# 3. Statewide Overview

## Species Summary

Virginia's 2015 Action Plan includes a list of 883 SGCN. DGIF and partners recommended that 89 of the species included in the 2005 Plan be removed from the SGCN list. In most of these cases, species were found to be more abundant than previously thought based on information gathered after the original Action Plan was published. Unfortunately, of these species, the green blossom pearly mussel is believed to have gone extinct since the Action Plan's publication and the Appalachian Bewick's wren is no longer found in Virginia.

Partners recommended adding 48 new species to the revised Action Plan SGCN list for a variety of reasons. Seven new bats were included to reflect the impacts of white-nose syndrome, a disease which did not exist in 2005. Species such as the common snapping turtle and marine mammals are being included to highlight actual and potential population declines due to human use and habitat development concerns. Seven bumble bees and the monarch butterfly have also been added in recognition of international declines in these pollinator populations.

DGIF biologists and partners also reviewed the remaining SGCN from the 2005 Action Plan and determined they should remain within the 2015 Wildlife Action Plan. Two dozen of these species were assigned a new Tier rank to indicate changes in their condition or circumstances. Additionally, the American Fisheries Society updated the taxonomy for several species of fish, mollusks, and crustaceans. As such, a handful of species may appear to be new additions to the Action Plan while they are, in fact, species that were formerly included under different names. The number of species within each taxonomic group and tier are identified within Table 3.1.

Table 3.1. Number of SGCN per Taxonomic Group by Tier.

| Taxonomic Group | Tier I | Tier II | Tier III | Tier IV | Total |
|---|---|---|---|---|---|
| **Amphibians** | 5 | 8 | 8 | 11 | 32 |
| **Reptiles** | 8 | 4 | 7 | 14 | 33 |
| **Fishes** | 18 | 8 | 19 | 50 | 95 |
| **Birds** | 14 | 13 | 18 | 35 | 80 |
| **Mammals** | 11 | 5 | 3 | 14 | 33 |
| **Aquatic mollusks** | 29 | 17 | 17 | 25 | 88 |
| **Aquatic crustaceans** | 9 | 26 | 14 | 4 | 53 |
| **Aquatic insects** | 5 | 24 | 39 | 80 | 148 |
| **Other aquatic invertebrates** | 5 | 4 | 1 | 2 | 12 |
| **Terrestrial insects** | 10 | 35 | 25 | 57 | 127 |
| **Other terrestrial invertebrates** | 7 | 70 | 35 | 72 | 182 |
| **Total** | **121** | **214** | **186** | **362** | **883** |

In addition to updating the Tier rankings to describe level of imperilment, each species was assigned a Conservation Opportunity Rank of A, B, or C (see Methods and Approach Section). This new prioritization scheme helps managers focus attention on species with specific management needs and opportunities. Of the 883 SGCN identified within the 2015 Action Plan, 23.4 percent are classified as Category A, indicating that managers have identified on the ground strategies to manage either the species or its habitat. Another 7.1 percent of the 2015 list of SGCN are classified as Category B, indicating either specific research is needed to facilitate on the ground action or on the ground opportunities cannot be implemented at this time due to a lack of resources. The remaining SGCN (69.5 percent) are classified as Category C, indicating managers have not identified on the ground strategies or specific research needs that will facilitate on the ground action. Species also were assigned to Category C when available conservation opportunities have been exhausted. It should be noted that baseline life history and distribution data are lacking for many of the SGCN. Given the broad nature of this research need and the difficulty of evolving such efforts into an on the ground management strategy, these species were classified as Category C.

The Tier and Conservation Opportunity Rankings are provided for SGCN within Appendix A. Appendix A also provides a brief explanation regarding why each species was assigned to a tier and conservation opportunity category. The SGCN that occur within each planning region are identified within the Local Action Plan Summaries.

### *Species Status*

The USFWS and DGIF track the status of many species with regards to the federal and state Endangered Species Acts. Species may be designated as being threatened or endangered at the state and/ or federal level. Species may also be designated as being “proposed” for protection, a “candidate” species, a “species of concern”, or a species of “collection concern.” An individual can be assigned to a single category or multiple categories. Virginia’s Fish and Wildlife Information Service indicates which species have been assigned to each of these categories. Of the 883 Action Plan species, 220 (24.7 percent) have been assigned to one or more of these additional categories (Table 3.2).

Table 3.2. Species with State and Federal Threatened or Endangered Status.

| # of Species | Classification | DGIF Coding |
|---|---|---|
| **58** | Federal Endangered/State Endangered | FE/SE |
| **10** | Federal Threatened/State Threatened | FT/ST |
| **1** | Federal Threatened/State Endangered | FT/SE |
| **12** | Federal Species of Concern/State Endangered | FS/SE |
| **9** | Federal Species of Concern/State Threatened | FS/ST |
| **22** | State Endangered | SE |
| **24** | State Threatened | ST |

## HABITAT SUMMARY: DESCRIPTIONS, STATUS, THREATS, AND CONSERVATION ACTIONS

Virginia boasts a broad diversity of habitats from beaches, dunes, and mudflats in the east to spruce-fir forests in the west. While it is convenient to think of habitats as isolated and self-contained communities, they are in fact interconnected and interdependent. Healthy upland habitats contribute to the quality of riparian and aquatic habitats. Likewise, the condition and quality of upstream habitats influences the health of downstream and marine habitats. The key factor linking these habitats together is water. Given the importance of water to terrestrial and aquatic habitats, conservation actions in this section and in the Local Summaries have a significant focus on water quality and maintaining that quality through habitat management and habitat restoration. Thus, actions in this Plan encompass a broad range of targets and provide opportunities for a diversity of partners. Other habitat specific actions are also important and included within the Action Plan, but water quality issues can be found across all habitat types.

A number of models have been developed to identify habitat types and describe their condition. Some models, such as the ecoregional descriptions produced by the USEPA describe areas of discreet biotic and abiotic conditions across large regional areas (Griffeth et al. 1999). The Natural Communities of Virginia: Classification of Ecological Community Groups is based on assemblages of co-existing, interacting species that are considered together with the physical environmental and associated ecological processes (Fleming et al. 2013). The National Land Cover Dataset (NLCD) has a finer spatial resolution than ecoregions and describes the landscape using over 20 different coarse land cover classes (Fry et al. 2011). The Nature Conservancy through the Northeast Terrestrial Habitat Map (NEHTM) and others have developed habitat models at a fine spatial resolution, using narrowly defined land cover classes (Anderson et al. 2013). However, the NETHM (as well as other spatial data sets such as NLCD, LANDFIRE, etc.) is primarily useful as a coarse-scale spatial planning tool, and it should not be relied upon, or at a minimum needs adaptation to be used, at finer scales (e.g., local level) for planning specific restoration and management actions. The NETHM lacks a comprehensive accuracy assessment and has been shown to inaccurately classify a number of reference sites into developed classes (Simon, personal communication). However, Virginia DGIF conducted an accuracy assessment for the NETHM within Virginia. Results demonstrated that at the ecosystem level, accuracy is approximately 50 percent, while accuracy improves to almost 80 percent when considering macrogroups or other similar habitat types (Klopfer and McGuckin 2014). This is understandable given its use of Forest Inventory Assessment (FIA) data which are underrepresented at finer spatial scales and for less common systems/habitats. Finer resolution mapping products have been developed by partners (e.g., ecological zones) and should be evaluated for local planning purposes (especially in the western and southwestern portions of the state).

This Action Plan borrows from these conservation models and tools and adapts their habitat data to best suit the needs of land and water managers. The Action Plan provides a crosswalk between the habitat definitions from the NETHM classification system to ensure this Action Plan is useful to all conservation practitioners as well as to demonstrate how the model classification can be used by land managers. Eight basic habitat types are described and referenced within this Action Plan. Within these habitat types, several other habitat subcategories are described. Habitats in this Action Plan include:

- Beaches, Dunes, and Mudflats
- Tidal wetlands
- Non-tidal wetlands
- Freshwater aquatic and riparian habitats
    - Tidally influenced warm water streams and rivers
    - Coldwater streams and rivers
    - Non-tidal warm water streams and rivers
    - Blackwater streams and rivers
- Open habitats
    - Post-agricultural lands
    - Glades and barrens
    - Pine and oak savanna

- Mixed hardwood/ conifer forests
    - Young forests
    - North Atlantic coastal plain maritime forest
    - Central Atlantic coastal plain maritime forest
    - Southern Atlantic coastal plain upland longleaf pine woodland
    - Southern Appalachian low elevation pine forest
- Spruce fir forests
- Karst and subterranean habitats

These habitat types were identified based on the meetings with DGIF staff and conservation partners (see Methods Section). Information about these habitats, threats that affect habitat quality, and actions that can be taken to address these threats at a statewide level are described below.

### *Beach, Dune, and Mud Flat Habitats*

Beaches, dunes, and mudflats are found along Virginia's coasts and barrier islands. Beach and dune vegetation is limited in distribution by the interaction between winds, changing sands, and wave action and also by the need to be salt-tolerant. Trees and shrubs, for example, are restricted to growing only in sheltered areas (Anderson et al. 2013). Moisture is maintained through salt spray and rain events. Virginia has over 3,300 miles of coast along the Atlantic Ocean and the Chesapeake Bay (DEQ 2014). Beaches and dunes are found in all four of the coastal planning regions adjacent to the Chesapeake or the Atlantic, but these habitats are relatively rare.

Much of Virginia's Atlantic beach and dune habitats on the Eastern Shore have been conserved by a combination of state, federal, and private entities. This area is known as the Virginia Coast Reserve. South of the Chesapeake Bay, along the Atlantic Coast of mainland Virginia, areas of beach and dune habitats are conserved within Back Bay National Wildlife Refuge and First Landing State Park. With a large amount of beach habitat under conservation, business and industrial development is not a significant a threat for this area of Atlantic beaches and dunes. Sea-level rise and land subsidence, however, are considered to be a threat. Several climate models indicate ocean levels could rise by three feet or more by 2100, potentially leaving hundreds of acres of Virginia's shorelines vulnerable to inundation (VIMS 2013).

Residential development is a concern on the Bayside of the Eastern Shore and other portions of Virginia's coastline. Building homes, roads, and other structures, combined with increasing levels of human activity, can impact beach nesting species and diminish the quality of these coastal habitats.

Partners also expressed concerns related to landowner and community efforts to protect developed areas from wind and wave activity. Coastal areas are dynamic with beaches and dunes shifting and migrating as they are influenced by wind, waves, and other factors. These shifting shorelines can threaten homes and other structures. Shoreline hardening, or the use of solid bulkheads or boulders to disrupt the natural movement of shorelines, is a relatively quick and economical way to protect these developed areas (NRC 2007; Kane 2011). Unfortunately, hardened shorelines limit wildlife use and access and, as sea levels rise, prevent beach migration, often resulting in beach habitats being submerged and lost. Invasive species, such beach vitex (*Vitex rotundifolia*), are also problematic for beaches and dunes as they can alter the shifting nature of dunes, cover beaches, and often eliminate native plants that are beneficial to wildlife.

There are three primary actions that will help conserve the quality and longevity of Virginia's beach and dune habitats. The first includes working with communities to manage human activities on beaches and dunes at specific times when wildlife, such as beach nesting birds and sea turtles, are most vulnerable to disturbance. This management action may not need to result in permanent human exclusion.

As noted earlier, beaches and dunes are active and dynamic habitats that move in response to wind and wave activity. If prevented from moving, these relatively rare habitats can be submerged or overgrown and converted into other, more common, habitats that do not support the unique set of beach and dune-dependent species. Preventing development and refraining from shoreline hardening in areas inland and adjacent to existing beach and dune systems would help ensure the long-term persistence of these systems as sea levels continue to rise and lands continue to subside.

The third action includes focusing on invasive species and predator control. Virginia's beaches, dunes, and mudflats are recognized as internationally important areas for migrating birds and other species (TNC 2015). The degradation of these habitats by invasive plants, or the disruption of nesting by predation, can have profound impacts on wildlife populations. It is important that conservation partners work to eradicate invasive plants as they are detected, prevent the introduction of new invasive species, and limit avian and mammalian predators as needed to support beach and dune nesting species.

### *Wetland Habitats*

The term "wetlands" refers to a complex combination of habitats. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and human disturbance. USEPA regulations define wetlands as, "…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (40 CFR 230.3(t))." Wetlands are frequently classified by the types of vegetation they support: emergent, shrub/scrub, and forested.

Across Virginia, there are approximately one million acres of tidal and non-tidal wetlands (DEQ 2014). Tidal wetlands are made up of both salt and brackish marshes that are dominated by grasses, forbs, and sometimes shrubs, and they are found along Virginia's coastal areas (Comer 2003). They also include tidally influenced swamps. Approximately 236,000 acres of tidal wetlands remain in Virginia (DEQ 2014). Tidal marshes are found in all eight coastal planning regions. Depending upon the planning region, they may occupy as little as 0.1 percent to approximately 8.0 percent of the land area.

The second wetland type within Virginia is freshwater, non-tidally influenced wetland. These freshwater, nontidal wetlands include a diversity of emergent, scrub/shrub, and forested wetland and swamps (Anderson et al. 2013). Freshwater systems are dynamic habitats which, as they age, can change from emergent to shrub, or forested forms. Freshwater wetlands can also include spring seeps in the mountains, sink hole ponds, vernal ponds, and other forest wetland communities. Approximately, 808,000 acres of non-tidal wetlands remain in Virginia (DEQ 2014). Non-tidal wetlands are found across all of Virginia and all planning regions. However, they often constitute a small portion of the total land cover within any given planning region.

Virginia has lost approximately 40 percent of all its precolonial wetlands (DEQ 2014). Of Virginia's remaining wetlands, 72 percent are in the Coastal Plain, 20 percent in the Piedmont, and 9 percent in the rest of the state (DEQ 2014). Wetland habitat quality is severely stressed in the Hampton Roads area and moderately to severely stressed around Richmond, Fredericksburg, and Northern Virginia (CZM 2011). Additionally, wetland water quality is also moderately to severely stressed in those same areas as well as much of southeastern coastal Virginia and the Eastern Shore (CZM 2011). Anderson et al. (2013) project a range of approximately 45 to 750 acres of Virginia's freshwater wetlands will be lost per year over the next 50 years.

