higher degree of specificity. Every threat listed in Appendices 6a and 6b has a corresponding “IUCN Code” according to this system. Further threat descriptions are occasionally included for clarity, but in most cases, this three-level approach is sufficient to properly articulate threats to species or habitats.

The following text is taken almost directly from this classification system, as recommended in the 2022 Northeast Lexicon (Crisfield & NEFWDC 2022). Not all threat categories or subcategories are relevant to Maryland—for example, category 10, “Geological Events”—but have been included in the text for the sake of accuracy. The only modification Maryland made to this classification system is the reinstatement of sub-categories for category 12, “Other Options.” This is because Maryland’s 2025 SWAP revision contains many threats that fall under this category, and it was felt that a higher degree of categorization was needed. These additions are marked below with an asterisk.

Category 1: Residential & Commercial Development

This threat category refers to all human settlements (cities, towns, etc.) or non-agricultural land uses with a substantial ecological footprint. It includes habitat conversion that is associated with



early phases of development (deforestation, filling/excavation, drainage, etc.), as well as infrastructure use, maintenance, and subsequent impacts that are related to the presence of infrastructure (e.g., birds flying into windows). This category excludes issues related to transportation (threat 4) and pollution (threat 9).

1.1 Housing & Urban Areas: Anything that is related to or integrated with urban or housing structures. Includes urban areas (cities), suburbs, villages, cottages, shopping areas, offices, schools, hospitals, and urban parks, among others.

1.1.1 Dense housing & urban areas: Medium- to high-density urban development for residential use and buildings for related services. Allows very little to no maintenance of ecological functions. E.g., urban areas, suburbs, villages, schools, libraries, seniors' housing, hospitals.

1.1.2 Low-density housing areas: Extensive development that is residential (including resorts), where the spacing allows ecological functions to continue to some extent. This type of development is seen particularly in rural and agroforestry areas. E.g., residential buildings in agricultural areas, cottages, vacation homes near water bodies, ecotourism lodges, fishing resorts, backcountry ski lodges.

1.2 Commercial & Industrial Areas: Anything that is related to or integrated with commercial or industrial structures, as well as designated areas for storing waste material. Includes animal deterrence activities, which are needed near certain infrastructures.

1.2.1 Commercial & industrial areas: E.g., industrial parks, manufacturing plants, offices, shopping centers, all military base facilities, power plants, seaports, shipyards, airports.

1.2.2 Open dump sites: Open-air facilities that are used to dispose of materials or to store them prior to recycling. E.g., automobile junkyards, metal recycling centers.

1.2.3 Landfills

1.2.4 Nuclear waste disposal facilities

1.3 Tourism & Recreation Areas: Tourist sites or recreational facilities with a significant ecological footprint. Excludes residential infrastructures (threat 1.1).

1.3.1 Parks and sports fields: Areas that are intensively managed (e.g., grass-cutting, thinning of woodlands) and are primarily designed for recreation activities, such as walking in urban parks and sports. Also includes outdoor sites that are managed for prayer or mourning (cemeteries). E.g., large spaces that are mown/maintained for walking, picnics, children's activities, mourning (cemeteries), golf courses, driving ranges, shooting ranges, sports fields/courts.

1.3.2 Campgrounds: Sites that are maintained for camping activities, for which the facilities may have some ecological impact. To be distinguished from wilderness camping without amenities (threat 6.1.5). E.g., car or RV camping areas, with or without services; camping with site management and/or facilities.

1.3.3 Ski resorts: Rights-of-way of ski trails (managed areas of the hills) and service facilities (ski lifts, visitor centers, etc.).



- 1.3.4 Recreational trails:** Creation of trails in parks (see Parks and sports fields, threat 1.3.1) or areas outside the urban environment for walking and recreation. Includes the creation and maintenance of trails in recreational parks as well as private properties. Excludes activities that are related to the use of the trail (e.g., hiking, threat 6.1.2).
- 1.3.5 Docks & marinas:** High-impact infrastructures that are associated with recreational boating. To be distinguished from the activity of recreational boating itself (threat 6.1.4) and includes local dredging. E.g., docks, marinas, boat launches.

Category 2: Agriculture & Aquaculture

This threat category encompasses threats from agricultural activities, such as the expansion and intensification of agriculture and livestock farming, including silviculture, mariculture, and aquaculture, and related infrastructures. This includes the initial conversion of habitat (deforestation, filling/excavation, draining of wetlands, etc.) that is associated with cultivation or infrastructure development, as well as uses and practices (intensification of agricultural practices, use of machinery, etc.), but not the transport of the resources that are produced (threat 4), crop irrigation (threat 7.2.4), or pollution (threat 9.3).

- 2.1 Annual & Perennial Non-Timber Crops:** Non-timber crops that are planted for food, fodder, fuel, or other uses; farms, crop fields, vineyards, mixed agroforestry systems, etc. For rotational crops, it is necessary to refer to the most intensive practice that is used. Considering the diversity of agricultural practices and related impacts, some specialty cultures will be pooled into a generic threat category (2.1.3).
- 2.1.1 Annual cropping systems (field crops):** Wide-row crops that require the most intensive agricultural practices and which have the most significant impacts. E.g., maize (corn), soybean, barley, vegetable crops, oats, wheat, canola, hemp.
- 2.1.2 Perennial cropping systems:** Crops that are associated with less intensive agricultural practices that have less of an ecological impact than do annual crops. E.g., pastures, forage crops, hay, alfalfa, clover.
- 2.1.3 Other types of agriculture:** Specialty crops for which the ecological impacts may vary depending on the practices that are used. E.g., cranberry bogs, vineyards, berry fields, sod production, greenhouse farming.
- 2.2 Plantations:** Wood plantations that produce timber, fiber, or other non-timber products that are made from trees and which maintain a certain amount of forest cover year-round. This type of plantation is generally located outside of natural forests and often consists of non-native tree species.
- 2.2.1 Plantation of pulpwood:** Cultivation of hybrid poplars and other species that are used for pulp production.
- 2.2.2 Ornamental tree plantations:** E.g., cultivation of ornamental cedars, Christmas tree farms.
- 2.2.3 Non-timber products from plantations:** Cultivation of trees outside of natural forests for the production of fruits, nuts, bark or sap. E.g., orchards, walnut production, rubber production.



2.3 Livestock & Poultry Farming: Farming of various domestic (cows, pigs, chickens, sheep, goats, turkeys, ducks, etc.) or semi-domesticated animals (llamas, alpacas, etc.); livestock rearing in outdoor pens (farms) or extensive rearing in natural habitat (pastures, ranching).

2.3.1 Outdoor extensive livestock operation (on pasture)

2.3.2 Outdoor intensive livestock operation (high-density)

2.3.3 Indoor livestock operation

2.4 Marine & Freshwater Aquaculture: Aquaculture that is conducted in different types of facilities (finfish aquaculture in the ocean, in tanks, in pens, along the shoreline, etc.). Farming fish for the purpose of stocking natural lakes falls under this category. It also includes the construction, maintenance, and use of facilities, but not the transport of resources (threat 4) and contaminants (threat 9).

2.4.1 Marine finfish aquaculture

2.4.2 Finfish aquaculture in outdoor tanks

2.4.3 Finfish aquaculture in indoor tanks

2.4.4 Algae cultivation

2.4.5 Marine shellfish cultivation

Category 3: Energy Production & Mining

This threat category encompasses threats from the production/development of non-biological resources, including the conversion of the original habitat, development of necessary infrastructure, and associated uses and practices (use of machinery, exploration, excavation, drilling and storage of ore or drill cuttings, tailings ponds, settling ponds, site reclamation after development, etc.). It excludes the transport of resources (threat 4) and contaminants (threat 9). This category also includes the impacts of wildlife collisions with the related infrastructures, such as wind turbines.

