Virginia's Strategy for Safeguarding Virginia's Species of Greatest Conservation Need from the Effects of Climate Change

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Executive Summary

Virginia's Wildlife Action Plan identifies more than 900 species that are being impacted by the loss or degradation of their habitats. Many of these species could become extinct or extirpated from the Commonwealth if steps are not taken to reverse these trends. In coming decades, climate change will exacerbate and intensify many of the existing threats and will likely result in new sets of impacts and stressors. *Virginia's Strategy for Safeguarding Virginia's Species of Greatest Conservation Need from the Effects of Climate Change* was created to provide initial guidance on actions Virginia's conservation community can implement immediately to enhance the conservation of wildlife and habitats in the face of climate change while more comprehensive adaptation strategies are developed. Conservation strategies include specific actions for conserving species and habitats, developing new data and climate modeling resources, and implementing new outreach efforts related to climate change.

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Introduction:

Over 900 of Virginia's wildlife species are believed to be imperiled by the ongoing loss or degradation of their habitats. During the coming decades, climate change will exacerbate and intensify these impacts and the consequences to wildlife could be profound. For example, coldwater species, like brook trout, which become physiologically impaired when water temperatures rise above 70 degrees Fahrenheit, could be extirpated from much of their current range. Other species in Virginia's mountains, such as salamanders in the genus Plethodon, will be forced into smaller ranges at higher elevations by rising air and water temperatures. Unfortunately, populations that cannot move to higher elevations, or fail to find suitable habitats, will be extirpated. Within Virginia's rivers, changes to precipitation patterns and flood regimes could have significant impacts on the abundance and diversity of freshwater mussels. Along Virginia's shores, the loss of coastal wetlands, changes in water temperatures, increased prevalence of marine diseases, and increased pollution could cause some important saltwater fisheries such as winter flounder, blue crab, and rockfish to decline or even collapse, resulting in economic hardship and the loss of recreational opportunities for many. Finally, Virginia's cherished outdoor traditions, including hunting and fishing, will also be significantly affected. Already, fewer waterfowl make their way to the Chesapeake Bay each year due to climatic changes impacting breeding grounds in the Prairie Pothole region, changes to migration patterns caused by milder winters, and decline of eelgrass habitat in the Bay region from warming water temperatures, turbidity, and sea-level rise. Although the pressure that global warming will put on the Commonwealth's habitats may make it harder to achieve conservation goals, we are confident that solutions can be developed to conserve, restore, and protect Virginia's habitats and help Virginia's fish, wildlife, and people adapt to global warming.

Despite the decades of research, climate change predictions vary greatly, and the impacts climatic changes will have on Virginia's people and resources are just beginning to be considered. It is beyond the scope of this document to outline an adaptation strategy that articulates and identifies a response for each of the myriad of predictions, scenarios, and potential outcomes suggested by existing climate models. These issues will need to be discussed and addressed during future planning efforts. This document, however, is meant to provide initial guidance on actions Virginia's conservation community can implement immediately to enhance the conservation of wildlife and habitats in the face of climate change while more comprehensive adaptation strategies are developed.

This effort to identify initial climate change adaptation strategies was initiated by the Virginia Department of Game and Inland Fisheries (DGIF), the National Wildlife Federation (NWF), and the Virginia Conservation Network (VCN). It is the intent of these organizations that this document be appended to Virginia's Wildlife Action Plan, an existing document created to focus conservation efforts on preventing species from becoming endangered.

Virginia's action plan was completed in 2005, and identifies: Virginia's Species of Greatest Conservation Need (SGCN), the habitats the SGCN require, the problems impacting SGCN and/or their habitats, and the actions needed to conserve SGCN and their habitats and to help keep species from becoming endangered. Although the action plan identifies several species (e.g., black rail, snowshoe hare, and red crossbill) likely to be impacted by the effects of climate change, the document does not provide a comprehensive discussion of this issue and how

climatic changes will impact all of Virginia's wildlife and habitats. Because Virginia's action plan represents the most comprehensive blueprint for protecting the Commonwealth's wildlife and habitats, it serves as a cost-effective and efficient mechanism for Virginians to both identify concerns and articulate actions needed to address the impacts of global warming on wildlife.