In addition to their habitat value, wetlands provide many valuable ecosystem services to human communities. Wetlands help prevent nutrients and other harmful materials from flowing into streams, they can protect inland areas from floods and storm surges, and they provide recreational opportunities for hunters, anglers, and wildlife watchers. Four issues represent the greatest threats to Virginia's wetland habitats:

- Degradation of water quality,
- Land conversion/ land use changes,
- Invasive species, and
- Sea-level rise/ inundation.

As discussed previously, the updated Wildlife Action Plan utilizes the Virginia Wetlands Catalog to identify healthy and intact watersheds that are priorities for conservation. Designation of wetland conservation priority areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 3.1) (Weber and Bulluck 2014). DCR also identifies degraded wetlands and prioritizes these areas based upon their restoration potential. The restoration wetlands were identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 3.2) (Weber and Bulluck 2014). Priority areas for conservation and restoration to address the threats described below are highlighted in each Local Summary using the rankings provided by the Virginia Wetlands Catalog. Maps of priority wetlands for conservation and restoration are provided within each Local Summary.

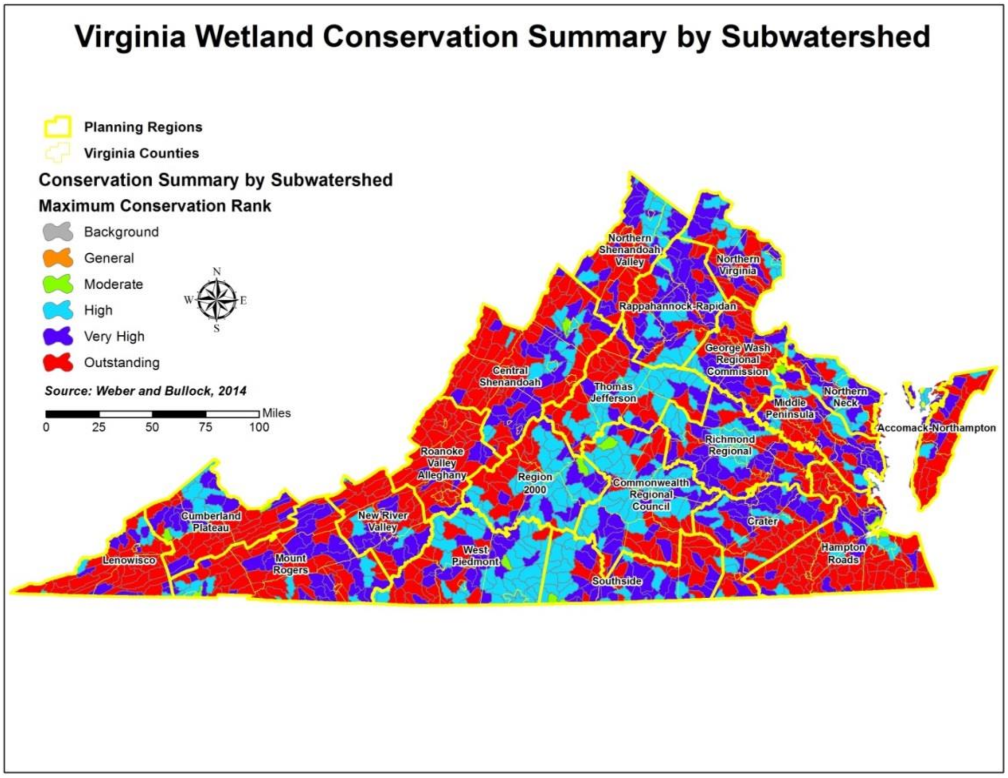


Figure 3.1. HUC12 Watersheds Containing Priority Wetlands for Conservation (Weber and Bulluck 2014).

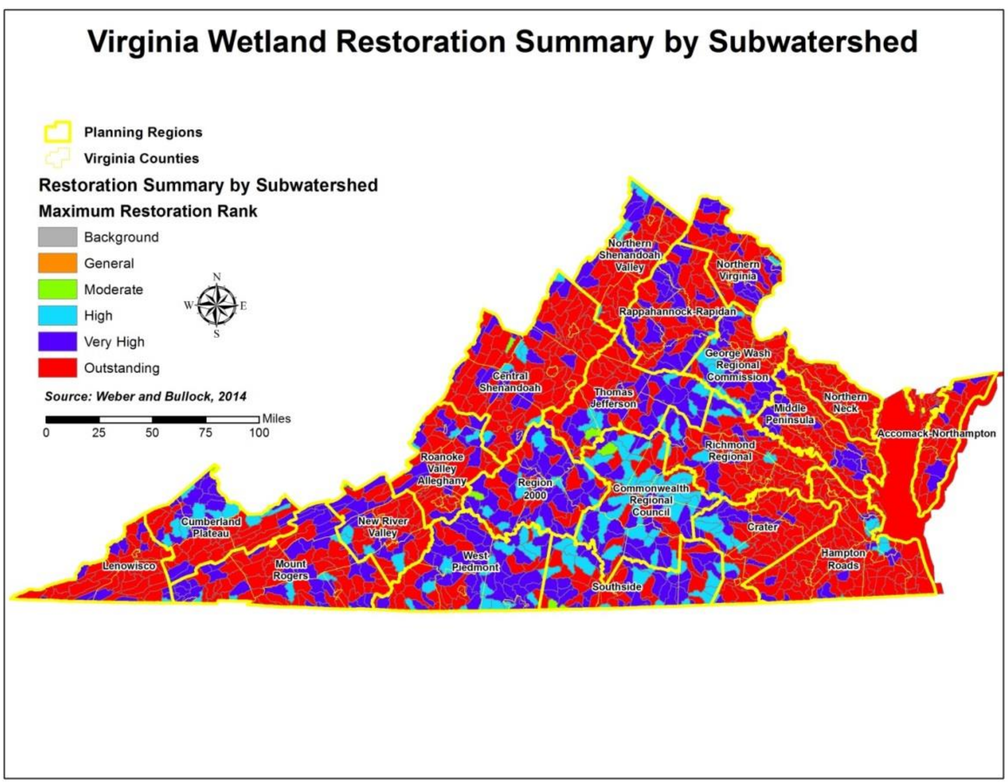


Figure 3.2. HUC12 Watersheds Containing Priority Wetlands for Restoration (Weber and Bulluck 2014).

### Wetlands and Water Quality

Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the Commonwealth. The most significant threats to water quality involve sediment, nutrients, chemical pollutants, and fecal matter flowing from the riparian areas and upland habitats into streams, and rivers. Efforts to address water quality issues will also benefit efforts to conserve and restore Virginia's wetland habitats.

### Wetlands and Land Conversion/ Land Use Changes

Although Virginia has a no net loss policy that applies to development projects and a permitting process established under the Virginia Water Protection Permit Program, all wetland types can be converted, either intentionally or accidentally, to other land uses. Many non-tidal wetlands are filled and converted to upland habitats that can be used for lawns, agriculture, commercial development, or other purposes. In other cases, the construction of impoundments inundates non-tidal wetlands and result in open water habitats (DEQ 2011). While wetland conversion conducted under a permit often require some form of wetland restoration, enhancement, or mitigation to offset the habitat loss, many small wetlands, which are difficult to map and track, can be quickly and easily inundated or converted with little risk of regulatory action (DGIF personal communication 2014).

The most significant and extensive threat to tidal wetlands involves the filling of wetlands to make areas suitable for residential and other types of development (CZM 2011; DEQ 2011). Sea-level rise and invasive species are also significant threats (CZM 2011). Hydrologic alteration (ditching, channelization, diversions, etc.), which prevents water from getting to the wetlands, and erosion, which fills wetlands, are moderate threats but extensive throughout the region (CZM 2011; DEQ 2011). Pollution is also a problem in much of the state (CZM 2011). Additionally, tracking of the no net loss policy and implemented mitigation is not as well established for tidal wetlands as it is for non-tidal wetlands (CZM 2011).

To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has that authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ or VMRC (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines that can negatively affect wetlands. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods, living shorelines can help protect private property from erosion while also protecting wetland habitats (Kane 2011; VIMS 2010). Establishing or protecting vegetative buffers upland and upstream of wetlands is important to protect the health of existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Although a proportion of tidal and non-tidal wetlands in many planning regions are protected in National Wildlife Refuges and other protected areas, the protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN.

### Wetlands and Invasive Species

Scores of invasive species have been introduced into Virginia. These invasive plants and animals often degrade the quality of wetland habitat through damage or loss to wetland vegetation. *Phragmites* is the most damaging invasive plant impacting Virginia's tidal wetlands. This species can out-compete native vegetation, creating a wetland monoculture with diminished function and habitat value. Purple loosestrife and Japanese stilt grass are also widespread in Virginia and degrade the quality of Virginia's freshwater wetlands. Faunal threats include mute swans, nutria, and feral hogs. Once populations of these species become established, they become incredibly difficult and expensive to eradicate (VISWG 2012).

Multiple state and federal agencies work to address invasive species issues within Virginia. Despite this effort, there are insufficient human and financial resources in Virginia to completely eradicate all invasive species. In order to facilitate and enhance the Commonwealth's ability to address invasive species, the Virginia Invasive Species Working Group completed the Virginia Invasive Species Management Plan (VISWG 2012). This document identifies seven goals (each with multiple strategies) for addressing invasive species issues in Virginia, many of which relate to wetlands (See Invasive Species section for more information below).

### Wetlands and Sea Level Rise / Inundation

As sea levels rise, wetlands may be inundated and convert to shallow open water habitats. Likewise, non-tidal and brackish wetlands may convert to higher salinity marshes. Shallow open water habitats and salt marshes will not support the same vegetative composition as the existing non-tidal and tidal wetlands, affecting the wildlife species that depend on these habitats (CCSP 2009). As botanical communities are degraded by changing conditions, they may become more susceptible to invasive species. Additionally, as storms become more intense, more frequent storm surges and inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances (CCSP 2009).

Climate-related wetlands conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

### *Freshwater Aquatic and Riparian Habitats*

Rivers and streams can be described using a variety of different factors such as flow, temperature, slope, water chemistry, and substrate. In discussions with conservation partners, four important freshwater habitat types were identified: *tidally influenced, non-tidally influenced warm water, cold water, and blackwater*.

Tidally influenced rivers experience some degree of tidal action. Salinity levels can vary greatly in tidally influenced waters (0.5 parts per thousand (ppt) to 35 ppt in the open ocean) and depend upon location within an estuary, the tides, and volume of freshwater inputs (VIMS website 2015). Tidal rivers and streams are typically associated with mudflats, swamps, and brackish and salt water wetlands (Anderson et al. 2013). Tidally influenced rivers occur east of the fall line in all eight coastal planning regions.

Blackwater streams and rivers are acidic, slow moving streams characterized by having a high level of tannins. Blackwater streams are confined to southeastern Virginia.

Cold water rivers and streams are characterized by the presence of trout and a water temperature that rarely exceeds 70 degrees Fahrenheit during the summer months (DGIF personal communication 2014). Cold water streams are generally found along the Blue Ridge and in the western mountains.

Non-tidal warm water rivers and streams encompass all rivers that are not cold water trout streams or tidally influenced. They represent the majority of streams and rivers within Virginia (Anderson et al. 2013). It is important to note that cold water rivers face challenges that the warm water aquatic systems do not experience. These additional threats are highlighted below.

Over 60 percent of Virginia's Action Plan species depend on one of these aquatic habitats. In reviewing their basic habitat needs, clean water and unsilted substrate were frequently identified as fundamental water quality requirements for many SGCN. Virginia's first Wildlife Action Plan indicated water quality can be impaired by a variety of factors and circumstances that allow or enhance the flow of sediment, chemicals, and nutrients into local watersheds. When input of these pollutants is negligible, water quality remains unimpaired; however, in cases when the flow of these materials is significant, water quality is often degraded to the point of threatening wildlife populations and human health.

Since the National Clean Water Act was implemented in the 1970s, substantial improvements have been made that curb point source pollution and water quality has dramatically improved. Non-point source pollution, however, continues to be a major threat to waterways in the state (Duke University et al. 2009). DEQ serves as the Commonwealth's lead agency for identifying and addressing nonpoint source pollution. DEQ staff test Virginia's waters to detect pollutants and identify threats to human health and safety. Water bodies that do not meet water quality standards are designated as being impaired. Water bodies are designated as impaired if they are found to:

- Exceed ambient water quality standards for aquatic life and human health;
- Require fishing restrictions or advisories;
- Require restrictions on the consumption of shellfish due to contamination;
- Show an over-enrichment of nutrients;
- Demonstrate significant declines in aquatic life biodiversity or populations; and/or

- Demonstrate sediment contamination at levels which violate water quality standards or threated aquatic live or human health (DEQ 2014).

Under section 303d of the Clean Water Act, many of the most severely impaired waters require a Total Maximum Daily Load (TMDL) be identified. The TMDL represents the total pollutant a water body can assimilate and still meet water quality standards. Once a TMDL has been established, DEQ staff, partners, and the public collaborate to create a Water Quality Improvement Plan that identifies and prioritizes actions needed to restore water quality.[2] This Action Plan recognizes the 325 watersheds with a TMDL and Water Quality Improvement Plans as conservation priorities for aquatic and riparian habitats (Figure 3.3).