3.1 Oil & Gas Drilling: Exploring for, developing, and producing petroleum or other hydrocarbons.

3.1.1 Onshore oil development

3.1.2 Offshore oil development

3.1.3 Oil development in freshwater

3.1.4 Onshore natural gas development

3.1.5 Offshore natural gas development

3.1.6 Natural gas development in freshwater

3.2 Mining & Quarrying: Exploring for, developing, and producing minerals, rocks, and various other substrates (sand, gravel, etc.). Includes tailings treatment (settling and tailings ponds), site expansion, and site reclamation after development. E.g., coal mines, mining of various sources of metals (gold, copper, nickel, magnesium, etc.), quarries,



sand pits. Peat harvesting is also included in this category. This threat does not include the transportation of resources (threat 4) and acid mine drainage (threat 9.2.2).

3.2.1 Underground mines

3.2.2 Open-pit mines

3.2.3 Quarries & sand pits

3.2.4 Peat harvesting

3.2.5 In-stream mining

3.2.6 Near-shore & off-shore mining

3.3 Renewable Energy: Exploring, developing infrastructure for, and producing renewable energy; excludes its transport (threat 4).

3.3.1 Hydroelectric dams

3.3.2 Wind farms

3.3.3 Hydrokinetic turbines

3.3.4 Solar farms

Category 4: Transportation & Service Corridors

This threat category includes threats from developing, using, and maintaining transportation corridors (roads, pipelines, power lines, etc.) and their rights-of-way. These types of facilities may create obstacles or hinder the natural movement of species in addition to causing disturbances during maintenance (e.g., disturbance of falcon nests during bridge maintenance). This threat also includes vegetation control during rights-of-way maintenance, as well as collisions with wildlife.

4.1 Roads & Railroads: Development, maintenance, and presence of the surface transportation network. The impact of rights-of-way may vary according to their size.

4.1.1 Roads

4.1.2 Railroads

4.1.3 Bridges: Includes road and rail network bridges.

4.1.4 Logging roads

4.2 Utility & Service Lines: Linear networks for transporting energy and various resources, including their rights-of-way. Possible impacts include electrocution, barrier to dispersal, habitat modification/loss, and fatal collisions.

4.2.1 Power & service lines: Networks of buildings, towers, pylons, and poles that are associated with electricity distribution and telecommunications, excluding hydroelectric dams or power plants (threat 3.3.1). The scope of rights-of-way may vary according to their size.

4.2.2 Oil & gas pipelines: Infrastructure network for transporting oil and natural gas products aboveground or underground, including seismic lines, but excluding extraction sites (threat 3.1).



4.3 Shipping Lanes: Threats associated with transporting people and goods on water (oceans, estuaries, rivers, etc.), as well as waterway development. This category does not include activities that are related to recreational boating (threat 6.1.4).

4.3.1 Shipping: Ships striking wildlife, damage associated with wake waves, disturbance caused by the presence of vessels transporting people and goods.

4.3.2 Dredging of shipping lanes: Dredging in order to facilitate the transit of boats. Excludes dredging within marinas and docks (threat 1.3.5) and dredging for locks and canals (threat 4.3.3).

4.3.3 Locks & canals: Creation, maintenance, and use of locks and canals. Includes the associated dredging.

4.4 Flight Paths: Using air space to transport people and goods, excluding recreational activities such as hang-gliding (threat 6.1.3) and drones (threat 6.1.6).

4.4.1 Flight paths: Flying airplanes, paragliders, helicopters, or ultralight aircraft at low altitudes, which could lead to collisions with birds or disturbance of other wildlife. E.g., disturbance of wildlife by low-altitude training flights.

Category 5: Biological Resource Use

This category encompasses threats that are due to the use/consumption of wild biological resources, including the impacts of legal, illegal, and unintentional harvesting. The disturbance and control of certain species fall under this threat category, which includes habitat conversion and degradation, the development of related infrastructure, and the uses and practices that are associated with the latter (e.g., use of machinery, wood storage, soil management). Excludes the transport of resources (e.g., logging roads, threat 4.1.4) and peat harvesting (threat 3.2.4).

5.1 Hunting & Collecting Terrestrial Animals: Hunting animal species or collecting animal products for commercial, recreational, subsistence, cultural, or control purposes. Includes hunting terrestrial species and trapping semi-aquatic species. This category also covers incidental captures, control, and persecution, but excludes harvesting for research purposes (threat 6.3.1).

5.1.1 Hunting: Harvesting of wild animal species by hunting for recreation or subsistence that is governed by management measures. Includes incidental killing, but illegal harvesting or killing is classified under “Poaching/Persecution of terrestrial animals” (threat 5.1.4). Excludes contamination of habitats due to solid lead from hunting ammunition (threat 9.4.2). E.g., hunting with firearms, bows or crossbows, or blunt objects for sport or subsistence, taxidermy, trophies.

5.1.2 Trapping: Harvesting of wild terrestrial or semi-aquatic animal species (e.g., beavers) by trapping that is governed by management measures. Includes incidental killing, but animal control by trapping is classified under “Management/control of terrestrial animals” (threat 5.1.5). E.g., trapping of wild terrestrial or semi-aquatic animals for fur, meat, taxidermy, trophies, non-target birds of prey caught in traps.

5.1.3 Non-lethal harvesting of terrestrial animal products: Harvesting of terrestrial animal products that does not require the killing of individuals and that is governed by management measures. E.g., down collection, guano collection.



5.1.4 Poaching/persecution of terrestrial animals: Illegal harvesting of terrestrial animals or animal products (e.g., feathers) for personal, commercial, or persecution purposes, or actions that would be interpreted as abuse or harassment of wildlife. E.g., hunters killing coyotes or birds of prey, people deliberately harming snakes out of fear, illegal collection of seabirds or shorebird egg collection, illegal wildlife trade for skins, meat, or the pet trade.

5.1.5 Management/control of terrestrial animals: Deliberately killing individuals of a terrestrial species for human gain that is governed by management measures. E.g., cormorant culling.

5.2 Gathering Terrestrial Plants or Fungi: Harvesting and gathering wild plants, mushrooms, or other non-animal/non-timber species for commercial, recreational, subsistence, cultural, or control purposes, but excludes research (threat 6.3.1).

5.2.1 Recreational or subsistence harvesting: Harvesting of plant or fungi species that has a lethal effect on the individual and is governed by management measures. Illegal harvesting is classified as “Poaching/eradication of terrestrial plants or fungi” (threat 5.2.4). E.g., recreational or subsistence harvesting of wild leeks.

5.2.2 Commercial harvesting: Commercial harvesting of plants or fungi species that has a lethal effect on the individual and is governed by management measures. Excludes peat harvesting (threat 3.2.4) and products from plantations (threat 2.2). E.g., commercial harvesting of fiddleheads.

5.2.3 Non-lethal harvesting of terrestrial plant products: Sub-lethal harvesting of plants or fungi related products, which is governed by management measures. E.g., collecting of cedar bark, tree tapping for sugar maple production.

5.2.4 Poaching/eradication of terrestrial plants or fungi: Deliberate and illegal harvesting of plants or fungi for personal or commercial purposes, or eradication due to prejudices against the species. E.g., illegal gathering of American ginseng, eradication of cow parsnip because of its similar appearance to giant hogweed, an invasive alien species.

5.2.5 Management/control of terrestrial plants or fungi: Deliberately destroying a plant species or fungi for human gain. Includes indirect or unintended impacts on other species, but excludes cutting or vegetation management due to maintenance activities or early phases of development. E.g., herbicide spray drift from residential areas.

5.3 Logging & Wood Harvesting: Harvesting trees/other forest species in natural environments for timber or fiber outside of plantations (threat 2.2). Includes cutting and the use of machinery, as well as wood storage and debris management, excluding their transport (threat 4.1.4) and associated erosion (threat 9.3.2.).

5.3.1 Complete removal of the forest cover: Cuttings removing the majority of the forest cover. E.g., clear-cutting and related cuts (CT, CRS, CPRS, CPHRS, CPPTM).