Project History

This project originated in April 2008, when the NWF received a Wildlife Action Opportunities Fund grant which was awarded by the Wildlife Conservation Society and funded by the Doris Duke Charitable Foundation. With these funds, the NWF initiated work in Virginia, Florida, and Washington, to help those states enhance their action plans to address climate change. Specific grant and project goals included:

1. Facilitating the implementation of existing global warming related conservation actions described with the action plans;
2. Collaborating with DGIF and the other state wildlife agencies to establish new adaptation strategies and integrate those strategies within the Plans;
3. Providing insights and advice to key agency leaders and elected officials across the nation regarding the "lessons learned" during this process; and
4. Expanding the scope and participation of the individual Teaming with Wildlife Coalitions to implement the adaptation strategies and safeguard wildlife from global warming via the action plan framework.

This document represents the work done by NWF, DGIF, and VCN personnel to achieve Virginia's portion of the second project goal, "…to establish new adaptation strategies and integrate those strategies within Virginia's Wildlife Action Plan."

As indicated previously, this document is not meant to be the final strategy/plan on climate change adaptation for Virginia's wildlife and habitats. Rather, it is meant to provide a starting point. It includes a list of concerns identified by the conservation community, actions that can be implemented to make wildlife and habitats more resilient to climate change, research projects needed to inform future planning and management efforts, and outreach efforts required to build the social and political support that will be needed to implement climate adaptation efforts.

By attaching this initial strategy to the action plan, the authors intend for this issue to remain prominent within conservation discussions and ensure that more robust and comprehensive adaptation strategies are developed and included in future iterations of the action plan. Virginia's action plan must be updated by October of 2015.

Finally, this document represents the DGIF's initial efforts to fulfill Recommendation 14D, included on page 34, from the Virginia Commission on Climate Change's Climate Action Plan which is available at: http://www.deq.virginia.gov/info/climatechange.html. Specifically, this recommendation indicates:

> "14D. Both DCR and DGIF have established planning documents (e.g., Natural Heritage Plan and Wildlife Action Plan) that identify important habitat types, specific habitat sites, areas important for maintaining biodiversity, and conservation actions needed to conserve all of Virginia's wildlife and native

habitats. Using these plans to identify critical conservation areas, Virginia should implement a statewide effort to conserve 5% of these areas that are currently unprotected by 2015 and 20% of these areas that are currently unprotected by 2025. This effort should utilize an assortment of management tools including education, financial incentives, regulations, and additional state investments."

Process:

In 2003, within guidance on creating wildlife action plans, the U.S. Congress indicated that efforts to create action plans must provide opportunities for the public and conservation partners to be informed about, and participate in, efforts to conserve their wildlife. As the action plan is being expanded to address climate change, it remains important that a diversity of perspectives and opinions be considered and incorporated within the adaptation strategy. As such, DGIF, NWF, and VCN worked diligently to talk with, and listen to, stakeholders and use these discussions to identify the key components presented within this document.

Workshops:

The VCN, NWF, and DGIF hosted two workshops to develop strategies to adapt Virginia's wildlife management, planning, and conservation efforts to address climate change and integrate climate change into the action plan. Hosting workshops allowed for maximizing participation with the available budget and within the time available. Maximum participation was a key goal of this effort as climate change will have an impact across organizational boundaries and jurisdictions, and implementation will require new and innovative partnerships. In addition, it was important to lay the ground work for developing those partnerships and to take advantage of the different ideas being generated across the Commonwealth. Having two workshops also provided multiple opportunities for people to participate (if someone missed the first), allowed for a long-term engagement of stakeholders, and perpetuated involvement by designing the second workshop to build upon information and ideas generated during the first workshop.

Tables 1 and 3 identify the organizations that participated in each workshop. Participants represented state agencies, local governments, conservation organizations, and the private sector. The first workshop was held in Wakefield, Virginia in October 2008 and the second workshop was held in Lynchburg, Virginia in March 2009. Both events were "invitation only" to ensure the discussions remained focused.