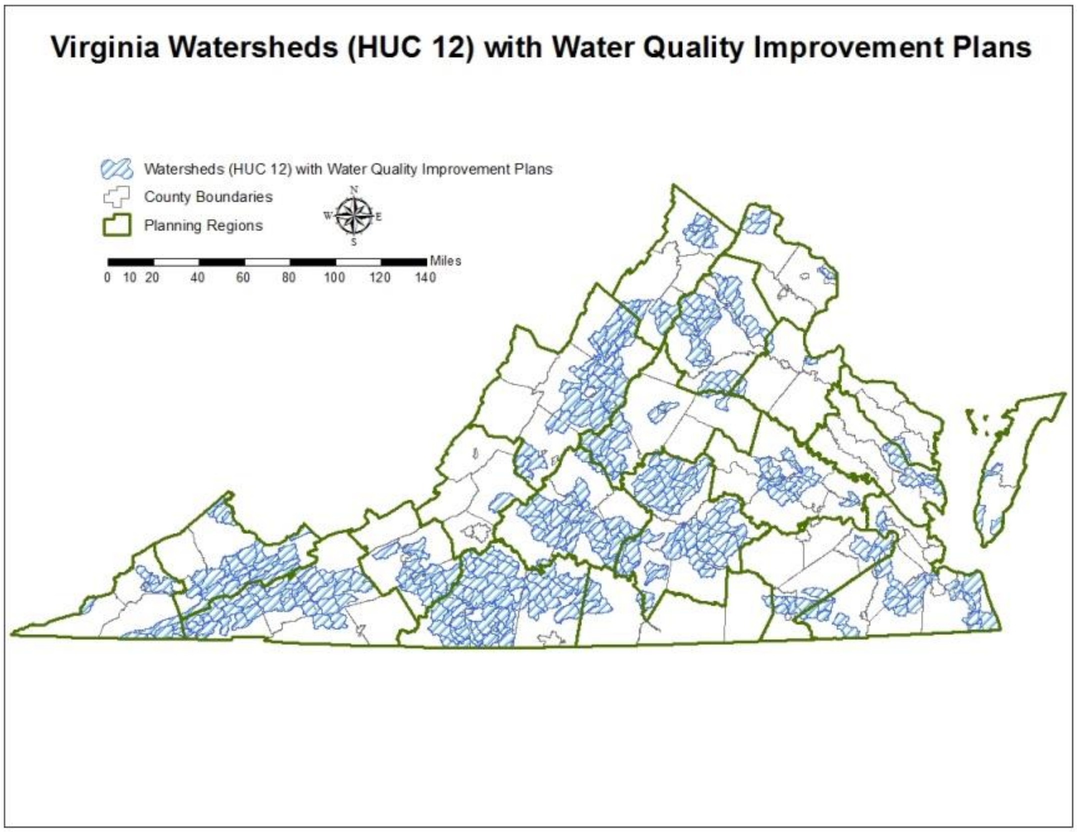


Figure 3.3. Virginia Watersheds with Water Quality Improvement Plans.

Some conservation partners have expressed concern about establishing a strong connection between the Action Plan and the TMDL program. These concerns warrant discussion.

1. The first concern involves the issue that some watersheds containing blackwater or swamp systems have naturally occurring lower levels of dissolved oxygen or low pH. Under TMDL guidelines, many of these watersheds could be classified as impaired even though the systems are healthy.

[2] A current list of available Water Quality Implementation Plans can be found on DEQ's website: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLImplementation/TMDLImplementationPlans.aspx

2. The second concern relates to how aquatic macroinvertebrates are used for biological monitoring under the TMDL system. Many macroinvertebrates are sensitive to pollutants, and monitoring changes in these invertebrate communities provides a reasonable measure of water quality. However, data are compiled at the taxonomic levels of genus or family, not at the species level (DEQ 2013). This approach may be appropriate to assess water quality for human health, but it does not provide specific enough data for identifying water impairment at a level that may be impactful on resident aquatic wildlife species. Aquatic wildlife can exhibit dramatically different tolerances to variations in stream flow or water chemistry, even if they are closely related. For example, the pheasantshell mussel (*Actinonaias pectorosa*) is in the taxonomic family Unionidae, is native to the Clinch River, and does not appear to be imperiled or in decline. Other members of this taxonomic family, such as the dromedary pearlymussel (*Dromus dromus*) and the elephantear (*Elliptio crassidens*) also occur in the Clinch River, but the dromedary pearlymussel is listed within the Wildlife Action Plan as a Tier I species (critical conservation need) and the elephantear is listed as a Tier IV species (moderate conservation need). By not evaluating rivers by the species they support, it is possible important wildlife conservation issues will not be identified.

3. There are instances where wildlife may be more sensitive to impairments than human communities or the invertebrates that are monitored to represent all wildlife. For example, the bridle shiner (*Notropis bifrenatus*) is a Tier I fish that hunts by sight. This shiner's ability to feed is impaired by even moderate levels of turbidity (Jenkins and Burkhead 1993). While a mild erosion issue would be unlikely to impact human communities and result in a TMDL, it could significantly impact the persistence of downstream bridle shiner populations.

4. Finally, impaired waters are described as stream segments. When monitoring for human health impacts, this level of precision is necessary to help the public avoid degraded areas. However, several aquatic biologists have noted that water quality impairments often reflect conditions throughout the entire watershed. This Action Plan is designed to address wildlife habitat, and focusing on efforts at the exact location of impairment may not be the most effective strategy for addressing water quality impacts upon habitat. Entire watersheds are prioritized for action as opposed to focusing only on impaired segments.

Despite these drawbacks, the TMDL system has a number of important strengths that will enhance Action Plan implementation. The TMDL program represents an ongoing, statewide, effort to measure and monitor water quality and make that information available to the public. Accessing and utilizing these data do not require human or financial investment on the part of DGIF or other members of the wildlife conservation community. Additionally, the Water Quality Improvement Plans were created to address water quality impairments, identify sources of those impairments, and describe actions needed to address those issues. While these plans are driven by human health concerns, the vast majority of TMDL impairments indicated within the improvement plans, such as eroding shorelines; degraded riparian vegetation; and the flow of fecal matter, fertilizers, and other harmful substances into rivers, also threaten wildlife populations. The Water Quality Improvement Plans, created with significant local collaboration and input, also articulate actions which, if implemented, address the documented impairments. Integrating these actions into the Action Plan allows practitioners to focus on conservation actions that have already been vetted through a formal public review process.

Finally, the issue of geographic specificity (stream reaches versus watersheds) can be addressed using GIS. The U.S. Geological Survey's National Hydrography Dataset has subdivided Virginia's landscape into

1,278 units known as HUC12 watersheds (Weary and Doctor 2014). Each HUC12 watershed ranges from 15 square miles to 65 square miles. DGIF used DEQ's map of impaired stream reaches to develop a map identifying the 325 HUC12 watersheds that contain impaired waters for which a TMDL plan has been written. Lacking a different system of similar rigor, Virginia's Wildlife Action Plan will utilize the Virginia TMDL framework to identify priority HUC12 watersheds for restoration and describe actions needed to improve aquatic habitat conditions.

An analysis of the existing Water Quality Improvement Plans indicates the most significant threats to water quality often relate to the management of riparian and upland areas. The most significant sources of water quality impairments include:

- Livestock allowed access to streams or insufficient controls to prevent animal waste from flowing into streams;
- Lack of vegetated riparian buffers;
- Lack of trees or other vegetation on highly erodible lands;
- Lack of cover crops on agricultural fields;
- Failing septic systems and "straight pipes" that deposit human waste into streams;
- Insufficient stormwater controls to prevent the flow of bacteria, phosphorus, and sediment into streams from areas with high levels of impervious surfaces; and
- Pet waste entering waterways.

Water Quality Improvement Plans also identified wildlife as a contributing source of fecal coliform impairments. Although no species were identified, it is assumed that deer, waterfowl, and aquatic mammals such as beaver, muskrat, and otter are the most likely contributors. At present, none of the existing plans discuss this issue in any detail or provide actions that can be taken to address this wildlife-related concern. Lacking additional guidance, it is assumed that the recommended list of conservation actions (see below) will help address at least some of the wildlife-related concerns. Broader, species-specific, conversations may be required.

A summary of each water quality improvement plan is provided as part of the aquatic habitat discussion within each Local Summary. The most frequently cited conservation actions include:

- Working with landowners to exclude livestock from streams;
- Establishing vegetated riparian buffers along waterways, especially along pastures and croplands to minimize soil erosion and the overland flow of fertilizers, pesticides, herbicides, and fecal material into streams;
- Repairing, stabilizing, and restoring stream banks to minimize erosion;
- Revegetating highly erodible areas and providing sediment retention/control to prevent sediment from flowing into streams;
- Maintaining cover crops on cropland to minimize the flow of sediment, fertilizers, pesticides, and herbicides into streams when fields are not being used to produce other crops;
- Repairing or replacing failing septic systems and eliminating "straight pipes" depositing human waste into streams;
- Maintaining and expanding systems to manage storm water runoff to prevent bacteria, phosphorous, and sediment from flowing into streams from areas of impervious surface;
- As needed, working with pet owners to implement a program to prevent pet waste from flowing into streams; and

- As needed, working to enhance sewage pump out sites for boats.

### Cold Water Streams

As indicated previously, cold water streams include water bodies that do not exceed 70 degrees Fahrenheit for extended periods (DGIF personal communication 2014). Brook trout is an Action Plan species that relies upon these cold water habitats and will be used to represent other similar cold water species. In addition to many of the issues identified for other rivers, cold water streams may also be degraded by thermal impairments and acid deposition.

Low water temperatures are maintained in cold water streams through stream shading and cold groundwater inputs. If trees are removed from these riparian areas or if the flow of groundwater into streams is disrupted, water temperatures can become too warm to support brook trout and other cold water species. The 2011 Eastern Brook Trout Joint Venture Conservation Strategy stresses the value of healthy riparian buffers and the utility of working with public and private landowners to restore riparian forests to improve degraded habitats (Eastern Brook Trout Joint Venture 2011). Working to maintain forest cover and minimizing the amount of impervious surface within a watershed will help maintain the infiltration of water into the groundwater system.

Many of Virginia's cold water streams are impacted by acidic precipitation. When acidic rain enters a stream, water chemistry is altered, which may eliminate or significantly degrade brook trout habitats. As indicated by the Eastern Brook Trout Joint Ventures Conservation Strategy adding lime (coarse limestone sand) to a stream can temporarily mitigate the impact of acid precipitation. While it is not a permanent solution, DGIF biologists have employed this technique to maintain specific brook trout populations (Eastern Brook Trout Joint Venture 2011). DGIF will continue collaborating with private, state, and federal partners to implement efforts to improve the condition of cold water habitats.

### High Integrity Watersheds

As indicated previously (see Habitat Focus), the Virginia Watershed Integrity Model considered a variety of biotic, abiotic, and human use factors to consider the quality of Virginia's watersheds and identify high quality drainages. In addition to restoring the quality of impaired waters, it is important that Virginia's conservation community work to maintain the health of Virginia's High Integrity watersheds (Figure 3.4). DGIF will continue collaborating with private, state, and federal partners to implement efforts to maintain or improve the quality of water within these watersheds. Information on high priority watersheds have been provided within each Local Summary and these data will be updated as new information becomes available.

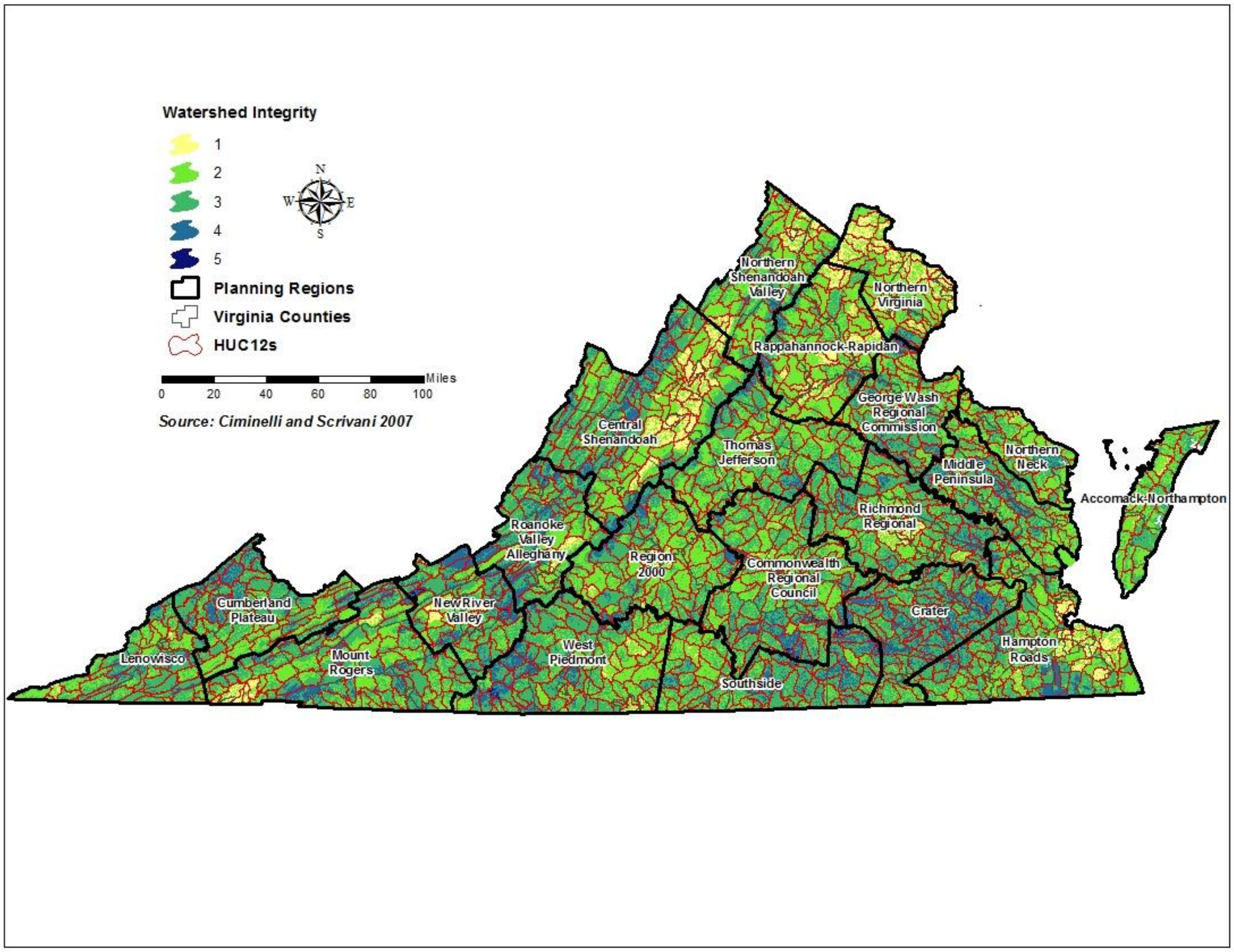


Figure 3.4. Virginia Watershed Integrity Model (Ciminelli and Scrivani 2007).