- 5.3.2 Partial removal of the forest cover:** Partial cutting of the forest leaving a certain amount of cover. E.g., shelterwood cutting, selection cutting.
 - 5.3.3 Silvicultural cutting in natural forests:** Silvicultural treatments that alter the composition of the forest to increase the growth of certain plant species. These interventions alter wildlife habitat by affecting the availability of food and shelter. E.g., pre-commercial thinning, tending felling.
 - 5.3.4 Artificial regeneration of forest stands:** Planting of trees in natural forests (as opposed to planting taking place outside of natural forests, threat 2.2) to promote the regeneration of stands that are composed of species of commercial interest where natural regeneration is absent or insufficient.
 - 5.3.5 Management of cutting areas:** Management of the area and debris during a cutting or afterwards. E.g., scarification, formation of windrows from woody debris.
- 5.4 Fishing & Harvesting Aquatic Resources:** Harvesting aquatic species (wild plants and animals) for commercial, recreational, subsistence, cultural, or control/scaring purposes. This category also covers incidental capture (bycatch) but excludes research activities (threat 6.3.1).
- 5.4.1 Recreational or subsistence fishing:** Harvesting of aquatic species for recreation or subsistence that is governed by management measures. Illegal harvesting by fishing is classified under “Poaching/persecution of aquatic species” (threat 5.4.4). Includes bycatch and damage to released individuals but excludes contamination of habitats due to solid lead from fishing gear (threat 9.4.2). E.g., recreational fishing of sturgeon, accidental catching of rare species during ice fishing, turtles ingesting hooks, personal collection for fishkeeping with authorized species.
 - 5.4.2 Commercial fishing:** Harvesting of aquatic species for commercial purposes that is governed by management measures for which the environmental impact is primarily on the species (as opposed to habitat damage from sea bottom trawling, threat 7.3.6). Includes bycatch but excludes ghost fishing gear entangling wildlife (threat 9.4.4). E.g., commercial fisheries, use of nets and fishing gear for eels, factory ships, marine mammals caught in industrial fishing nets.
 - 5.4.3 Poaching/persecution of aquatic species:** Deliberate and illegal harvesting of aquatic animals for personal or commercial purposes or persecution, harassment, abuse, or to cause deliberate harm due to prejudices against the species. E.g., poaching of glass eels.
 - 5.4.4 Management/control of aquatic species:** Deliberately killing individuals of an aquatic species for human gain that is governed by management measures. E.g., control of lampreys using lampricides, control of mosquitoes in their aquatic larval stage (BTi), water weed cutting.

Category 6: Human Intrusions & Disturbance

This threat category includes threats from human activities (unrelated to the use of biological resources) that disturb, alter, or destroy habitats and their species.



6.1 Recreational Activities: Activities with generally low ecological impact that are conducted in natural areas for recreational purposes away from road networks (threat 4). To be distinguished from threat 1.3 (tourism and recreation areas with a significant footprint), which is a source of pressure primarily on habitats, whereas recreational activities (6.1) have a more direct impact on individuals of species (disturbance, mortality) and, to a lesser extent, habitats.

6.1.1 Motor vehicles: Using recreational motor vehicles. E.g., ATVs, motocross motorcycles, snowmobiles.

6.1.2 Hiking: Walking, cycling, or horseback riding on or off trails in natural environments. Includes opportunistic observation of nature but excludes disturbance by intensive observation/photography that is oriented towards one of several target species (threat 6.1.8). E.g., walking, jogging, running, dirt biking, geocaching, orienteering, disturbance from users or their domestic animals.

6.1.3 Recreational use of cliffs & rock faces: E.g., rock climbing, hang-gliding.

6.1.4 Recreational boating: Use of recreational boats and watercraft that disturb wildlife, incur collisions with animals, and induce wake damage. Excludes the spread of invasive species (threat 8.1). E.g., yacht, zodiac boats, watercraft.

6.1.5 Wilderness camping without amenities: Temporary camping without amenities, away from dedicated networks. Distinguished from threat 1.3.2 (campgrounds) by the lack of amenities.

6.1.6 Drones

6.1.7 Caving

6.1.8 Wildlife observation/photography: Wildlife observation activities without any gathering that disturb the target species due to harassment or through the use of attractants and lures. E.g., photographers attracting birds of prey with domestic rodents.

6.1.9 Special events in natural environments: Outdoor performances or gatherings in natural settings that cause trampling and disturbance of habitat. Does not include noise pollution (threat 9.6.3). E.g., outdoor concerts, gatherings on beaches that incur some trampling, outdoor sports competitions in natural habitats.

6.2 War, Civil Unrest & Military Exercises: Military and paramilitary activities that do not have a permanent ecological footprint. To be distinguished from the construction and use of permanent military bases (threat 1.2.1).

6.2.1 War: E.g., military intervention in conflicts, transportation using military vehicles, minefields.

6.2.2 Riots

6.2.3 Military exercises: Off-base military training activities with a local footprint. E.g., unexploded ordnance, trampling from military training activities, firing ranges, military equipment testing.



6.3 Work & Other Activities: Activities carried out in natural areas (undeveloped areas) for purposes other than recreational or military activities.

6.3.1 Research activities: Research activities that are governed by management measures that can affect species by causing a disturbance, by collecting individuals, or by degrading the environment. E.g. Research fisheries requiring mortality, trampling by research teams.

6.3.2 Illegal activities: Illegal activities that are unrelated to the harvesting of wild animal or plant species. Also includes habitat or species disturbance during related law enforcement interventions. E.g., illegal activities or law enforcement intervention, drug trafficking.

6.3.3 Vandalism: Deliberate and illegal destruction of structures that are of benefit to animal and plant species. E.g., destruction of gates limiting access to bat caves.

Category 7: Natural System Modifications

This category encompasses threats from activities that are generally carried out to improve human welfare, but may result in habitat degradation or destruction. It includes the development or redevelopment (management) of natural and semi-natural habitats, as well as certain natural processes that can act as threats. Stopping a conservation action or a practice that is conducive to conservation (threat 7.4) is not interpreted as a threat in and of itself, but as a return to the source threat (e.g., vegetation succession affecting pioneer species). Excludes meteorological or climate change-related threats that may modify natural systems (threat 11).

7.1 Fire & Fire Suppression: Suppression or increase in fire frequency, severity, or scope; changes in the natural fire regime that are directly related to human activity.

7.1.1 Increase in the fire regime: Increase in fire frequency/scope/severity due to human activities. E.g., out of control agricultural burning, campfires.

7.1.2 Suppression in the fire regime: Interventions aimed at preventing and putting out forest fires (fire management). E.g., putting out forest fires, controlled burning, creating firebreaks and trenches, and other measures. Also includes the loss of fire regimes in fire-adapted and fire-dependent habitats.

7.2 Dams & Water Management / Use: Facilities or activities that alter the natural water regime (flow or water levels).

7.2.1 Water level management using dams: Construction, operation, and water management using non-power dams. Includes the dismantling of man-made dams but excludes dams used for power generation (threat 3.3.1) and lock systems (threat 4.3.3) E.g., dams and weirs for containing water.

7.2.2 Beaver dam management: Structures (dams) built by beavers create habitats for a number of species; however, these dams may be dismantled by humans. Dismantling of dams results in habitat loss by drying out the beaver-created basin and flooding lands downstream. It could also potentially cause loss of accumulated sediments due to increased flow in streams farther downstream. E.g., dismantling of dams, development of infrastructure that promotes the free flow of water (installation of drains), decision to maintain dams.