Table 1. Workshop 1 – Participating Organizations

Environment Virginia	Friends of Dyke Marsh	Friends of the Potomac River Refuges	Garden Clubs of Virginia	George Washington and Jefferson National Forest
Izaak Walton League (Suffolk-Nansemond Chapter)	Marine Corps Base Quantico	Maryland Department of Natural Resources	National Audubon Society	National Oceanic and Atmospheric Administration
National Wildlife Federation	Natural Resources Conservation Service	North Carolina Wildlife Resources Commission	Office of the Secretary of Natural Resources	Piedmont Environmental Council
Rappahannock Valley Garden Club	Richmond Audubon Society	Shenandoah National Park	The Nature Conservancy	The Wildlife Foundation of Virginia

U.S. Fish and Wildlife Service	VA Beach Convention and Visitors Bureau	VA Chapter American Fisheries Society	VA Chapter of the National Wild Turkey Federation	VA Chapter of The Wildlife Society
VA Council of Trout Unlimited	VA Department of Agriculture and Consumer Services	VA Department of Conservation and Recreation	VA Department of Environmental Quality	VA Department of Forestry
VA Department of Game and Inland Fisheries	VA Department of Transportation	VA Farm Bureau	Virginia*Forever*	VA Herpetological Society
VA League of Conservation Voters	VA Native Plant Society	VA Waterfowlers' Association	Virginia Conservation Network	

Both workshops allowed participants to voice concerns on impacts to wildlife and habitats that will likely occur because of climate change and brainstorm actions to address those impacts. Table (2) identifies the presentations and topics covered during the morning of the first workshop. Three breakout discussion sessions were held in the afternoon, focusing on concerns about climate change, impacts from climate changes, and needed actions and priorities for dealing with climate change. When all comments and input were analyzed, three main strategies were identified. Participants felt Virginia should:

- Do more to address the loss of species and habitats;
- Collect more data and produce modeling information at an appropriate scale to capture future climate impacts within Virginia; and
- Develop more outreach efforts related to climate change.

Table 2. Workshop 1 – Presentations

Topic	**Speaker**
Welcome and Introduction	Austin Kane, NWF
Climate Change and Wildlife Adaptation	Douglas Inkley, NWF
Va's Wildlife Action Plan and Climate Change	David Whitehurst, DGIF
Virginia's Climate Commission	L. Preston Bryant Jr., Va Secretary of Natural Resources
Federal Conservation and Climate Change Funding Opportunities	John Kostyack, NWF
Teaming With Wildlife Coalition, Virginia	Mark Humpert, Assc. Of Fish and Wildlife Agencies

Taking the information from the first workshop, partners from the NWF, VCN, and DGIF collaborated to develop draft strategy documents (three-to-four page “reaction pieces”) to propose ways to conserve species and habitats, collect needed information, and develop specific outreach tools and messages. These documents served as the basis for the second workshop, which focused on how the three strategies (conservation of species and habitats, data and modeling needs, and education and outreach) could be addressed. Presentations (Table 4) given in the morning focused on these three topics. The afternoon breakout sessions were designed to initiate a discussion and query participants about the appropriateness of proposed actions in the draft reaction pieces given their knowledge of their programs and their experiences in Virginia. As with the first workshop, DGIF and NWF personnel compiled and reviewed the information

provided by the participants, and this data guided the development of the draft adaptation strategy.

Table 3: Workshop 2 – Participating Organizations

Amherst Planning District Commission	Appalachian Power	B.A.S.S. Federation Nation of Virginia	Center for Climate Change Communication	Coastal Conservation Association
Defenders of Wildlife	Dominion Resources	Friends of Dyke Marsh	Friends of Potomac River Refuges	Garden Club of Virginia
Washington and Jefferson National Forest	Izaak Walton League (Suffolk-Nansemond Chapter)	National Audubon Society	National Parks Conservation Association	National Wildlife Federation
Natural Resources Conservation Service	Piedmont Environmental Council	Rappahannock League for Environmental Protection	Richmond Audubon Society	Shenandoah National Park
Southern Environmental Law Center	The Rappahannock Valley Garden Club	The Wildlife Foundation of Virginia	U.S. Fish and Wildlife Service	USGS Patuxent Wildlife Research Center
VA Chapter National Wild Turkey Federation	VA Chapter of American Fisheries Society	VA Chapter The Wildlife Society	Virginia Conservation Network	Virginia Council of Trout Unlimited
VA Dept of Agriculture and Consumer Services	VA Dept of Conservation and Recreation	VA Dept of Environmental Quality	VA Dept of Forestry	VA Dept of Game and Inland Fisheries
VA Dept of Transportation	Virginia Herpetological Society	VA Marine Resources Commission	Virginia Native Plant Society	Virginia Polytechnic Institute and State University
Virginia Society of Ornithology	Virginia Waterfowlers' Association	Wild Virginia	Wildlife Center of Virginia	