## Aquatic Connectivity

A lack of aquatic connectivity has been identified as a significant threat to the conservation of aquatic SGCN (Martin and Apse 2013) (DGIF 1991) (Martin et al. 2014). DGIF implements a Fish Passage program that works to enhance aquatic connectivity by either removing or modifying dams and other impediments so that fish and other aquatic species may move more freely throughout individual watersheds. This program has been funded with State Wildlife Grants and other resources. DGIF intends to continue using State Wildlife Grants and other resources to enhance the connectivity of Virginia's rivers. Likewise, these resources may be used to document the effectiveness of these restoration efforts by monitoring changes in habitats, water quality, and aquatic wildlife communities after the impairment has been removed or modified. It is DGIF's intent to use the Chesapeake Bay Fish Prioritization Tool, the Southeast Aquatic Connectivity Assessment Tool, landowner willingness, and other criteria to identify priority areas (Figure 3.5) for work during DGIF's annual budgeting and work planning process.

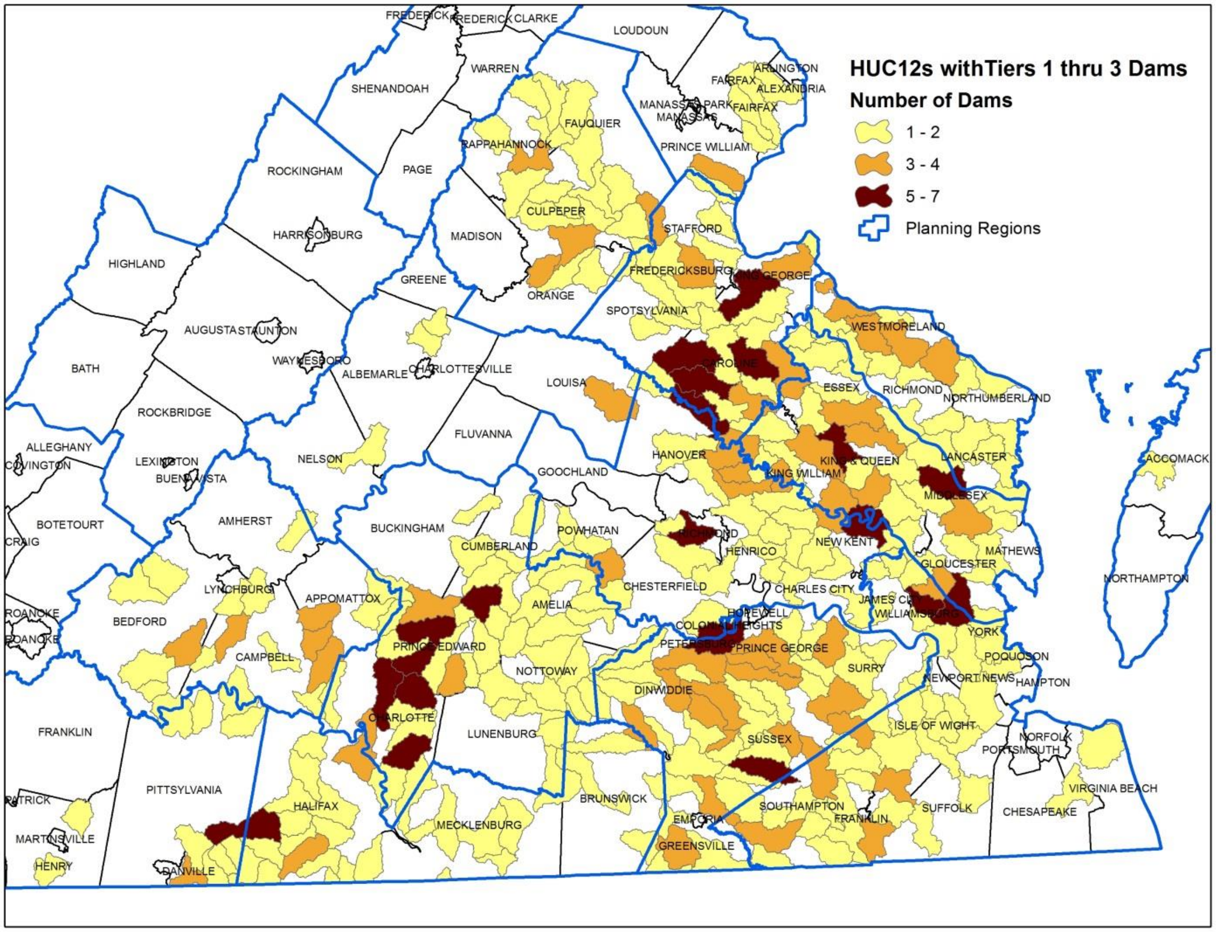


Figure 3.5. Watersheds in the Chesapeake and Albemarle Drainages Identified as Priorities for Improving Aquatic Connectivity (Martin and Apse 2013).

## *Open Habitats*

For this Action Plan, DGIF uses the term "open habitats" to represent an assortment of communities that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have identified several types of open habitats that are important for Action Plan species. These habitats include glades and barrens, savannas, and post-agricultural (old field) habitats. They also can include openings or clearings which are primarily herbaceous fields within woodlands. These open habitats are important to a variety of SGCN, including northern bobwhite quail, golden-winged warblers, the seven SGCN bumble bees, the monarch butterfly, and other native pollinators. Two issues threaten the existence and quality of Virginia's open habitats. The first is development. Open habitats can be easily converted to human uses. The second involve the lack of natural disturbance regimes that hinder natural successional processes. Given the Commonwealth's climate, latitude, and soils, Virginia's landscape can support a diversity of forests. During precolonial times, natural and anthropogenic fires, floods, hurricanes, ice storms, and insect outbreaks would create and maintain large areas of open habitat within the larger forested landscape (Oehler et al. 2006).  In modern times, many of these issues are controlled; allowing trees to grow and create a canopy that eliminates the open character of these habitats. Open habitats must be managed using fire or other tools that preserve their openness.

### Glades and Barrens

Glades and barrens are naturally occurring open habitats that are characterized by shallow soils and rocky substrates. These habitats generally have a grassy layer with some low shrubs and herbs and scattered trees (often less than 40 percent of tree cover) as well as patches of moss and lichen (Anderson et al. 2013; Fleming et al. 2013; Comer 2003). Open rocky areas can also be predominant (Comer 2003). Glade and barren habitats are found in 12 planning regions in the more central and western portions of the state.

Glades and barrens represent distinct botanical communities (C. Ludwig, VA Dept. of Conservation and Recreation, Natural Heritage Program, personal communication 2015). Because of their small size, prolonged disturbances can eliminate these botanical communities, and because these habitats tend to be geographically isolated, once a community is eliminated, it may be impossible for many species to reoccupy a site without human intervention. Historic threats to these systems have included intense quarrying, which has resulted in loss of many habitat patches and the fragmentation of surrounding areas (Anderson et al. 2013). Some glades and barrens occur within agricultural lands, which also can lead to fragmentation and degradation of the habitat from overgrazing. The introduction of non-native and invasive species threatens native species endemic to these habitats, and recreational activities within these habitats often results in trampled vegetation (USFS 2014).

In order to conserve glade and barren habitats, the conservation community can work collaboratively with public and private landowners to conserve these areas either through easement, acquisition, or agreement. As agencies consider land acquisitions, they should consider giving greater priority to properties that contain current or historic glade and barren habitats. Where these habitats have been conserved, important management actions include prescribed burns and managing wildfires, monitoring and controlling non-native species, and managing the recreational use of areas to prevent the trampling of rare plant communities (USFS 2014).

### Savannas

Savannas are unique communities dominated by large mature trees, open canopies, low densities of young trees, and abundant grass and forb ground covers. A few examples of hardwood savannas occur on military installations in northern and eastern Virginia and small acreages of longleaf pine savanna occur on conserved lands in southeast Virginia. Historically, savannas would have been maintained by wildfires or anthropogenic fires that would have removed shrubs and young trees while leaving mature trees intact. Today, savannas are maintained by prescribed fire. While existing savanna habitats can be maintained with management, new savannas are not likely to be created through natural processes.

While savannas offer unique habitat conditions that can support an assortment of species, they have limited economic value. As such, few private landowners can afford to manage their properties to include a savanna habitat. Historic fire suppression on conserved lands has allowed diverse mixed forest communities to exist in areas that were once savanna communities. The only viable means of creating and maintaining savannas involves working with public and private landowners to conserve areas through acquisition, easement, or agreement and managing those areas with fire to preserve mature trees while eliminating younger aged trees and shrubs. To maximize the benefit of these efforts, Virginia's conservation community should focus such efforts on areas either adjacent to, or in close proximity to, existing savanna habitats.

### Post Agricultural (Old Field) Habitats

Post-agricultural habitats include fields, orchards, or pastures that are taken out of production and allowed to go fallow. Two basic circumstances can result in the creation of a post-agricultural habitat. First, changing markets or other circumstances create a situation where a property is economically unviable. In other instances, a conservation-minded landowner may choose to manage portions of their property as habitat for some suite of wildlife. Although it can be incredibly useful from a wildlife management perspective, very little post-agricultural habitat exists in Virginia. Relatively high crop prices and the potential for a developing biofuels industry allow many agricultural properties to remain economically viable. In many cases, despite a desire to provide habitat, many landowners lack the financial means needed to bring portions of their property out of production. Likewise, some agricultural landowners may be influenced by a persistent cultural attitude that fallow land represents a management failure by the owner.

Small acreages of post-agricultural lands can be found throughout Virginia, and these can be managed to provide a diversity of wildlife habitats. Unfortunately, because these lands may be valuable for agricultural purposes, they tend to be very expensive to acquire. Despite this, the diversity of management opportunities makes these areas desirable for wildlife conservation. Agriculturally viable soils are one factor considered by the DGIF when evaluating a parcel for acquisition, because healthy soils facilitate establishment of beneficial habitats. When retired agricultural lands have been conserved, their unique habitat conditions tend to persist for 10 to 20 years before maturing into a different (likely a forested or shrub) habitat type. Working with willing private landowners to conserve these properties through acquisition, easement, or agreement will provide a means of bringing these properties into a conserved state.

One of the primary programs for conserving and restoring open habitats within Virginia is Virginia's Quail Recovery Initiative (QRI), which is a robust multi-partner effort. While the QRI uses quail as a focal species, quail compatible habitats are known to support a suite of other SGCN including field sparrows, eastern towhees, brown thrashers, prairie warblers, seven bumble bee species, and the monarch butterfly. QRI efforts are directed towards six focus areas based upon Soil and Water Conservation Districts (SWCD). The six focus areas include:

- Chowan Basin SWCD – covers Sussex, Southampton, and Greenville Counties;
- Halifax SWCD – covers Halifax County;
- Big Walker SWCD – covers Bland and Wythe Counties;
- Headwaters SWCD – covers Augusta County;
- Culpepper SWCD – covers Green, Orange, Madison, Culpepper, and Rappahannock Counties; and
- Three Rivers SWCD – covers Essex, King and Queen, and King William Counties

These six districts will be recognized as priorities for open habitat conservation within the Action Plan. As the QRI is updated or adapted, new priorities will be incorporated into the online version of the Action Plan.

## *Forest Habitats*

Virginia's forests cover approximately 62 percent of Virginia (15.8 million acres), of which 15.3 million acres are available for commercial harvest, and 500,000 acres are reserved forested lands (or lands not in production) (DOF 2010). More than 12.9 million acres (over 80 percent) of forests in the state are privately owned, while approximately 16 percent of the forested area is publicly owned (owned by federal, state, or local agencies) (DOF 2010). The USFS manages the largest portion of public forested lands, 1.6 million acres, while Virginia's DOF manages 65,000 acres in 20 different state forests (DOF 2010). There are two main types of forests described within this Action Plan – mixed hardwood/ conifer and spruce fir. Mixed hardwood and conifer forests can host a range of oak, hickory, and pine species, including pitch pine (*Pinus rigida*), Table Mountain pine (*P. pungens*), shortleaf pine, white pine, white oaks, southern red oak, northern red oak, chestnut oak, and live oak (Comer et al. 2003). Other tree species that may be found in these forests can include red-cedar, American beech, sugar maple, American basswood, and yellow birch, among others (Comer et al. 2003).

### Mixed Hardwood/ Conifer Forests Habitats

Mixed hardwood and conifer forests are found across the state and in all 21 Planning Regions. They make up a large percentage of existing forests. However, threats and conservation actions can vary slightly depending on the location. Threats and conservation actions are described below for mixed hardwood/conifer forests west of the Piedmont and mixed hardwood/conifer forests in the Piedmont and Coastal Plain. Additionally, there are five specific types of mixed hardwood and conifer forests in the state that face varying sets of threats and actions as well. These five forest types (young forests, North Atlantic coastal plain maritime forest, Central Atlantic coastal plain maritime forest, Southern Atlantic coastal plain upland longleaf pine woodland, and Southern Appalachian low elevation pine forest) will be described in more detail individually below.

The habitat value of mixed hardwood and conifer forests west of the Piedmont is limited by a lack of oak and pine regeneration (USFS 2014). This issue is of most concern on publicly owned forests and is of minimal concern on private forests. Information from the Virginia Forest Inventory Assessment indicates less than 5 percent of Virginia's mountain forests are younger than 10 years (DOF 2010). The lack of any regeneration was identified by many Action Plan contributors as being the single greatest challenge for wildlife conservation in Virginia's western mixed hardwood/ conifer forests. While mature forest habitats provide benefits to an assortment of aquatic and terrestrial species, the conspicuous lack of young forest habitats severely limits opportunities for open habitat species such as the northern bobwhite quail, golden-winged warbler, field sparrows, eastern towhees, brown thrashers, prairie warblers, chestnut sided warbler, yellow breasted chat, ruffed grouse, American woodcock, and bumble bee species.

Many of these habitats on federal lands are impacted by destructive insect species (USFS 2014). Gypsy moth (*Lymantris dispar dispar*) caterpillars and emerald ash borer (*Agrilus planipennis*) larva are particularly destructive to oak and ash, respectively. Various pine bark beetle species (Family Scolytidae) infest pine species. In each of these cases, insect activity can either kill mature trees or stress infested trees to the point they become vulnerable to other pests and diseases (Virginia Tech 2008). Impacts from insects can vary from year to year with the greatest effects occurring during outbreak years when large insect populations can affect large numbers of trees over a wide area.

Finally, conservation partners identified acid precipitation and climate change as threats that degrade these forested habitats at higher elevations (i.e., above 3000 feet). The USEPA indicates that acid precipitation can stress trees either by enhancing the leaching of soil nutrients or by dissolving rock and releasing toxic elements such as aluminum into the soil (EPA website 2012). Trees at higher elevations can also be affected by acidic clouds and fog that damage leaves and needles. While acidic precipitation may not immediately kill trees, the additional stress often makes trees susceptible to other issues such as diseases and invasive species. At the current time, no viable on-the-ground management strategies have been identified to address acid precipitation.