- 7.2.3 Water management using culverts:** The design, installation, and management of culverts that are used to permit water flow under roads or railroads can cause discontinuities in streams and promote erosion.
- 7.2.4 Drainage in agricultural environments:** Construction and maintenance of channels that drain surface waters in agricultural environments. Excludes the use/management of culverts (threat 7.2.3). Excludes erosion/sedimentation associated with this drainage system (threat 9.3.2).
- 7.2.5 Drainage in forest environments:** Construction and maintenance of channels that drain surface waters in forest environments. Excludes the use/management of culverts (threat 7.2.3). Excludes erosion/sedimentation associated with this drainage system (threat 9.3.2).
- 7.2.6 Withdrawal of surface water:** Withdrawal of fresh surface water for human consumption, crop production, or other purposes. E.g., withdrawal by municipalities, spring water bottling companies, and farmers; reservoirs for firefighting, creation of man-made lakes.
- 7.2.7 Withdrawal of groundwater:** Withdrawal of groundwater for human consumption, crop production, or other purposes. E.g., pumping water from the water table.
- 7.3 Other Ecosystem Modifications:** Other activities that contribute to habitat alteration or loss by redeveloping natural systems to improve human welfare. To be distinguished from the development and maintenance of urban parks (threat 1.3.1).
 - 7.3.1 Shoreline alteration:** E.g., shoreline hardening, riprap along shorelines, breakwaters, concrete walls, shoreline filling.
 - 7.3.2 Vegetation succession:** Natural vegetation succession causing habitat loss for species of early successional habitats.
 - 7.3.3 Natural erosion and sedimentation:** Removal, transport, and deposition of sediments caused by natural erosional processes. To be distinguished from the transport of sediments that is associated with tides (threat 4.3.1), or by drainage systems in agriculture (threat 7.2.5) and forestry (threat 7.2.6).
 - 7.3.4 Beach development:** Creation of beaches, their nourishment (substrate replenishment), and maintenance.
 - 7.3.5 Removal of snags in watercourses:** Removal of snags and other structures that are used by wildlife within watercourses to promote water flow, embellish the landscape, or facilitate boating. Excludes the maintenance of road ditches (4.1.1) and agricultural ditches (7.2.4), as well as shoreline clean-ups that are performed as a conservation action. E.g., removal of rocks or snags that are used by river turtles for basking.
 - 7.3.6 Sea bottom trawling:** Trawling of the sea bottom that alters marine habitats. Excludes the impact of harvesting on target species (threat 5.4.2).
- 7.4 Removing / Reducing Human Maintenance:** As noted above, this subcategory is better defined as a return to the original threat rather than its own distinct threat.



- 7.4.1 Reducing or ceasing vegetation control:** E.g., reducing, removing, or ceasing prescribed fire, removal of invasive species, maintenance of early successional vegetation.
- 7.4.2 Reducing or ceasing hydrology control:** E.g., reducing, removing, or ceasing waterfowl impoundments and dam flow regimes.
- 7.4.3 Reducing or ceasing human disturbance control:** E.g., reducing, removing, or ceasing bat gats, seasonal beach closures to ORV, fencing to rope off nesting areas.
- 7.4.4 Reducing or ceasing predator control:** E.g., reducing, removing, or ceasing predator exclosures on shorebird nests, APHIS activities.
- 7.4.5 Reducing or ceasing other management activities:** E.g., reducing, removing, or ceasing fisheries seasons or harvest limits, seasonal limitations for ecosystem modifications, fish passage or ladders at dams, species propagation.

Category 8: Invasive & Other Problematic Species, Genes, & Diseases

This threat category includes threats posed by non-native and native species (plants, animals, pathogens, or genetic materials) that have or are expected to have harmful effects on biodiversity following their introduction, spread, or increase in population (abundance).

8.1 Invasive Non-Native / Alien Plants & Animals: Harmful plants and animals that were not originally present within an ecosystem but were directly or indirectly introduced into or spread in the ecosystem as a result of human activities. The concept of exotic species includes species that are not native to a specific habitat; it can therefore include the introduction of species that are considered native to a different region of the same general area of the country. Domestic species are also considered non-native, whether they are feral or semi-domesticated (e.g., domestic cats going outside). Also includes introduction of wildlife due to “mercy releases.”

8.1.1 Terrestrial animals

8.1.2 Terrestrial plants

8.1.3 Aquatic animals

8.1.4 Aquatic plants

8.2 Problematic Native Plants & Animals: Plants and animals that were originally present in ecosystem(s), but whose populations have increased to a level where they are now “out of control” or overabundant as a direct or indirect result of certain human activities.

8.2.1 Habitat alteration by beavers: Flooding/drainage of habitats caused by beavers.

8.2.2 Increased grazing by vertebrates: E.g., increased grazing by white-tailed deer and resident geese.

8.2.3 Localized increase in invertebrate grazing: E.g., increased grazing of American ginseng by native slugs.



- 8.2.4 Insect pest epidemics:** Increases in insect pest density, resulting in large-scale impacts on the ecosystem. To be distinguished from localized increases in invertebrate grazing (threat 8.2.3).
- 8.2.5 Increased predation by mesopredators:** E.g., raccoons, striped skunks, foxes, coyotes.
- 8.2.6 Increased predation by large predators:** E.g., increased predation by seals, intentional reinforcement of predator populations.
- 8.2.7 Ectoparasites:** E.g., fleas, ticks, mites.
- 8.2.8 Interspecific competition with a favored species:** Direct competition with a favored species.
- 8.3 Introduced Genetic Material:** Human modified or altered organisms/genes that pose a threat to biodiversity in natural environments by competing with wild populations or hybridizing with them and altering their gene pool.
 - 8.3.1 Genetic material from agriculture:** E.g., pesticide-resistant cereals/forages, use of genetically modified insects for biocontrol.
 - 8.3.2 Genetic material from silviculture:** E.g., genetically modified trees.
 - 8.3.3 Genetic material from aquaculture:** E.g., genetically modified salmon.
- 8.4 Pathogens:** Diseases caused by various taxa of pathogenic micro-organisms living within hosts.
 - 8.4.1 Bacterial pathogens**
 - 8.4.2 Viral pathogens:** E.g., ranavirus in amphibians, rabies in raccoons.
 - 8.4.3 Fungal pathogens:** E.g., white-nose syndrome (WNS) in bats, snake fungal disease (SFD), salamander chytrid disease (Bsal).
 - 8.4.4 Worm-induced disease:** Any diseases directly induced by a worm (helminthiasis). E.g., flatworms, nematodes, nemertean worms.
 - 8.4.5 Protozoan-induced diseases**
 - 8.4.6 Prion diseases:** E.g., chronic wasting (CWD).
- 8.5 Intrinsic Biological Limitations**
 - 8.5.1 Loss of genetic diversity:** E.g., population isolation, inbreeding, bottlenecks.
 - 8.5.2 Depends on another species that has declined:** E.g., pollinators with specific host plants, fish-glochidia relationships, parasitic hosts, red knot dependent on horseshoe crab

Category 9: Pollution

This category encompasses threats that are associated with the introduction of foreign or excess material/energy from point and non-point sources. Threats that are posed by pollution are typically correlated with other human activities listed in the other sections (e.g., air pollution from cars, water pollution from sewage, agricultural effluents). Although there is a direct



correlation between pollution and these other threats, their impact (scope and severity) is often evaluated separately from the source activity.

9.1 Domestic & Urban Wastewater: Point or non-point source wastewater from residential and urban areas; these discharges (may) contain nutrients, sediments, toxic substances, chemicals, etc.

9.1.1 Domestic wastewater: Liquid domestic waste that is produced by urban centers and discharged primarily by the sewage system. E.g., discharges from municipal waste treatment plants, leaks from sewers/septic tanks, untreated discharges, pit toilets, medical components in water (birth control hormones, antidepressants, antibiotics), toxoplasmosis, etc.

9.1.2 Runoff: Effluents resulting from urban activities that are separate from the water supply system. For oils and other hydrocarbons, refer to threat 9.2.1. E.g., salt/sand used to de-ice roads, fertilizers and pesticides used for lawns, parks, golf courses.

9.2 Industrial & Military Effluents: Wastewater (pollutants) from industrial and military sectors, including mines, energy production sectors, and other resource extraction industries. These effluents may result from deliberate or accidental spills that are legal or illegal and (may) contain various nutrients, sediments, toxic substances and chemicals, among others. Considering the difficulty in identifying contaminants or contaminant “cocktails” that are responsible for environmental damage, other unknown contaminants from industries are listed within 9.2.7. This section excludes natural sources of contaminants that are found in the environment (e.g., mercury found in soils or in river substrates). Intoxication due to natural sources of these contaminants is likely to result from an indirect threat increasing exposure and to which conservation actions can be matched.

9.2.1 Oil spills: Spills from vehicle fuel tanks or from facilities that are associated with hydrocarbon extraction and transportation. E.g., oil spills from grounded vessels, military vehicles, pipeline failures.