Table 4. Workshop 2 – Presentations

Topic	**Speaker**
Welcome	Bob Duncan, DGIF
What have we learned? What are we doing? Where are we going?	Nathan Lott, VCN
Wildlife Responses to Climate Change, Management Challenges and Opportunities to Help Species Adapt in Virginia	Jean Brennan, Ph.D., Defenders of Wildlife
Climate Change Communication Strategies	Edward Maiback, Ph.D., George Mason University
Conservation Tools Available in Virginia and Implications for Adapting Wildlife Management and Conservation to Climate Change	Chris Burkett, DGIF
Ecosystem Services Assessments: An Example of a Conservation Tool to Protect Wildlife and Habitats	David Whitehurst, DGIF
How the Teaming With Wildlife Coalition is a Vehicle for Change	Austin Kane, NWF

The strategies, actions, and information contained within this document were developed, in large part, based on comments received at the two workshops. Unfortunately all comments and suggestions could not be addressed, and this text focuses on efforts that are most needed to address common concerns and ideas. A complete copy of comments from both workshops is available upon request.

Final Review:
During June 2009, DGIF, NWF, and VCN personnel produced this draft strategy to protect Virginia's SGCN and their habitats from climate change. This document was provided to all workshop participants who were encouraged to review the information and provide any additional thoughts or comments by July 6, 2009. Comments were compiled and reviewed by DGIF and NWF personnel and used to produce this final document.

Three Main Strategies

During the first climate change workshop, participants identified three main strategies that should be initiated to help safeguard Virginia's SGCN and their habitats from the effects of climate change. These initial actions include:
1) Conserving species and habitats as the climate changes,
2) Addressing data and modeling needs related to climate change, and
3) Expanding outreach and education efforts.

The following narratives provide brief background information about each strategy and specific, initial, actions that can address these needs. When possible, ongoing efforts to implement these actions are also described.

Strategy 1: Conserve Species and Habitats as the Climate Changes

During the first climate change workshop, participants were concerned that a changing climate would impact Virginia's wildlife and wildlife habitats. Participants hypothesized that the impacts will be most pronounced along Virginia's coastlines and at higher elevations, but they were less certain about how intermediate elevation habitats would be affected. They were also uncertain about how Virginia's wildlife and habitats, collectively, will respond to these changes over time. Finally, some were concerned that Virginia's growing human population, and society's efforts to adapt the Commonwealth's economy and infrastructure in response to climate change, would intensify and exacerbate the future climatic impacts on wildlife and native habitats. This uncertainty prompted participants to identify various data and modeling needs that could help answer some of these questions. Please see the discussion on **Data and Modeling Needs**.

Although the groups were unable to identify a consistent long-term strategy, there was a general consensus that something should be done immediately to address issues already causing the loss of wildlife and habitats. It was felt that by working to restore and maintain healthy habitats and wildlife populations, now, these species and systems will be better able to adapt to future climate stresses. Workshop participants identified five basic actions that could help mitigate immediate issues impacting SGCN and their habitats and implement actions that will help conserve species as the climate changes. These actions include:

1. The conservation and restoration of native habitats to promote resilience to changing conditions;
2. The identification, conservation, and creation of linear habitat corridors to link geographically isolated populations and facilitate the natural expansion of species' ranges toward higher elevations and more northerly latitudes, as well as inland from the coast;
3. The revision to Virginia's Endangered Species Act to expand opportunities to conserve species protected under this legislation;

4. The creation of new public and private resources to implement conservation actions that will help safeguard species and habitats from climate change; and
5. Expanding the use of captive breeding and reintroductions to enhance the population and distribution of Virginia's SGCN.

1. <u>The conservation and restoration of native habitats to promote resilience to changing conditions.</u>
   Virginia's Wildlife Action Plan indicates that the loss or degradation of native habitats constitute the single greatest threat impacting Virginia's SGCN.