In terms of conservation actions, the restoration of successional processes was identified by conservation partners as the most important effort that could be undertaken within the mixed hardwood/ conifer forests on public lands in the western portions of Virginia. Such efforts would provide a greater diversity of habitats capable of supporting dozens of SGCN. In 2014, the USFS determined the desired ecological condition for broad groups of oak forest types in the George Washington National Forest would include a mosaic of compositional and structural diversity of patches, articulated in various age classes and canopy conditions (Tables 3.3 and 3.4) (USFS 2014). These desired conditions could be achieved and maintained through natural disturbances, timber harvest and the use of prescribed fire.

Table 3.3. Desired Ecological Condition of Oak Forest by Age Class (USFS 2014).

| Structure | Open | Mid-Successional Closed Canopy | Mid- Successional Open Canopy | Late Successional Open Canopy | Late Successional Closed Canopy |
|---|---|---|---|---|---|
| **% of ecological system** | 12 | 7 | 10 | 57 | 14 |
| **Age** | 0-15 | 16-69 | 16-69 | 70+ | 70+ |

Table 3.4. Desired Ecological Condition of Pine Forest by Age Class (USFS 2014).

| Structure | Early | Mid-Successional Closed Canopy | Mid-Successional Open Canopy | Late Successional Open Canopy | Late Successional Closed Canopy |
|---|---|---|---|---|---|
| **% of ecological system** | 13 | 3 | 25 | 54 | 5 |
| **Age** | 0-15 | 16-70 | 16-70 | 71+ | 71+ |

Other important conservation actions include working with industry and localities to create development plans that avoid priority forest patches as well as maintaining robust forest buffers along rivers, wetlands, and unique botanical communities such as glades and barrens.

Issues impacting hardwood and conifer forests in the eastern portions of Virginia are distinctly different from the issues impacting similar forests in the western portions of the Commonwealth. For example, forests in the eastern portion of Virginia have a much greater diversity of age structures (DGIF personal communication 2014). They also tend to be more highly fragmented and at greater risk of being converted to other land uses (Anderson et al. 2013). Action Plan partners also noted that these forests are affected by a greater number of invasive species than are found in the west portions of Virginia.

The loss or fragmentation of hardwood and conifer stands was identified by conservation partners as being the single greatest threat to this habitat in the eastern portions of Virginia. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other cases, such as conversion to pine plantations, one specific forest habitat is lost, but these lands can be managed as open habitats that support a diversity of other landowner goals, wildlife species, and recreational opportunities. If BMPs established by the Virginia DOF are followed, impacts to waterways and adjoining properties may be prevented or mitigated (DOF 2011).

Actions for conserving hardwood and conifer forests in Virginia's piedmont and coastal plain include working to conserve, either through acquisition, easement, cooperative management, or incentives large intact forest patches capable of supporting a variety of SGCN. Initial priorities for conservation include patches of hardwood and conifer forests adjacent to conserved lands (wildlife management areas, state parks, national parks, municipal parks, Heritage sites, national wildlife refuges, etc.) and forests buffering rivers, streams, wetlands, and unique botanical communities. These networks of secured lands could be enhanced with new areas to achieve larger, more functional forest cores that are buffered and connected. TNC's Resilient Sites for Terrestrial Conservation analysis can be used to help identify and prioritize protection and conservation of sites that would contribute to a resilient network of forests as well as provide habitat for SGCN (Anderson et al. 2012).

### Young Forests

The term "young forest" is loosely defined and refers to areas dominated by woody seedlings and saplings (Oehler et al. 2006). The term can be applied to any forest type. Previously, young forests have been referred to as a form of early successional habitat. Virginia's forests, especially on public lands in the western portions of the state, lack significant areas of young forests. Given that young forest habitats support a multitude of Action Plan species, DGIF is actively involved with the Wildlife Management Institute's Young Forest Initiative.

Prior to European contact, a variety of natural and anthropogenic disturbance factors resulted in some portion of a forested landscape in North America being made up of younger forest age classes (Oehler et al. 2006). Disturbance factors included floods, hurricanes, ice storms, insect outbreaks, wild fires, and human induced fires. During later periods, logging and land clearing also produced significant amounts of young forest habitat (Oehler et al. 2006). During the last century, with flood control and fire suppression, many of the natural forces that create young forest have been minimized or altered. Likewise, in many parts of the country, logging has become less economically viable – especially on public lands. These altered natural disturbance regimes have resulted in a significant decline of young forests.

Areas can retain young forest conditions for up to 50 years post disturbance, depending upon the location, soil fertility, tree species, and other variables (Oehler et al. 2006). The Wildlife Management Institute, however, indicates young forest conditions are more likely to remain for 15 to 20 years before the botanical community transitions into a mature forest type. Although patches young forest habitats are found throughout Virginia, due to their transient nature, these habitats are profoundly difficult to represent geographically. Young forests are most prominent in the Coastal Plain and southern Piedmont. Of the young forests in the Coastal Plain, many have been planted as pine plantations. These plantations are most likely to occur on private lands (DOF personal communication 2014).

Timber harvest and prescribed fire are the two primary means of creating a young forest habitat from a mature forest habitat (Oehler et al. 2006). The effectiveness of each process will be influenced a variety of factors, including:

- What types of wildlife the manager is interested in conserving?
- What are the current and past conditions of the property (soil type, slope, land use, etc.) that will influence the ability to achieve management goals?
- Does the land have the potential or inherent ability to produce the types of habitats needed for the target wildlife species?
- How large is the property?
- How does the property fit into the overall landscape perspective?
- What management actions are needed to achieve the desired young forest conditions?

Within the Technical Manual, *Virginia's Forestry Best Management Practices for Water Quality* (2011), DOF has established BMPs to help land owners and property managers plan and execute both timber cuts and prescribed burns in ways that achieve management goals and prevent undesirable impacts for young forests (DOF 2011).

### North Atlantic Coastal Plain Maritime Forest

Patches of North Atlantic Coastal Plain Maritime Forest are found along the shores of the eastern portion of Virginia, north of the James River and along Virginia's Eastern Shore barrier islands. This forested habitat may be adjacent to or mixed within dune, swale, or beach habitats. Because of its proximity to the coastline, this forest type typically has few tree species and trees are often stunted. A dense vine layer may also be present (Anderson et al. 2013). Depending on location and exposure to maritime forces, tree species vary but can include pines (e.g., pitch, Virginia, loblolly, and shortleaf pine) and oaks (e.g., scarlet, black, scrub, and post) and eastern red cedar, black cherry, American holly, sassafras, and red maple. Vegetation and habitat is affected by salt spray, wind, sand and dune deposition, and sometimes inundation (Anderson et al. 2013).

There is some disagreement regarding the amount of this habitat that remains in Virginia. In 2007, the Virginia Institute of Marine Science (VIMS) completed a survey to delineate and determine the current distribution of maritime forests in Virginia (Berman and Berquist 2007). Their review of satellite imagery and field surveys indicated that 1,389 acres of this habitat remains, and these communities are only found on the Eastern Shore. This report also indicated over 88 percent of the remaining north Atlantic coastal plain maritime forests occur on conserved lands. By contrast, Anderson et al. indicated Virginia possesses over 14,000 acres along both the eastern and western shores of the Chesapeake Bay (2013). Anderson et al. estimates that 15.6 percent of this habitat occurs on conserved lands (2013). The primary distinction between the two models appears to involve the classification of appropriate soils, the inclusion of wetlands, and distance from a coastal shoreline. The VIMS model included a significant ground survey, specifically targeting maritime forests while the Anderson et al. model was evaluated more generally (2013).

Berman and Berquist (2007) indicate climate change, including sea-level rise and projected increasing storm intensity and frequency, and development are the principal issues threatening these remaining patches of north Atlantic coastal plain maritime forests. When practicable, efforts to reconcile the two habitat maps would help determine if additional acres of north Atlantic coastal plain maritime forest exists. If such habitats are found, it would be advantageous for agencies to work with willing landowners to bring those habitat patches into conservation through acquisition, easement, incentive, or agreement. Given that the vast majority of known acreage has already been conserved, the near-term threat of extirpation is likely slight.

### Central Atlantic Coastal Plain Maritime Forest

This forest type includes a mosaic of forests and shrublands on Atlantic Coast barrier islands and similar coastal strands from Virginia Beach to central South Carolina. Typically less than two miles from the ocean, these maritime forests are influenced by salt spray, extreme disturbance events, and the distinctive climate of the immediate coast. Salt-tolerant evergreen tree species are most common, particularly live oak, wax-myrtle, and loblolly pine. Embedded freshwater depressional wetlands are typically dominated by shrubs or small trees, such as red maple, swamp tupelo, stiff dogwood, or swamp bay (Anderson et al. 2013).

There is also some disagreement regarding the amount of this habitat that remains in Virginia. In 2007, the Virginia Institute of Marine Science (VIMS) completed a survey to delineate and determine the current distribution of maritime forests in Virginia (Berman and Berquist 2007). Their review of satellite imagery and field surveys indicated that 2,704 acres of this habitat remains within the borders of Virginia Beach. This report also indicated all of the remaining central Atlantic coastal plain maritime forests occur on conserved lands. By contrast, TNC indicates Virginia possesses almost 6,300 acres (2013). Anderson et al. (2013) estimate that over 88 percent of this habitat occurs on conserved lands. The primary distinction between the two models appears to involve the classification of appropriate soils, the inclusion of wetlands, and distance from a coastal shoreline. The VIMS model included a significant ground survey, specifically targeting maritime forests while the Anderson et al. model was evaluated more generally.

Berman and Berquist (2007) indicate climate change, including sea-level rise and the threat of increasing storm intensity and frequency, and development are the principal issues threatening these remaining patches of central Atlantic coastal plain maritime forests. When practicable, efforts to reconcile the two habitat maps would help determine if another 3,600 acres of central Atlantic maritime forest exists. If such habitats are found, it would be advantageous for agencies to work with willing landowners to bring those habitat patches into conservation through acquisition, easement, incentive, or agreement. Other than working to support the management and conservation actions at Back Bay National Wildlife Refuge, False Cape State Park, and First Landing State Park, additional conservation actions do not appear to be warranted at this time.

### Southern Atlantic Coastal Plain Upland Longleaf Pine Woodland

Southern Atlantic coastal plain upland longleaf pine woodland is found in a few small patches in southeastern Virginia within the coastal plain on sites characterized by sandy soils. Specific forest composition varies based upon management. In areas that experience infrequent fires, oaks (e.g., southern red, post, blackjack, turkey) dominate, while areas with more frequent fires are dominated by longleaf pines. The understory may be made up of scrub oaks or heath shrub. This forest type was once more prevalent in Virginia, but with clearing, agricultural conversion to other species and fire exclusion over the decades, longleaf pine has largely been replaced by loblolly pine (Anderson et al. 2013).

Anderson et al. (2013) indicate fewer than 600 acres of this forest type occur in Virginia. Of these, 28 percent occur on conserved lands. Although longleaf pine has a variety of economic values, many private landowners find loblolly pines to be a more viable economic alternative (DOF 2007). In the near term, priorities for conserving and restoring longleaf pine woodlands should focus on working with willing landowners to conserve the remaining stands of southern Atlantic coastal plain upland longleaf pine woodlands either through acquisition, easement, or agreement and continuing efforts to restore longleaf pines to forest communities on conserved lands. Opportunities may also exist to collaborate with private landowners to help restore longleaf pines to forest communities through easements, incentives, or cooperative agreements. Priority needs will focus on private lands that are either adjacent, or are in close proximity to, existing longleaf pine stands and pine savannas.

#### Southern Appalachian Low Elevation Pine Forest

This habitat is described as an open forest or woodland of acidic substrates at low elevations in southwest Virginia (Anderson et al. 2013). Vegetation is dominated by Virginia pine and shortleaf pine, occasionally with pitch pine. Hardwoods may be abundant, especially dry-site oaks such as southern red oak, chestnut oak, and scarlet oak, but also pignut hickory, red maple, and others. A heath shrub layer may be well developed. Herbs are usually sparse, though communities of this system may have been grassy when fires were more frequent. The ecological character and natural distribution of this system has been obscured over the years by the loss of shortleaf pine due to human settlement, universal logging, pine beetle outbreaks, and fire suppression (Anderson et al. 2013). Despite the forest type's tolerance for a wide range of ecological conditions and its economic viability, the Virginia Cooperative Extension indicates a decline of almost 90 percent of shortleaf acreage since 1940 (Gagnon and Johnson 2009).

Given the dramatic decline of shortleaf pine in recent decades, there is a growing realization that shortleaf pine restoration is warranted. Such restoration efforts could potentially benefit a number of SGCN including northern bobwhite and red cockaded woodpecker (Burns et al. 1990). Working to restore or enhance shortleaf pine within existing patches of southern Appalachian low elevation pine forests as well as new areas would be beneficial. Efforts could occur on agency lands and in coordination with interested private land owners. Virginia Tech Cooperative Extension indicates growing and mature shortleaf pine benefit from thinning strategies (Gagnon and Johnson 2009). When working to establish new stands of shortleaf pine, especially if no shortleaf seed bank is expected to exist, the Virginia Tech Cooperative Extension recommends clear cutting and implementing an artificial regeneration technique such as direct seeding or planting seedlings (Gagnon and Johnson 2009).

### *Spruce-Fir Forest Habitats*

Spruce-fir forests are found in western Virginia at elevations of 3,200 to 5,000 feet on high peaks that are cold and windy. Red spruce is predominant, along with Frasier fir in southwest Virginia and balsam fir in the northwest of the state (Anderson et al. 2013). Some significant areas of this forest type remain, but much of it has been lost and is now grass-shrub-hardwood scrub (Anderson et al. 2013). Spruce fir forests are typically found in older aged stands with a relatively high level of connectedness, likely due to the fact they are found higher upslope in areas with less development. Many of Virginia's spruce-fir forests were logged during the early 20$^{th}$ century. Anthropogenic fires, fueled by logging slash, converted large areas of former spruce-fir forest into a grass-shrub-hardwood habitat, and spruce-fir forests have not recovered to conifer dominance after 90 years (Anderson et al. 2013).