9.2.2 Acid mine drainage

9.2.3 Flame retardant

9.2.4 Polychlorinated biphenyls (PCBs)

9.2.5 Mercury

9.2.6 Industrial lead: Lead released into the environment by industrial effluents. Excludes lead contamination due to hunting ammunition or fishing gear (9.4.2).

9.2.7 Other industrial discharges: Unidentified or mixed toxic liquid chemicals that are released from industrial plants.

9.3 Agricultural & Forestry Effluents: Wastewater (pollutants) that is generated by agricultural, silvicultural, and aquacultural activities. These discharges are transported primarily in drainage systems, runoff, and eroded soil; they (may) contain various nutrients, toxic substances, chemicals, etc. Excludes erosion and sedimentation that is



associated with drainage systems in agriculture (threat 7.2.4) and forestry (threat 7.2.5), or oil spills from machinery (9.2.1).

9.3.1 Nutrient loads: E.g., manure, compost, chemical fertilizers.

9.3.2 Soil erosion, sedimentation: Erosion and sedimentation that are due to agricultural or silvicultural activities, regardless of the presence of local drainage systems (threat 7.2.4 and 7.2.5).

9.3.3 Herbicides & pesticides: Includes the use of inputs for controlling crop pests. E.g., herbicides, insecticides, fungicides.

9.4 Garbage & Solid Waste: Garbage and solid waste, including materials that can intoxicate or entangle plants and animals (strangulation/asphyxiation from plastic bags, elastic materials, ropes, etc.).

9.4.1 Garbage: Garbage and solid waste in the environment. Excludes waste in open dumpsites (threat 1.2.2), landfills (threat 1.2.3), and ashore or adrift in the ocean (threat 9.4.4). E.g., municipal waste, litter discarded on roads from vehicles, floating waste from recreational boats, construction debris/waste, etc.

9.4.2 Solid lead: Lead released into the environment in a solid form (e.g., pellets) from a source other than industrial effluents (threat 9.2.6). E.g., lead from ammunition or fishing gear contaminating the environment, ammunitions from shooting ranges.

9.4.3 Asbestos

9.4.4 Drifting plastic & entanglement rubbish: Plastic garbage adrift or ashore of oceans or large water bodies that intoxicate or entangle wildlife. E.g., floating rubbish, nets, ropes, buoys, ghost or derelict fishing gear, plastic bags.

9.5 Air-Borne Pollutants: Air contaminant emissions from a point or non-point source.

9.5.1 Acid rain

9.5.2 Smog: Smog caused by air pollutant emissions from vehicles.

9.5.3 Ozone: Atmospheric nitrogen deposition.

9.5.4 Dust & ashes: Fine particles carried by the wind that pollute the environment when deposited or taken in by organisms. Excludes ash from volcanic eruptions (threat 10.1.1). E.g., radioactive fallout, wind dispersion of pollutants/sediments, smoke from forest fires or wood burning.

9.6 Excess Energy: Inputs of heat, sound, or light that disturb wildlife or ecosystems.

9.6.1 Light pollution: E.g., lamps that attract insects or birds, lights on beaches that disorient turtles.

9.6.2 Thermal pollution: E.g., heated water discharges from power plants (coal, gas, nuclear, etc.), atmospheric radiation resulting from ozone layer thinning.

9.6.3 Noise pollution: E.g., noise from highways and air traffic, submarine sonar that disturbs whales and other marine mammals, loud music from outdoor events, and engine noise from marine traffic.



Category 10: Geological Events

This category includes all threats from catastrophic geological events. It is worth noting that none of these have been identified as major threats to Maryland’s species or habitats.

10.1 Volcanoes: Volcanic activities, eruptions, emissions of volcanic gases.

10.1.1 Eruptions

10.1.2 Emissions of volcanic gases

10.2 Earthquakes / Tsunamis: Earthquakes and associated events (tsunamis, etc.).

10.2.1 Earthquakes

10.2.2 Tsunamis

10.3 Avalanches / Landslides

10.3.1 Avalanches

10.3.2 Landslides & mudslides

Category 11: Climate Change

This category encompasses threats from major changes in ecosystems and severe climate/weather events outside of the natural range of variation that could harm species or habitats. Generally related to climate change, though not always.

11.1 Habitat Shifting & Alteration: Major changes in habitat composition or location.

11.1.1 Changes in vegetation communities: Major changes in an ecosystem resulting in changes to vegetation communities. To be distinguished from natural vegetation succession, which may threaten open-country species (threat 7.3.2). E.g., migration of deciduous trees towards the boreal forest, rising sea levels, desertification, coral bleaching.

11.1.2 Phenological mismatch: Behaviors that have evolved to adapt to seasonal changes become unsynchronized due to irregularities or delays in the cycle of the seasons.

11.2 Changes in Geochemical Regimes: Large-scale changes in an ecosystem’s physio-chemical makeup.

11.2.1 Changes in pH of habitats: E.g., ocean acidification.

11.2.2 Changes in salinity

11.3 Changes in Temperature Regimes: Periods in which temperatures of the air, water, or soil either exceed or fall below the normal range of variation.

11.3.1 Heat waves

11.3.2 Extreme cold spells

11.3.3 Gradual temperature change: E.g., altered sex-ratio in species relying upon a temperature dependent sex determination, reduction of dissolved oxygen that is available to fish species, earlier ice-free dates, thawing of permafrost affecting bird breeding sites.



11.3.4 Increase in temperature fluctuations: Increase in temperature fluctuations, which disturbs the phenological responses of wildlife. E.g., rise in the frequency of freeze-thaw events, rain-on-snow events, etc.

11.4 Changes in Precipitation & Hydrological Regimes: Periods in which the amount and frequency of precipitation either exceed or fall below the normal range of variation. Excludes periods that are associated with storms and heavy weather (threat 11.5).

11.4.1 Overabundant rains

11.4.2 Droughts

11.4.3 Gradual change in the precipitation regime

11.4.4 Increase of fluctuations in the precipitation regime: Increase in the fluctuations that are related to the precipitation regime, which have impacts on the hydrology of natural habitats.

11.5 Storms & Severe Weather: Strong winds and extreme weather events or a major change/shift in the storm season.

11.5.1 Storms & severe weather: E.g., thunderstorms, tropical storms, hurricanes, cyclones, tornadoes, hailstorms, ice storms, blizzards, dust storms.

11.5.2 Storm surges: E.g., erosion of shorelines/beaches during storms.

Category 12: Other Options

This threat category includes all threats not addressed above. Though only Levels 1 and 2 are included for this category in the original classification system, Maryland has added Level 3 back in for certain subcategories. This is because this category encompasses most of the “absence” or “scarcity” threats described in the opening paragraph of this chapter, of which there are many, and another level of classification was deemed necessary for the sake of organization. This added third level is based on the classification system used in the 2015 SWAP revision; additions are marked with an asterisk.

12.1 Other Threats: Threats are known but not listed elsewhere.

12.2 Resource Needs: Includes data collection, monitoring, and funding needs.

***Management decision needs:** Includes the need for fish, wildlife, and/or habitat planning

***Resource information collection needs:** Includes lack of sufficient data (both baseline and current), lack of or inadequate surveying efforts, unanswered research questions, etc.

12.3 Education & Outreach: Includes gaps in education and outreach efforts, both to targeted groups and the general public.

***Education needs:** Generally related to insufficient understanding or appreciation of a topic, habitat, or (group of) species.

***Outreach needs:** Generally related to stakeholder and public engagement needs, lack of volunteers, inadequate visibility, needed lobbying efforts, etc.

12.4 Administrative Needs: Needed improvements to administration and



coordination of conservation organizations, programs, and projects.

***Coordination/administration needs:** Inefficient or insufficient coordination, administration, etc. that make conservation efforts less effective.

***Infrastructure needs:** Inadequate technical coordination efforts, such as the efficient sharing of data between different databases.