Virginia's remaining spruce-fir forests are impacted by a variety of threats. Invasive species such as the balsam woolly adelgid, the hemlock woolly adelgid, and the eastern spruce beetle cause considerable damage and mortality to Fraser firs, balsam firs, and red spruce throughout the southern and central Appalachians (Burns et al. 1990). Acid precipitation also has been a contributing factor to the decline of spruce-fir forests in the eastern United States by damaging plant needles and altering soil chemistry (EPA website 2014). Collectively, these impacts can make trees more susceptible to disease and pest issues. Finally, recent climate models indicate that under current greenhouse gas emission scenarios, Virginia's climate could become unsuitable for red spruce by mid-century (Klopfer et al. 2012).

Efforts to conserve spruce-fir forests should focus on several actions. First, maintaining conditions that will be favorable to growth and expansion in existing stands will be important (USFS 2014). Efforts to restore red spruce could be focused on areas that have existing populations of Norway spruce and red pine (USFS 2014). Planting red spruce seedlings should also be part of any restoration effort (USFS 2014). Working with landowners, forestry groups, planning district commissions, and others to ensure development in high elevation areas does not destroy or fragment these rare forest communities will be necessary. Robust review and commenting on any residential/ commercial development and energy development proposals from interested agencies and other groups could also help ensure conservation measures are taken or development is guided towards less sensitive areas.

### *Subterranean Habitats*

Virginia has two basic categories of subterranean habitats – karst and groundwater. Karst habitats are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas are often underlain by limestone or dolostone bedrock and characterized as landscapes with underground drainage networks (Figure 3.6). These areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2015). Maps of areas with karst features are provided within the local summaries. There are over 4,300 known caves in the state (DCR 2008). Karst systems provide important habitats for many SGCN invertebrates as well as bats. Karst habitats are primarily located in eight of the western planning regions; however, some smaller karst systems can be found in the Piedmont and Coastal Plain (DCR website 2008).

Several subterranean SGCN invertebrates occur in nonkarst aquifers. These species are rarely encountered but have been collected from wells and springs in the northern portions of the Piedmont and Coastal Plain (W. Orndorff and C. Hobson, Va Dept. of Conservation and Recreation, Natural Heritage, personal communication 2015).

These subterranean systems are some of the least understood habitats represented within Virginia's Action Plan. While these systems are distinct and each supports a unique set of fauna, these subterranean habitats are often impacted by similar threats and would benefit from similar conservation actions. For example, these subterranean habitats can only be sustained with clean and abundant water resources flowing through them. If water quality or water quantity is impaired, habitat suitability diminishes. Most water-related threats originate from surface land use, including pollution allowed to infiltrate into groundwater systems, over withdrawal of groundwater for human uses, dumping of garbage and other debris into sinkholes, and impervious surfaces that direct water away from groundwater recharge areas (DCR 2008).

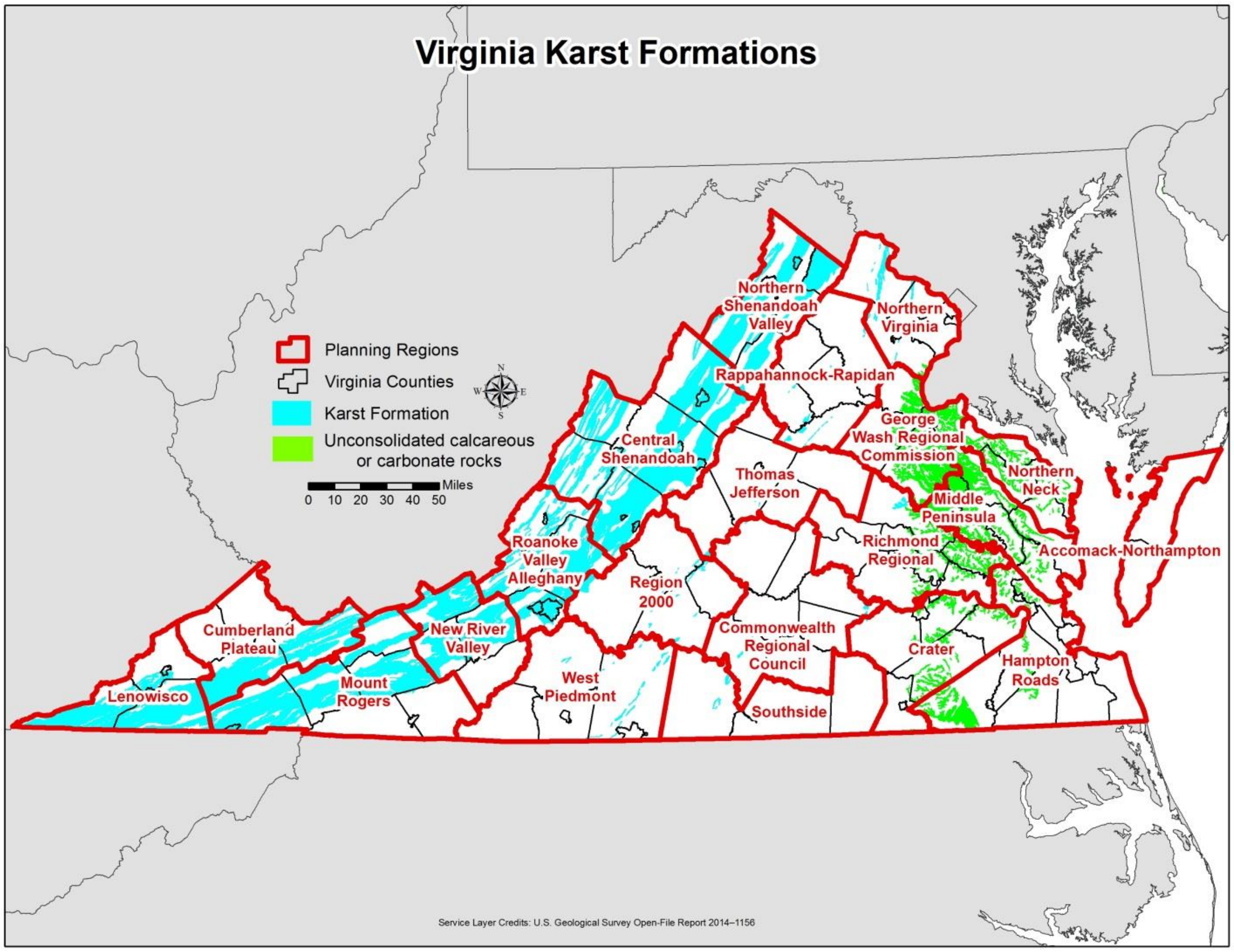


Figure 3.6. Virginia's Karst Formations (Weary and Doctor 2014).

Actions to conserve these habitats are limited by a lack of data describing how water enters and moves through the groundwater systems. Being underground limits the opportunities for direct observation, and access to wells and springs may be limited by private landowners. As such, it is impossible to provide specific guidance or prioritize specific areas for additional conservation. Until such data are available, general guidelines include maintaining as much vegetative cover as possible in areas that overlay karst topography or aquifers, establishing vegetative buffers around springs and sinkholes, and working to limit opportunities for surface pollution to contaminate springs and seeps.

## *Statewide Threats to Multiple Habitats*

### Invasive Species

In addition to the impacts invasive species have on wetland habitats (see above), the Virginia Invasive Species Management Plan identifies several species that have a profound impact on terrestrial ecosystems. Invasive species such as the gypsy moth, ramorum blight, sirex wood wasp, and emerald ash borer are known to kill large numbers of trees and alter forest health and composition. Invasive plant species, such as tree of heaven, privet, and Japanese stilt grass are aggressive colonizers, taking advantage of degraded natural habitats, outcompeting native species, and significantly altering the character and quality of local habitats. Virginia's Natural Heritage Program has identified over 90 invasive plant species. Additionally, invasive wildlife species such as fire ants and feral hogs are known to degrade the quality of native habitats, damage crops, kill native wildlife, and, in some cases, be dangerous to humans.

Unfortunately, there are insufficient human and financial resources in Virginia to eradicate all known invasive species. Virginia's Invasive Species Management Plan identifies seven goals (each with multiple strategies) for addressing invasive species issues in Virginia (VISWG 2012). These goals include:

- *Coordinate state, federal, and stakeholder prevention and management of invasive species infestations;*
- *Prevent known and potential invasive species from entering the state through detecting and interrupting all unauthorized species introductions;*
- *Promote and enhance professional and volunteer invasive species early detection through education and reporting tools;*
- *Enhance rapid response capability to implement eradication or containment procedures for target species through planning;*
- *Provide control of priority invasive species through containment, abatement, and other management strategies—including habitat restoration and use of native species—to minimize environmental and economic impacts;*
- *Support or conduct research, monitoring, and risk assessment necessary to assess, prioritize, and control invasive species; and*
- *Provide current information on invasive species, their negative impacts to environmental and economic resources, and methods of prevention and control to the general public, environmental nongovernmental organization, special interest groups and K-12 science teachers (VISWG 2012).*

### Climate Change Impacts

Based on numerous regional and state specific research and reports, it is likely that Virginia's climate will change and have impacts on the state's fish, wildlife, and habitats. Climate change will likely affect these resources directly, but more importantly, climate change is expected to exacerbate existing threats such as water quality and habitat degradation. Although many climate impacts represent longer-term threats, some, with more immediate implications, such as more frequent storm events and heat waves/ higher temperatures, are already occurring. Understanding the impacts and what those changes may mean for species and habitats within Virginia is important to ensure conservation actions are robust and effective now and into the future. This section provides a general overview of likely climate impacts in Virginia, what those changing conditions may mean for species and habitats, and the types of climate-smart conservation actions will help address climate change impacts within the state.

All available climate models project the Northeast and Virginia will experience a substantial increase in temperature by the end of the century. A recent study focusing on the Northeast and Midwest notes that temperatures within the region may increase from 4°C to 5 °C by mid-century (Staudinger et al. 2015). The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Virginia's 2008 Climate Action Plan projects that average temperatures in Virginia will increase by 3.1°C (5.6°F) by the end of the century (Governor's Commission on Climate Change, 2008). Although there are a range of projections, there is consensus that temperatures will increase. It is likely that heat waves and more extreme temperatures will also become more prevalent (Staudinger et al. 2015).

Models also project that precipitation yearly averages will likely increase in the Northeast due to more intense rainfall events. However, precipitation events will likely become less frequent but last longer (Staudinger et al. 2015). In turn, this may mean more dry spells, and with projections showing increases in precipitation more likely to occur in winter and spring months. As a result, this may mean more droughts in the summer months as well as more flooding, during the more intense events (Staudinger et al. 2015; Pyke et al. 2008). It is important to note that precipitation projections are less robust than those for temperature due to the difficulty in simulating the complex processes related to precipitation (Staudinger et al. 2015). Specifically, in Virginia the NCA projects a 6 percent increase in precipitation (Melilo et al. 2014). Observation data has already shown an 11 percent increase in the amount of precipitation occurring during a storm (intensity) within the state from 1948 to 2011 (VIMS 2013; Madsen and Wilcox 2012). Models project that storms will become more intense along the Atlantic Coast region (Staudinger et al. 2015). Frequency of extreme storm events has also increased over the last 50 years (VIMS 2013). More intense or frequent storm events will likely result in an increase in storm surges and flooding in coastal areas (CCSP 2009; VIMS 2013; Staudinger et al. 2015).

Sea-level rise is also likely to be significant in Virginia, with recent studies projecting rates higher than originally estimated on the East Coast (Sallenger et al. 2012). Historic data demonstrates that sea levels have risen over 1.5 feet in the Mid-Atlantic region since 1900 and a foot in the last 80 years in the Hampton Roads area (Staudinger et al. 2015; VIMS 2014). Models also project that the region may see 1.5 to 6 feet of sea-level rise by the end of the century (Staudinger et al. 2015). A recent study conducted by VIMS for the state of Virginia projects a range of approximately 1.5 feet to over 7 feet of sea-level rise by 2100. The study recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013).

#### *Climate Change and Species and Habitats*

Understanding these potential climate impacts is important for designing short-term conservation strategies and actions to protect Virginia's fish and wildlife and the habitats where they live. Although some of these impacts may not occur in the next 10 to 25 years, it is very possible that extreme heat wave or storm events may occur earlier than average temperature or precipitation increases and have a more significant, immediate, effect on resources. These extreme events rather than averages will likely have the greatest impacts on species (Klopfer et al. 2012). Warmer winter temperatures could also affect vegetation phenology, which could have cascading impacts on wildlife species that depend on them (Staudinger et al. 2015). Another example involves cold water streams and dependent species. A cold water streams is defined in Virginia as a stream whose average annual water temperature does not rise above 70°F. If a heat wave in the summer increases water temperature over 74°F for a week or more, this temperature may appear to have a small impact on the stream's annual average water temperature, but it could cause the local extirpation of many species that are impaired by summer water temperatures warmer than 70°F (Klopfer et al. 2013).

DGIF worked with partners and CMI to develop a species climate vulnerability assessment (Kane et al. 2013). This project is described in detail in the Methods Section, but it provided significant climate data for Virginia and neighboring states as well as projections of climate impacts for a suite of SGCN from the original Action Plan. Based on this work and other research, some generalizations can be made about climate impacts on species in the state. For example, species that are at the southern end of their range in Virginia, such as red spruce may be lost as temperatures increase and habitats may become too warm. Conversely, species at the northern end of their range, such as southern red oak or bald cypress, may be able to expand further within Virginia as habitats become more hospitable. As forest composition potentially changes, the range of wildlife species that depend on these habitats may also be altered. Temperature changes may also affect species that have narrow temperature tolerances such as cold water fish species, amphibians, and some reptiles and mammals (Kane et al. 2013).

Increased amounts of precipitation, especially in winter and spring, may result in flashier stream conditions, exacerbating water quality issues such as erosion and sedimentation, stormwater runoff issues, and nutrient pollution. Additionally, if precipitation increases occur earlier in the year and taper off in the summer when temperature increases, drought conditions would become more severe. This would affect water quality conditions, especially the concentration of nutrients and pollutants, directly affecting wildlife, fish, and invertebrate species. Sea-level rise will allow salt water to inundate areas further inland; affecting both freshwater and brackish wetlands. Increasing salinity levels would affect both plant and fish and wildlife species that have narrower salinity tolerances. More extreme storm events may result in significant and prolonged inundation may affect habitat availability for species such as shorebirds, waterfowl, and migratory birds that depend on coastal wetlands within Virginia for food, nesting, and wintering habitat.