12.5 State Specific Issues: Needed changes to state regulations, policies, programs, etc.

12.6 Unknown: Threats are unknown.

Priority Threats for Maryland

Throughout the process of revising Maryland’s SWAP, a number of topics were raised repeatedly by different groups of partners, experts, and MD DNR staff. The repeated nature of these conversations—along with the fact that concerns were raised by those working across different species groups and habitats—signaled that particular attention should be paid to these topics going forward. Fourteen topics were identified in this manner: eight threat categories, and six resource need categories. Most of the topics identified are long-standing issues (e.g., invasive species, habitat loss, inadequate funding); others are not necessarily new, but their urgency has greatly increased in recent years (e.g., threats to coastal habitats).

Individual threats and actions associated with these fourteen topics are not necessarily marked as high priority in the SWAP (see Appendices 6a and 6b for the list of actions, Chapter 6 for an explanation of the prioritization scheme). Instead, these areas of concern have been highlighted as topics to pay special attention to in the next 10 years or longer. In other words, to build on the momentum that the 2025 SWAP revision process has helped create, MD DNR and its partners intend to further efforts in these areas through continued conversation, outreach, and coordination to strengthen capacity to address these concerns. Some of this work has already begun; for example, in late 2025, MD DNR collected detailed information from partners regarding their work in these 14 areas. This included which of the 14 topic areas each partner works in, as well as the type of work (e.g., advocacy, land preservation, data collection, education). Virtual meetings were then held for seven of these 14 areas to collect more detailed information on what work is already being done, what needs to be done in the future, and what would make such work easier to accomplish. Though not all of these results are included in the 2025 SWAP revision, it is the intention of MD DNR to continue working in these areas.

The following subsections summarize concerns in the eight threat categories; an additional subsection is also included to summarize the six major resource need categories. Examples of actions that address these topics are included in the “Addressing Priority Threats for Maryland” subsection of Chapter 6.

Priority Threat: Threats to Urban and Suburban Habitats

Urban and suburban areas are not typically thought of as “traditional” areas for conservation work. However, the denser, more populated areas of Maryland can serve as important habitat for a variety of species—if properly managed. For example, many migratory bird species rely upon street trees and small urban parks as stopover habitat during their long journeys in the spring and fall, and the degradation of these trees or areas can have an outsized impact on their journey’s success. Major threats identified for these habitats include lack of biodiversity due to



overreliance on non-native plant species, frequently mowed grassy areas, and pesticides and herbicides; increases in impervious surfaces, which leads to increased temperatures and pollution via runoff; overuse of artificial light, especially at night; urban and suburban sprawl, which is a driving factor behind habitat loss and fragmentation; and lack of awareness, appreciation, or understanding regarding these habitats and the species that rely on them. The new Urban and Suburban Environment KWH was created for the 2025 SWAP revision in part to assist in addressing this last concern.

Priority Threat: Threats to Coastal Habitats

Habitats such as Maryland’s Coastal Bays, marshes, and small islands are of particular concern in the 2025 SWAP revision. These are some of Maryland’s most unique and at-risk habitats in the state. Additionally, some SGCN—including the federally Threatened eastern beach tiger beetle (*Habroscelimorpha dorsalis dorsalis*), the globally imperiled saltmarsh sparrow (*Ammospiza caudacuta*), and multiple species of nesting terns—are found only in these parts of the state, where sandy beaches and wetlands turn into the brackish or saline waters of the Coastal Bays, Chesapeake Bay, and Atlantic Ocean. These habitats face multiple threats, including increasing coastal development; pollution, sedimentation, and excessive nutrient input via runoff; and, perhaps most urgently, sea-level rise and increased flooding. This is especially true for Maryland’s Small Coastal Plain Islands, a new KWH in the 2025 SWAP revision. Many of these islands have already disappeared due to a combination of factors, especially sea-level rise and land subsidence. While restoration efforts (i.e., placement of sandy dredge material) have had some success, the process is costly, difficult to coordinate, and requires frequent upkeep.

Priority Threat: Threats to Working Lands

This habitat group includes anthropogenic lands such as agricultural fields, recently logged forests, and reclaimed strip mines. Some existing working lands can be managed to promote biodiversity and support SGCN that are dependent on or associated with grassland and shrubland habitats. Although these species once occupied tens of thousands of acres of grasslands and savanna-like habitats across the state (Mayre 1920, 1955), their natural habitats have nearly vanished in Maryland due to habitat loss resulting from development, agriculture, solar electricity production, fire suppression, and the disappearance of large grazing mammal species. Now, strongholds of this habitat type exist nearly exclusively in the form of hayfields (including those enrolled in particular Conservation Reserve Enhancement Program practices), reclaimed strip mines, and utility rights-of-way that provide the structure and plant composition to support animal SGCN. Some plant SGCN in particular are limited to utility rights-of-way where they still occur in remnants of natural habitats that persist due to the frequency of disturbance. For these surrogate habitats, threats include incompatible management practices (e.g., over-mowing, tree planting, herbicide and pesticide use); habitat loss due to land conversion, especially to low-density residential development and solar farms; and lack of awareness, appreciation, or understanding regarding these habitats and the species that rely on them, similar to urban and suburban habitats. Some KWHs in the 2025 SWAP revision were restructured under the new “Working Lands” subcategory in part to address this last concern.

Priority Threat: Managed Species

Managed species of concern include white-tailed deer, resident Canada geese, and beavers. Although more commonly referred to as “nuisance” species, the Maryland 2025 SWAP revision



uses this term because these species are not considered nuisances in every instance; rather, they can act as boon or threat depending on the circumstance. Though threats posed by each managed species can vary, major ones include overgrazing on the part of deer and geese, which can lead to food source loss and the spread of invasive plants; and detrimental changes to the hydrological regime on the part of beavers when they settle in habitats where their work as “ecosystem engineers” does more harm than good. In the case of deer and geese, the main objective is to reduce these negative impacts, partially through reducing their populations. In the case of beavers, it is more a matter of determining where and when beavers are beneficial versus detrimental.

Priority Threat: Invasive (Plant) Species

Although invasive fish and wildlife are also major concerns in Maryland, the threat of invasive plant species was raised in almost every meeting throughout the 2025 SWAP revision process. This is because invasive plants negatively impact nearly every habitat and species in Maryland. Invasive plants are closely tied to other threats as well, including managed species and climate change. Specific threats posed by invasive plant species include the loss of food sources and host plants, as invasive plants tend to out-compete natives once established; loss of trees or declining tree health, as a number of invasive plants are vines that can strangle trees; and difficulty in managing invasive plants, as they spread quickly and are difficult to remove once present in an ecosystem. This is due to the labor-intensive way that invasive plants must be removed, the inherent difficulty in eradicating a species that rapidly spreads, and the logistics of coordinating such efforts. Improved coordination has been identified as a priority for managing invasive plants, as county- or even state- or region-wide management efforts can provide much-needed sharing of knowledge, labor, and other resources for this massive effort.

Priority Threat: Pollution

Pollution is another threat that negatively impacts nearly every habitat and species in Maryland, although it is of particular concern for aquatic and semi-aquatic species. Because this threat is discussed in detail below in the Regional Threat: Pollution subsection, having been identified as the number one threat facing species and habitats in the Northeast region, please refer to the Regional Threat text for more information. In addition to the threats articulated there, pollution, much like invasive plant species, is a threat that is closely tied to and exacerbated by other threats. This includes climate change, development, transportation, agriculture, and more.

Priority Threat: Climate Change

Climate change is also addressed below in the Regional Threat: Climate Change subsection. In Maryland in particular, climate change impacts are most commonly tied to water-related issues such as sea-level rise, saltwater intrusion, increased storm severity, and increased flooding. Change in the temperature regime is also a major issue, resulting in problems such as phenological mismatch and species range shifts. As with invasive plant species and pollution, climate change is closely tied to and exacerbated by other threats. One of these threats is development, as an increase in shoreline hardening and impervious surfaces combined with worsening rain events results in increased stormwater and flooding impacts.

Priority Threat: Habitat Loss and Fragmentation

Habitat loss and fragmentation is tied to every other threat in Maryland’s 2025 SWAP revision. It affects every region, habitat, and species in Maryland, whether terrestrial or aquatic. The threat



presented by habitat loss speaks for itself. Threats associated with habitat fragmentation include the loss of large-scale habitat connectivity and corridors, which makes it more difficult for species to migrate and shift their ranges in response to climate change; the isolation of populations, which can result in reduced population sizes, genetic erosion, and inbreeding; and increased mortality, as animals are forced to navigate human-dominated landscapes and roads in order to find food, migrate, and breed. Habitat loss and fragmentation is a particularly difficult threat to address, as most changes must be made on a larger scale in order to have any impact. The most effective ways to address this threat are through regulation/policy change and land preservation, both of which require a large amount of money, time, effort, and political will.

Priority Threat: Scarce Resources

As stated in the opening paragraph of this chapter, threats can also take the form of the absence of something rather than its presence. While this is true of natural phenomena—for example, the lack of a once-present fire regime in a fire-dependent habitat—it can also take the form of the inadequate resources available to conduct needed conservation work. Six resource need categories were identified during the 2025 SWAP revision process as areas of particular concern:

- Funding
- Coordination
- Policy and regulations
- Education and outreach
- Research
- Monitoring

All these concerns have associated threats and actions in Appendices 6a and 6b. It is also important to note that vital work is already being done in all these areas; the issue is not so much of the total lack of these resources than it is the ongoing struggle to obtain enough resources to continue this work. Furthermore, as additional species become rare and the SGCN list continues to grow, the amount of funding and other resources is not sufficiently increasing to keep pace. Funding and coordination were highlighted as particular areas of concern, and it is MD DNR’s intention to continue having in-depth conversations with stakeholders and partners, as improvements in these two areas will positively affect all other aspects of conservation work in the State of Maryland.

Regional Threats

The Northeast Regional Conservation Synthesis for 2025 State Wildlife Action Plans (TCI & NEFWDTC 2023) summarizes the issues and challenges identified in the 14 Northeast SWAPs (TCI & NEFWDTC 2017) that may adversely affect regional SGCN (RSGCN) or their habitats. It also describes the priority research and survey efforts needed to support restoration and improved conservation of these species and habitats. Included in these efforts was the identification of the top five threats to Northeast RSGCN; the threats with the highest number of associated RSGCN are ranked higher. According to the 2023 synthesis, these are:

1. Pollution
2. Climate Change



3. Invasive and Other Problematic Species, Genes, and Diseases
4. Biological Resource Use
5. Natural System Modifications
6. *Residential and Commercial Development: Not listed in the top five but included in the document's text as another high-ranking threat.

Certain portions of the 2023 synthesis have been included below regarding these six threat categories. Their complete descriptions can be found in the [full document](#). Much of the text included focuses on which RSGCN taxonomic groups are most impacted by each threat. For a list of Maryland SGCN that are also considered RSGCN, please see Appendix 3a.

Regional Threat: Pollution

Pollution is by far the most common regional threat, impacting 81% (338 species) of the RSGCN and Proposed RSGCN on the 2023 list. Many of the taxonomic groups that are most heavily impacted are aquatic; pollution imperils the entire diversity of the stonefly, mayfly, marine invertebrate, freshwater mussel, firefly, and diadromous fish taxonomic groups. Additionally, though pollution does not impact all freshwater fish or lepidopterans, these two groups contribute the largest number of species impacted.

Pollutants come from point and non-point sources. Point source pollutants can be traced back to a single identifiable discharge point, such as a pipe, ditch, ship, or smokestack. Non-point source pollutants cannot be traced to a single specific source, as point-source pollutants can. Instead, these pollutants come from many sources throughout the landscape. For example, as water moves overland or through the ground, it collects many different pollutants from many different places and brings them all together to more concentrated areas, such as rivers and streams.

Another important aspect of many pollutants is that they can bioaccumulate. Bioaccumulation is the gradual buildup of chemical substances, such as pesticides, in an organism. The body is unable to rid itself of these compounds, so concentrations increase over time, even if the amount of the compounds in the environment is very low. As the concentration of the compounds in the body increases, individuals may suffer from a wide variety of symptoms, or may die, depending on the chemical. Bioaccumulation has important impacts on food webs, since the compounds continue to aggregate in higher trophic levels as predators consume contaminated individuals, a process known as biomagnification.

Many aquatic RSGCN are highly sensitive to pollution; therefore, their presence or absence makes them indicators of water quality. Eastern hellbenders (*Cryptobranchus alleganiensis*), mayflies, stoneflies, caddisflies, and mussels thrive in high-quality water conditions. Pollution acutely impacts aquatic species because these contaminants are ubiquitous within the habitat. Pollutants are found in the water column, sediments, and potential food sources. By contrast, contaminant distribution is less homogenous in terrestrial systems; combined with the ability of terrestrial species to move away from pollutants, contaminant exposure is a function of concentration and repeated exposure (Smith et al. 2007). In both aquatic and terrestrial systems, exposure from the environment occurs via ingestion, absorption through the skin, accumulation on gills or filters, inhalation, or a combination (Smith et al. 2007; Honda & Suzuki 2020). Some pollutants, including heavy metals, polychlorinated biphenyls (PCBs), pharmaceutical



compounds, per- and polyfluoroalkyl substances (PFAS), and certain pesticides, persist for extremely long periods in the environment or hardly break down at all (i.e., “forever chemicals”), resulting in long-term contamination of the environment and bioaccumulation of these pollutants throughout the ecosystem (McKinney et al. 2015; Ali et al. 2019; Honda & Suzuki 2020).

Regional Threat: Climate Change

Climate Change is a rapidly growing concern in the region, impacting 73% (305 species) of the RSGCN and Proposed RSGCN. All of the species in the stonefly, reptile, mayfly, marine invertebrate, mammal, and caddisfly taxonomic groups are considered vulnerable to climate change impacts, highlighting these groups’ sensitivity to future changes. As knowledge of climate change and its impacts on species and habitats is still evolving, it is likely additional species are impacted by this threat in ways we do not yet understand.

At the time of the 2015 Northeast SWAPs, climate change was considered one of the highest priorities of all threats identified. Climate change is considered to be one of the most impactful threats in the Northeast because of uncertainty about the full effects on individual species, variability in species responses, the infeasibility of addressing sources of climate change at local and state scales, and the irreversibility of some impacts (TCI & NEFWDC 2017).

The Northeast Climate Adaptation Science Center (NECASC), a consortium of the United States Geological Survey (USGS) and university researchers housed at the University of Massachusetts, Amherst, is a crucial resource for climate-related information, research, and planning in the Northeast. One of the USGS’ nine regional Climate Adaptation Science Centers, their goal is to deliver science to help fish, wildlife, water, land, and people adapt to a changing climate. NECASC produced a regional synthesis that compiled a summary of the current literature, strategies and actions, tools, and case studies for addressing multiple and simultaneous threats from climate and non-climate stressors to natural and cultural resources into searchable databases (Staudinger et al. 2015). This report analyzed how climate has and is expected to change; the relative vulnerability of fish and wildlife species and their habitats; likely responses of species of concern to these changes; and the approaches, strategies, and actions that could sustain fish, wildlife, and their habitats across the region. In 2024, NECASC updated and released this document for the 2025 SWAP revision process (Staudinger et al. 2024).

Regional Threat: Invasive and Other Problematic Species, Genes, and Diseases

More than half of the species on the 2023 RSGCN and Proposed RSGCN list—55%, or 228 species—are imperiled by interactions with invasive or problematic species, face complications due to genetic integrity, are impacted by disease, or have natural biological limitations that reduce recovery potential. This includes all reptiles and marine invertebrates, and all but one mammal. Though not all freshwater fish, mussels, and lepidopterans are associated with this threat, these taxonomic groups contribute as many species, if not more, as mammals. Many invertebrate groups have five or fewer species for which this threat is known to be a cause of decline. This is likely due to data deficiencies and a limited understanding of how these threats impact these groups, rather than an indication that these groups are not sensitive to these threats.

The subjects categorized under this threat are incredibly diverse, touching on invasion ecology, competition and predation, parasitism, population and conservation genetics, epizootology, and



other ecological and biological concepts. The breadth of these topics makes it difficult to generalize about the overall trends and patterns within the Northeast region at this topmost level. The impacts of these threats are not concentrated within certain habitat types or taxonomic groups; instead, they are found universally. More in-depth descriptions of the different threats and discussions of the trends and patterns in the Northeast are discussed in the full document, linked above.