It is important to consider, however, that these climate projections and potential impacts are generalizations, and the variability of actual climate impacts and species responses makes it difficult to provide detailed information about how individual species will respond to climatic changes. Species distribution will not just move to higher altitudes or upstream, but their movement will be based on a combination and interaction of factors. It is likely that climate change will result in species expanding or contracting their ranges in unexpected ways due to new and unique habitat conditions being created (Kane et al. 2013). Additional factors that will affect habitat and species distribution and movements include vegetation structure, landscape characteristics, topography, and soil characteristics. It is unlikely these features will change as rapidly as climate. How these variables interact will determine the success or failure of species in specific areas on the landscape (Kane et al. 2013). For example, while climate factors may increase the probability of occurrence for bobwhite quail in an area, the species' response is more likely to be influenced by habitat conditions on the ground. If landscapes are not managed to provide suitable nesting, brood-rearing, and escape cover, it is unlikely quail populations will be able to increase their populations or expand their distribution regardless of how favorable the climate becomes. Conversely, using proven habitat management strategies that can help address climate impacts, wildlife managers may be able to help species, such as quail or brook trout, withstand inhospitable conditions for a longer period of time (Kane et al. 2013).

#### *Conservation Lands and Climate Assessment*

Another way to consider climate impacts involves how climate change may affect "on the ground" conservation management, specifically in terms of conserved lands. The Conservation Lands and Climate Assessment (see Approach and Methods Section) considers how climate classes (enveloped) may change across Virginia and what that may mean for lands currently held in some form of conservation. The assessment identifies 9 climate classes (envelopes) based on combined temperature-precipitation for Virginia on both conserved and non-conserved lands. In comparing climate classes on conserved and non-conserved lands in the late 20$^{th}$ century to those projected for 2070, 2 climate classes present in the late 20th century are likely to be absent in the late 21st century (classes 34 and 54). The climate class with the largest loss (by area) on conserved lands is class 44 with a nearly 80 percent reduction in distribution by 2070 across the study area (Table 3.5) (Figures 3.7 and 3.8) (Klopfer and McGuckin 2015).

Table 3.5. Proportion of Climate Classes within Conserved and Non-Conserved Lands in Virginia (Klopfer and McGuckin 2015).

| | Late 20th Century | | Late 21st Century | |
|---|---|---|---|---|
| **Climate Class** | % of Non CLN | % of CLN | % of Non CLN | % of CLN |
| **34** | 2.7% | 12.3% | 0.0% | 0.0% |
| **35** | 4.8% | 7.9% | 1.2% | 2.6% |
| **36** | 1.7% | 0.2% | 2.2% | 1.4% |
| **37** | 0.1% | 0.0% | 0.9% | 0.1% |
| **44** | 39.4% | 42.1% | 8.5% | 3.3% |
| **45** | 25.4% | 14.9% | 34.2% | 52.2% |
| **46** | 0.2% | 0.1% | 7.6% | 10.3% |
| **47** | 0.0% | 0.0% | 0.3% | 0.0% |
| **54** | 17.9% | 14.2% | 0.0% | 0.0% |
| **55** | 7.8% | 8.3% | 34.0% | 21.7% |
| **56** | 0.0% | 0.0% | 11.2% | 8.5% |

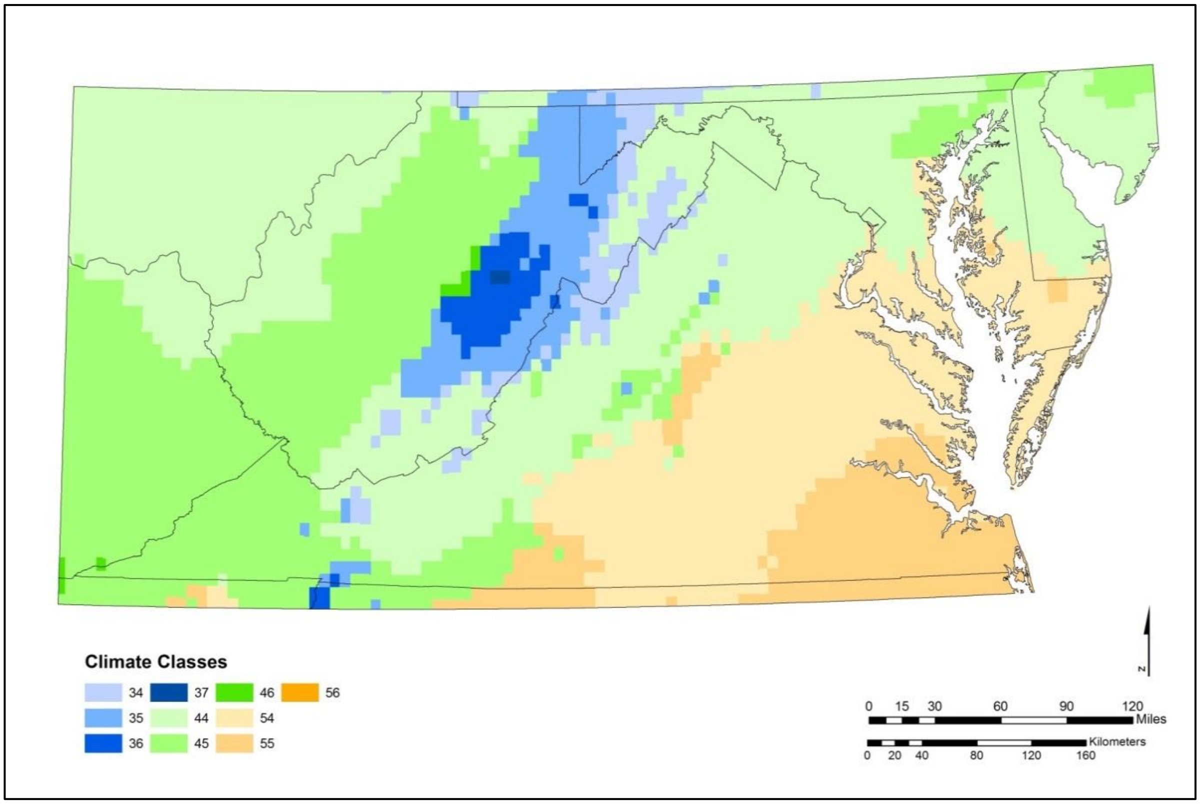

Figure 3.7. Climate Classes across Virginia in 2000 (Klopfer and McGuckin 2015).

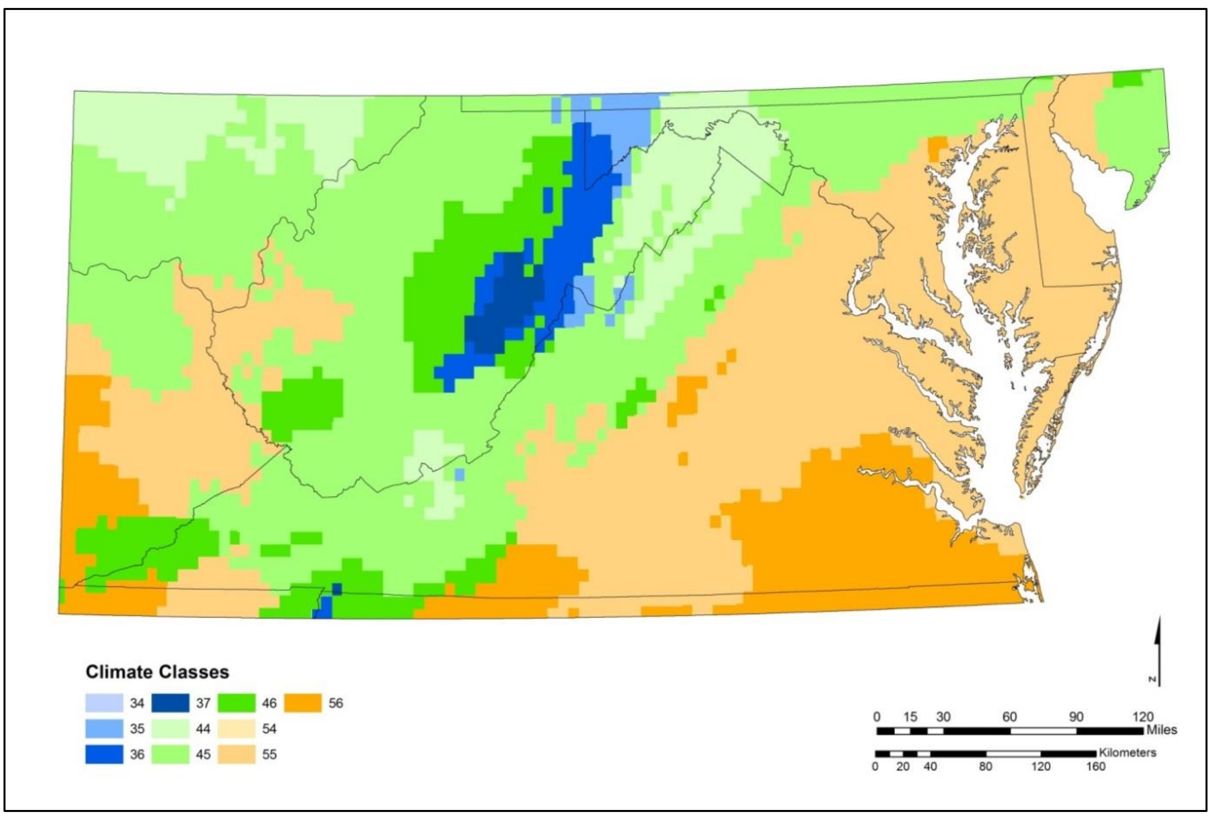

Figure 3.8. Climate Classes across Virginia in 2070 (Klopfer and McGuckin 2015).

The climate changes projected to occur across Virginia will result in shifting patterns from those evident in the late 20th century. While some climate classes will disappear completely, opportunities to bolster protection of other types with decreasing representation do exist. Further, some types with limited representation on current conservation lands will increase in composition into the future suggesting immediate actions to preserve those types may be unnecessary.

An example of a climate class that will disappear completely is climate class 34, which corresponds to the colder and drier areas of the higher elevations and latitudes in Virginia. While there is no direct evidence to support correlations between the climate classes used in this analysis and species distributions, it is interesting to note that this region has already been identified as containing species at the southern extent of their range (e.g., northern flying squirrels, snowshoe hare, etc.). Previous studies have suggested that these types of species are among the most vulnerable to climate change impacts due to the rarity of these habitat types and their relative isolation from other suitable habitat areas (Heller and Zavaleta 2009). The disappearance of this climate type from the landscape suggests that the resiliency of the landscape for supporting these species is low and that localized extirpation is a possibility.

On the other hand, dedicated habitat improvement actions may provide some level of mitigation of impacts and adaptation opportunities. For example, the range of the ruffed grouse extends southward along the Appalachians into the Carolinas even though the species core range is the Great Lakes and Northeast regions. Historically, this species was likely more widespread throughout the southeast, but their range has contracted to the highest elevations with increasing temperatures since the last glacial period. The persistence of this species on the landscape may have to do with an abundance of early successional forest regeneration following primary clearing after colonization and sustained through the early to mid-20th century.

Similarly, dedicated habitat management for target species may decrease the overall impacts of climate change for select species and locations. Further using models and analyses like these, managers may be able to identify areas to receive focus more intensive habitat management with sufficient lead time to allow for long-term activities to become effective. For example, understory tree manipulations performed today would affect the canopy characteristics 40 or more years from now and benefit target species. These actions could allow an improvement of overall habitat value and compensate for losses due to changing climate.

## On the Ground Conservation Actions

In reviewing the list of SGCN, DGIF staff and partners were asked to assign each species into one of three triage categories related to conservation and management opportunity (see Methods and Approach Section). Category A was reserved for instances when managers have identified “on the ground” strategies expected to benefit species and/or habitats. Category A also requires that at least some of these strategies be able to be implemented with existing resources and have a reasonable chance of improving a species’ conservation status.

Of the 883 SGCN identified for 2015, 207 (23.4%) are classified in Category A. For these species partners identified 31 basic management actions that could be implemented to improve their conservation status. The list of 31 actions follows. The number following each action represents the number of species to which that action applies. For specific actions identified for each of the 207 species, please see Appendix A.

1. Address water quality impairments (82)
2. Implement captive propagation/ translocation/ reintroduction (45)
3. Conserve/ restore wetland habitats (27)
4. Create/ restore/ manage – open habitats (glade, grassland, savanna) (21)
5. Engage in public education/ outreach (14)
6. Conserve/ restore of beaches, dunes, and mudflats (14)
7. Exclude/ manage human use of habitats <u>at specific times</u> (primarily beaches) (13)
8. Engage in predator control (12)
9. Control invasive plant and animal species (9)
10. Exclude humans from caves occupied by sensitive species (8)
11. Maintain the quality and quantity of water flowing into karst and other groundwater systems (8)
12. Continue environmental commenting and engagement with industrial citing for wind energy (6)
13. Manage diversity of young and old forest habitats (5)
14. Regulate legal harvest (4)
15. Restore aquatic connectivity (4)
16. Protect known fall roosts and swarm areas for bats (4)
17. Conserve/ restore large forest blocks (3)
18. Work with industry to modify operation of wind farms during fall migration period (2)
19. Develop professional standards for wildlife control operators (2)
20. Research use of artificial nest boxes (2)
21. Enforce collection laws (2)
22. Protect (aquatic) spring habitats (2)
23. Conserve/ restore occupied canebrake rattlesnake habitat (1)
24. Conserve/ restore coastal eel grass beds (1)
25. Conserve/ restore migratory habitats for birds in coastal areas (1)
26. Create artificial wetlands (1)
27. Modify and enforce baitfish regulations (1)
28. Reduce/ eliminate heavy metal and pesticide contamination (1)
29. Maintain/ create artificial roost structures (1)
30. Restore the freshwater drum – fish host of the fragile papershell (1)
31. Conserve/ protect specific habitats occupied by the Virginia fringed mountain snail (1)

## Priority Research Needs

Conservation Opportunity Ranking Category B was reserved for those species that met one of two conditions. Either managers have identified specific research needs that must be addressed before more “on the ground” actions can be initiated or the conservation community has been precluded from implementing “on the ground” actions due to a lack of personnel, funding, or other circumstances. Of the 883 SGCN, 63 (7.1%) are assigned to Category B. The list of research needs for these species follows (no priority order). In future budget discussions, it is DGIF’s intention to use this list to prioritize the research projects funded through State Wildlife Grants.