Regional Threat: Biological Resource Use

Biological Resource Use impacts 48% (200) of the species included as RSGCN and Proposed RSGCN in the 2023 list. This includes all members of the marine invertebrate, reptile, and marine fish taxonomic groups. Mammals, amphibians, and diadromous fish are also largely included in the species impacted by this threat. Most of the species known to be impacted by biological resource use are vertebrates or are harvested for human consumption. This threat likely has less impact on most terrestrial invertebrate species, but the smaller numbers may also reflect data deficiencies in these groups.

Biological resource use refers to the removal of biotic components of the environment for human consumption or benefit. This includes hunting and fishing, bycatch in regulated animal harvest, persecution and management of species considered dangerous or problematic, unregulated collection of wildlife, and the harvest of timber and other plant products. The impacts of biological resource use on RSGCN and Proposed RSGCN are often direct, physically removing individuals from the ecosystem. The exception to this is logging, which indirectly impacts many species by removing, fragmenting, and otherwise altering habitat. Regardless, these removals have major impacts on the individual, population, community, and ecosystem levels.

The individuals removed are intended for human use or benefit, as opposed to the mortality of flora and fauna as a result of some other threat factor. These removals can be either intentional, where the species is the target, or unintentional, where the species is collected incidentally along with a target species. Many of these forms of biological resource use are regulated, but some species, especially invertebrates and amphibians, may lack formalized protection at state, national, or international levels. Other species are targeted despite legal prohibitions on their collection. Due to the human dimensions of this threat coordinated actions, consistent messaging, and shared regulatory decisions are needed across the Northeast for successful management.

Historically, many species in the Northeast were negatively impacted by forms of biological resource use. Hunting for sustenance led to significant declines in many iconic mammals and birds in the region (Foster et al. 2002). Persecution of large predators and other “nuisance” species, including bounty systems, led to declines and regional extirpations (Foster et al. 2002). Historic overfishing contributed to population crashes and declines of many marine fish species and coastal ecosystems (Jackson et al. 2001). Logging and the collection of plant species altered habitat on large scales across the region, contributing to widespread species declines and shifting wildlife communities better suited to agricultural landscapes (Foster et al. 2002). Human use of biological resources has had a strong influence on the ecosystems in the Northeast.



Regional Threat: Natural System Modifications

A total of 198 species (47%) on the 2023 RSGCN and Proposed RSGCN list are impacted by Natural System Modifications. Diadromous fish, reptiles, tiger beetles, and odonates are the most heavily impacted, with more than 80% of the species in each of these groups known to be imperiled by these threats. The largest number of species impacted are lepidopterans, freshwater mussels, and freshwater fish. For the other invertebrate groups and marine fish, very few species are associated with this threat, both in terms of total numbers and proportion of the taxonomic group. This is likely due to data deficiencies and a limited understanding of how natural system modifications can impact these groups, rather than an indication that these groups are not sensitive to these threats.

Natural system modifications are a threat to many RSGCN and Proposed RSGCN species because, while they may not eliminate a habitat, they alter the structure and function of these ecosystems. Habitat degradation or other impacts on quality and condition can make some habitats unsuitable for more sensitive species. Some of these modifications can alter important processes, such as disturbance and succession, changing the functionality of a habitat over long time scales. Other modifications may fragment habitats, preventing species movements and isolating populations.

Many species in the Northeast RSGCN and Proposed RSGCN list are considered indicator species, where their presence or absence is indicative of habitat condition at that site. These indicator species can be related to the presence of pollutants or other contaminants (Evers et al. 2003), management history (Blossey et al. 2019), or overall ecosystem health (Edsall et al. 2005; Jones et al. 2009). In particular, aquatic insects such as mayflies, caddisflies, and stoneflies are frequently considered indicators of water quality and are sensitive to changes in streamflow. Many insects, such as the northern barrens tiger beetle (*Cicindela patruela*), are closely associated with pine barrens habitats and often decline in the absence of fire.

Regional Threat: Residential and Commercial Development

Residential and Commercial Development does not rank as highly as the other threats discussed previously. However, it impacts at least 40% (169) of the species on the RSGCN and Proposed RSGCN lists and remains a major concern in the Northeast. All eight tiger beetles are impacted by this threat, as are most reptiles and bees. Lepidopterans, birds, and mammals provide the largest number of species impacted by development, though smaller proportions of these groups are impacted. Aquatic species appear to be less impacted by this threat, potentially since development more directly impacts terrestrial habitats, and indirect threats, such as those from impervious surfaces, may need additional research. Data deficiencies for many invertebrate taxonomic groups likely make it appear that development is not a concern for these species when in reality we are uncertain what the impacts truly are.

The most direct impact of development is habitat loss and alteration. Habitat loss can eliminate key areas or result in decreased habitat area, which in turn restricts the number of individuals and species able to be supported by the remaining habitat. Development also fragments habitats into smaller patches. Fragmentation alters the arrangement of habitat such that it results in reduced habitat area, increased patch isolation, and the creation of more edge habitats. Smaller habitat patches support less diverse wildlife communities and fewer individuals as a result of limited



resource availability (Laurance et al. 2002; Haddad et al. 2015). Isolation between patches restricts the movement of individuals between patches, which has consequences for metapopulation dynamics and genetic integrity (Lande 1988; Laurance et al. 2002). Increased edge habitat can change the community structure by altering patterns of energy flows and resource availability while also creating space for unique interactions between species that do not usually interact (Laurance et al. 2002; Ries et al. 2017). All of these changes to habitat structure impact ecosystem processes, such as nutrient cycles, pollination, and succession, and change the resilience of the ecosystem (Haddad et al. 2015).

Studying wildlife interactions with development is complicated because not all species respond in the same way (Birnie-Gauvin et al. 2016). Responses are often contextual and dependent on the reason for habitat loss, the surrounding landscape matrix—the patterns and organization of habitat types—and the intensity of human activity and use. Many species change their behavior in response to development, either avoiding areas of anthropogenic disturbance or changing their behaviors in ways that allow them to utilize these areas (Lowry et al. 2013; Ritzel & Gallo 2020). Others adapt and evolve to be better able to utilize anthropogenically altered environments (Cheptou et al. 2017; Johnson & Munshi-South 2017). Even in species that can utilize developed areas, factors such as increased stress levels, lesser nutritional content of available food resources, anthropogenic noise interfering with communication, and increased exposure to hazards such as pollution and disease can have negative impacts on individuals (Birnie-Gauvin et al. 2016).

In the Northeast region, the impacts of development are almost ubiquitous. The region contains some of the most densely populated areas in the United States, which have been heavily modified by human land use change since European colonization. Very little of the region remains unimpacted by the effects of development and agriculture, and these impacts are likely to increase over the next few decades (Theobald 2010; Venter et al. 2016). Urban centers are not the only concern. Areas where low-density housing is developed near or intermixed with natural habitats, commonly referred to as the wildland-urban interface, are also widespread in the Northeast (Radeloff et al. 2005). These interfaces alter the risk of fire, vehicle collisions and mortality, invasion of non-native and human-subsidized species, and disease transmission (Bar-Massada et al. 2014; Kreling et al. 2019). In the conterminous United States, ten states have at least 33% of their area within the wildland-urban interface; eight of these states are within the Northeast region (Radeloff et al. 2005). This high level of intermixing has implications for conservation for the region. An analysis of Conservation Opportunity Areas identified in the 2015 SWAP revisions showed that a majority of these sites are vulnerable to future projected development or are constrained by current development (Carter et al. 2019). Management of this threat will require careful planning to balance the needs of the growing human population in the region and conservation priorities.

This chapter reviewed threats facing Maryland’s wildlife species and their habitats (**Element #3**). It provided an overview of the threat classification system and discussed priority threat areas identified by both Maryland and the wider Northeast region. Please see Appendices 6a and 6b for a complete list of Maryland’s threats and their associated actions. Chapter 6 will discuss the many conservation actions and strategies to address the threats in this chapter.



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