- Improve detection methods for hellbenders to better estimate population size and distribution – both to document initial conditions as well as to help evaluate effectiveness of conservation actions.
- Investigate the utility and opportunity of using translocation as a management and recovery tool for hellbenders.

- Assess the impacts of wind farms on migratory birds in the coastal region to enhance species management, habitat management, and environmental commenting.
- Determine American woodcock wintering and breeding abundance to facilitate creation of a management strategy.
- Determine how or if a growing peregrine falcon population on the Eastern Shore impacts red knot populations.
- Research belted kingfisher, black-billed cuckoo, chimney swift, eastern wood peewee, green heron, and northern flicker to determine the circumstances that threaten these species and the impacts of these threats to populations so that appropriate management strategies can be developed.
- Develop conservation plans for a the following species:
  - Variegate darter,
  - Tennessee darter,
  - Atlantic sturgeon, and
  - Marine mammals, including Atlantic bottlenose dolphin, harbor porpoise, fin whale, humpback whale, northern right whale, West Indian manatee.
- Determine if the following species would be suitable candidates for reintroduction into suitable, vacant habitats:
  - Duskytail darter,
  - Ashy darter,
  - Candy darter,
  - Greenfin darter,
  - Longear sunfish,
  - Orangefin madtom,
  - River redhorse,
  - Sauger,
  - Smallmouth redhorse, and
  - Spotfin chub.
- Investigate the issue of "genetic swamping" to determine if contact with rock bass populations is a critical threat to the genetic distinctiveness of the Roanoke bass.
- Determine if conservation of the roughhead shiner is limited by competitive interactions with the telescope shiner or other members of the genus *Notropis*.
- Determine if or how changing climatic conditions are affecting the Allegheny pearl dace.
- Determine if or how changing climatic conditions are affecting the Swannanoa darter.
- Locate maternity colonies of the eastern big eared bat populations.
- Determine effects of wind turbines on eastern big eared bat and Indiana bat populations.
- Determine the extent and effects of insecticide contamination and bioaccumulation on eastern big eared bat and Indiana bat populations.
- Assess coastal migration patterns for hoary bats, silver-haired bats, red bats, and Virginia big eared bats.
- Determine why various bat species appear to be attracted to wind turbines and work to develop deterrents.
- Evaluate the productivity and survivorship of little brown bats, northern long-eared bats, tricolored bats, southeastern myotis, and eastern small footed myotis at maternity colonies as a means of evaluating the success of conservation actions.
- Identify foraging habitat preferences for Virginia big eared bats.

- Determine if the following freshwater mussel species are suitable candidates for captive propagation and, if so, develop propagation techniques:
    - Appalachian monkey face,
    - Crackling pearly mussel,
    - Deer toe,
    - Cumberland monkey face,
    - Fine rayed pig toe,
    - Tennessee club shell,
    - Rough rabbits foot,
    - Shiny pigtoe,
    - Elephant ear,
    - Tennessee heel splitter,
    - Tennessee pig toe,
    - Slabside pearly mussel,
    - Northern Lance mussel,
    - Pimpleback,
    - Pistol grip,
    - Spectacle case,
    - Three ridge, and
    - Pink heelsplitter.
- Resolve taxonomic confusion between the purple bean and the Cumberland bean so appropriate brood stocks can be identified to support captive propagation efforts.
- Determine the genetic distinctiveness of alewife floater populations in the Rappahannock, Pamunkey, James, Chickahominy, and Chowan basins so propagation and reintroduction strategies can be developed.
- Determine if the Virginia pigtoe is a distinct species or a population of the Atlantic pig toe.
- Determine if sufficient numbers of slippershell mussels exist to serve as brood stock for a captive propagation program.
- Determine if the two known populations of Bunting's crayfish in Virginia (one in the Big Sandy Basin and the other in the Clinch River) represent one species or two so appropriate management and conservation strategies can be developed.

### *SGCN Distribution, Abundance, and Life History Information*

The vast majority (69.5%) of Virginia's 883 SGCN species were included in Management Opportunity Category C. Species were included in this category for one of two reasons. In many cases, such as the Shenandoah salamander, conservation opportunities have been exhausted. While this species may remain imperiled, no additional actions can be taken on their behalf as the only known population in Virginia is contained within a National Park system.

Category C was also used when managers were unable to identify "on the ground" actions or research needs that could benefit the species or its habitats. The vast majority of these species lack the basic distribution, abundance, and life history information needed to formulate a management strategy or applied research program. This is an overwhelming issue, affecting many SGCN. However, given current personnel and financial resource limitations, it is a logistical impossibility that DGIF and partners will ever be able to fully address this data need.

It is DGIF's intention to continue to commit some portion of State Wildlife Grant dollars to collect baseline data on Category C species. However, this list of species will be reviewed and prioritized to ensure that resources are used efficiently and efforts provide the greatest management utility in terms of keeping species from becoming endangered.

Before Virginia's next Action Plan is written (2025), DGIF will institute a prioritization process, involving DGIF biologists and administrators, as well as representatives from other state, federal, and private organizations that will identify priority species and areas for collecting baseline species and habitat data.

### *Propagation and Restoration of SGCN*

Virginia's aquatic habitats support some of North America's most diverse assemblages of aquatic mollusks, fish, and crayfish. Historic and continuing loss of habitat and habitat fragmentation, water pollution, sedimentation, invasive species introductions, hydrologic modification and impoundments have reduced many of these populations to critical levels and severely restricted many species' distribution.

Virginia has a long history of propagating game fishes in hatcheries to augment existing populations and establish new populations in unoccupied habitats. In 1997, Virginia Tech's Freshwater Mussel Conservation Center began propagating and releasing endangered mussels to augment wild populations. In 1998, DGIF established the Aquatic Wildlife Conservation Center (AWCC) near Marion, Virginia to restore populations of imperiled mussels in the Upper Tennessee River drainage. The AWCC has also propagated the endangered spiny river snail (*Io fluvialis*) and eastern hellbenders (*Cryptobranchus alleganiensis*). In 2007, the DGIF and USFWS established the Virginia Fisheries and Aquatic Wildlife Center (VFAWC) at the Harrison Lake National Fish Hatchery in Charles City County to propagate mussels for release into Virginia's Atlantic slope rivers. Since 2010, DGIF has contracted with Conservation Fisheries Inc. to propagate and release federally endangered yellowfin madtom (*Noturus flavipinnis*) into the upper reaches of Copper Creek, a tributary of the Clinch River. Efforts are also underway to propagate and release yellowfin madtoms into the North Fork Holston River.

It is DGIF's intention to continue supporting these propagation and restoration activities with State Wildlife Grants and other resources. While current SGCN efforts largely focus on aquatic species, species in other taxonomic groups may also be considered as appropriate. The target species, the use of State Wildlife Grants, and the priority of individual efforts will be determined during DGIF's project planning, annual budget development, and annual work planning efforts.

## DATA MANAGEMENT FOR MIGRATORY SPECIES

Virginia's 2015 Action Plan identifies dozens of migratory birds, fish, and insects that, throughout the course of their life, cross regional, national, and international borders. State fish and wildlife agencies collect and compile a wide variety of biological and ecological data which, when assembled with similar data collected by other states, regions or countries can greatly enhance our ability to evaluate trends in species population sizes and distribution, habitat losses and gains and other common parameters across broad geographic areas. Unfortunately, these disparate data are rarely compiled or managed to provide biologists with "the big picture" that would better inform local conservation efforts. As more migratory species are included within Action Plans, there is a growing need among managers to coordinate survey and monitoring efforts, using standardized data collection methods and protocols. To be most effective, this data should be compiled and managed in a centralized database that is accessible to all users. Such a system has been developed to support waterfowl conservation and management. Lessons learned by the waterfowl community can inform and enhance efforts for other taxonomic groups.

Unfortunately, the USFWS lacks the human, financial, and technical resources needed to develop, house, and manage such a large and long-term data effort. In response, state wildlife agencies are exploring opportunities to:

- Develop a partnership agreement, guiding data ownership, use, and management access;
- Establish a storage location for the assembled data that can be accessed by the partners;
- Establish a database or data warehouse (i.e., a set of databases) with a mapping component that can display the data; and
- Partition development costs and annual costs of long-term database QC/QA and general maintenance responsibilities among data-contributing states.

Developing such a system would enhance Virginia's ability to contribute to the conservation of species that cross multiple jurisdictions. The use of State Wildlife Grants to support this effort will be considered as part of DGIF's annual budgeting process.

## International Conservation

Dozens of migratory SGCN songbirds, waterfowl, shorebirds, and the monarch butterfly utilize habitats in Virginia as part of their annual migratory cycle. Due to threats impacting these species in other states or countries, conservation efforts in Virginia may be insufficient to ensure the long-term conservation of many of these species.

DGIF currently participates in several multi-stakeholder programs (Joint Ventures, Fly-Way Council, Partners in Flight, Southern Wings Program) that work to monitor and conserve these migratory species. As part of these collaborative efforts, DGIF may consider using a portion of its State Wildlife Grant allocation to conserve habitats or conduct research in other jurisdictions if those efforts have the potential to improve the status of one or more of Virginia's SGCN. DGIF's participation with such a project would be considered as part of DGIF's annual budgeting process and contingent upon an internal review by appropriate agency staff.

## Northeast Wildlife Diversity Technical Committee and the Regional Conservation Needs Program

The Northeast Association of Fish and Wildlife Agencies, traditionally, has supported a strong technical committee structure to further wildlife conservation. Technical committees are species or habitat-focused groups that exchange ideas and develop common approaches to wildlife issues. Typically, these conservation actions are implemented by individual states using their own funds; however, in some cases additional funding has been made available through the Northeast Wildlife Agency Directors. In one such case, the Directors established the Regional Conservation Needs (RCN) Program which is managed by the Northeast Wildlife Diversity Technical Committee.

The RCN Program utilizes a small percentage of each state's annual State Wildlife Grant allocation to address SGCN needs across multiple states. Specifically, the RCN Program is used to coordinate and implement conservation actions that are regional/ sub-regional in scope and build upon the many regional initiatives that already exist. Since 2007, thirty-seven different projects have been implemented. The resulting reports and products can be found at RCNgrants.org. Output measures related to the RCN Program include monitoring the number of conservation actions and research projects selected by the participating agencies, the number of projects completed by the funding recipients, and the number of articles, publications, and technical reports developed each year as a result of funded projects.

It is DGIF's intent to continue contributing SWG funds and personnel resources to support the RCN program and the Northeast Wildlife Diversity Technical Committee.

## Conclusion

From a statewide level, reviewing conservation needs in this Action Plan may be discouraging as hundreds of species are identified as being of greatest conservation need. Many species populations are already critically impaired, and their long-term survival is in doubt. Management concerns over the loss or degradation of Virginia's aquatic, wetland, terrestrial, subterranean, and coastal habitats, which will likely be compounded by the potential impacts of climate change, land subsidence, invasive species, and sea level rise, are not inconsequential. If we fail to address these issues, more species could be legally classified as endangered, which could have profound impacts for people, businesses, and communities, as well as wildlife.

Alternatively, the statewide chapter can be viewed from the perspective of implementation. The chapter focuses on what the conservation community can do to best protect and conserve species and habitats within the Commonwealth. Management actions have already been identified for scores of these species and habitats that, if implemented, are likely to benefit hundreds of additional SGCN. Important research needs have been identified that should allow conservation partners to implement more "on the ground" conservation for dozens of species. Many of the threats affecting Virginia's terrestrial and aquatic habitats can be addressed with known techniques and technologies. In several cases, habitat programs already exist. Finally, and perhaps most importantly, Virginia has a robust and dedicated conservation community, comprised of agency and NGO staff, academics, and talented enthusiasts, who have proven that great things can be accomplished when efforts are focused and burdens are shared.

Sir Patrick Geddes (1854 – 1932) was a Scottish sociologist, geographer, and town planner who is credited with championing the notion that biogeography, geomorphology, and human systems are interrelated and that the healthiest communities recognize the importance of, and manage to maintain, the health of these relationships. Geddes work has often been credited as the inspiration for the slogan "Think Globally, Act Locally" used by grassroots activists worldwide. In this tradition, it is DGIF's intent that the revised Action Plan will define problems based on areas of common interest. This updated version was created to find ways to keep species from becoming endangered. While this perspective may seem limited, the majority of conservation issues we face are not just "wildlife issues" but are, in fact, Virginia issues for which wildlife are an indicator. Clean and healthy rivers are important for wildlife, people, communities, and industries. Healthy riparian forests, wetlands, and upland habitats provide people with economic and recreational opportunities, while also supporting diverse wildlife species and helping to ensure clean water flowing thru our landscapes. As waters flow from Virginia towards the Atlantic Ocean or the Gulf of Mexico, these rivers, and their adjacent habitats, support even more species, communities, industries and recreational opportunities. Working to keep species from becoming endangered benefits our communities, our economy, and our quality of life by addressing the problems that exist within our collective habitats and preventing them from becoming a crisis.

Based on the idea that local actions can generate regional shared benefits, and using a format perfected by the Virginia Department of Conservation and Recreation, this Action Plan was created around 21 Local Action Plan Summaries. Each of these local chapters describes the wildlife and habitat priorities identified by DGIF and partners within each multi-county planning region. These local chapters are not mandates. Rather, they identify shared problems and describe the types of actions that can be taken to address conservation priorities. Ideally, these summaries will inspire collaboration among the conservation community and provide guidance as to how limited time, money, and people can be utilized to best effect. Groups with other focuses such as clean water, open space, outdoor recreation, commercial fisheries, or civic enhancement may use these documents as a means of forging new collaborations that achieve mutual goals. By defining collective problems, the Local Action Plan Summaries may provide opportunities to find or develop new conservation funding and resources.

The problems outlined within this revised Wildlife Action Plan can be addressed. It will require time, resources, and dedication, and a little luck. It is within our ability to prevent many of these species from becoming endangered while also doing beneficial things for human communities. Like any thousand-mile journey, this one will start with the first step.

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