   Over 60 percent of Virginia's SGCN are aquatic and another 15 to 20 percent rely upon riparian and wetland habitats. The action plan and workshop participants indicated that the following are the most significant challenges currently impacting Virginia's major rivers and specific wetland types:
   - Big Sandy River – water extraction; introduction of organic pollutants; and sediment load alteration and increased turbidity (erosion);
   - Chowan River – sediment load alteration (erosion); increased nutrient loads; and introduction of herbicides, fungicides, and insecticides;
   - Clinch/Powell River system – sediment load alteration and increased turbidity (erosion); channel or shoreline alteration; dewatering; and introduction of organic pollutants;
   - Delmarva River – introduction of organic pollutants; increased nutrient loads; and introduction of herbicides, fungicides, and insecticides;
   - Holston River – sediment load alteration and increased turbidity (erosion);
   - James River – sediment load alteration and increased turbidity (erosion) and introduction of herbicides, fungicides, and insecticides;
   - New River – sediment load alteration and increased turbidity (erosion) and increased nutrient loads;
   - Pee Dee River – sediment load alteration and increased turbidity (erosion); channel or shoreline alteration; and increased nutrient loads;
   - Piankatank River – heavy metal contamination and sediment load alteration (erosion);
   - Potomac River – introduction of herbicides, fungicides, and insecticides; sediment load alteration and increased turbidity (erosion); channel/shoreline alteration; increased nutrient inputs; and decreased surface permeability within the watershed;
   - Rappahannock River – sediment load alteration and increased turbidity (erosion) and introduction of herbicides, fungicides, and insecticides;
   - Roanoke River - introduction of herbicides, fungicides, and insecticides; sediment load alteration and increased turbidity (erosion); habitat fragmentation; hydrologic regime change; and introduced fish species;
   - York River - sediment load alteration and increased turbidity (erosion) and introduction of herbicides, fungicides, and insecticides;
   - Coastal Plain Wetlands – introduction of herbicides, fungicides, and insecticides; habitat destruction and fragmentation; road mortality; fire suppression; introduction of pollutants; and conversion to other uses;
   - Wooded Wetlands – fragmentation for human use; "edge effect" resulting from loss of upland habitats; and conversion to other uses; and

- Coastal Marshes - change in sea level and conversion to other uses.

Virginia's other SGCN occupy a wide variety of terrestrial habitats. The action plan and workshop participants indicated the following are the most significant challenges impacting these habitats and the species they support:

- Barrier Islands and Beaches – invasive species, change in sea level;
- Early Successional and Grasslands – conversion to agriculture; predation by native and exotic species; propagation of nonnative grasses;
- High Elevation Forests – commercial harvest; acid precipitation; habitat destruction from exotic plants and insects;
- Mature Deciduous Forests – commercial harvest; destruction or fragmentation by other human uses; degradation by native species; and
- Pine Savannahs – altered fire regime; conversion to commercial forests.

Climate change is expected to exacerbate many of these threats and will likely cause new impacts to be added to these lists of existing issues. Sea level rise, for example, will likely inundate a variety of coastal habitats. In Virginia's higher elevations, warmer air temperatures and altered rainfall patterns could eradicate the last fragments of boreal forests. In aquatic systems, if rainfall increases, aquatic species may be forced to contend with increased sediment loads and altered stream morphology. Conversely, if Virginia experiences prolonged droughts punctuated by brief, intense, storm events, sediment and pollution loads might decline due to decreased normal flows while stream morphology would almost certainly be altered by the brief and dramatic influx of storm water. Each of these potential climatic impacts could have a profound impact on the quality and character of Virginia's land and water resources and would have an equally profound impact on the wildlife species that currently utilize those habitats. If species are unable to adapt to the new conditions or relocate to suitable habitats elsewhere, extirpations and extinctions will likely occur.

Unfortunately, these problems could be further compounded by Virginia's growing human population. As of the July 2009, the Virginia Employment Commission (http://www.vec.virginia.gov/vecportal/lbrmkt/plugins/lmiapp.cfm/popproj#) estimates that, between 2010 and 2030, Virginia's human population will increase by almost 23 percent. These future communities will have to deal with climatic impacts. For example, changing precipitation patterns could affect the availability of clean drinking water. In order to support the growth of human communities, the Commonwealth will have to implement social, technical, and economic responses to climate change. These adaptations will almost certainly bring human communities into conflict with natural communities over the allocation of land and water resources.

Until more detailed climate models are available, and climate experts, resource managers, and elected officials have the opportunity to review and interpret the new information, it is difficult to make precise predictions regarding the impacts Virginia's natural and human communities will experience. As such, this initial strategy will not attempt to provide a comprehensive set of actions to mitigate all the possible scenarios that could impact Virginia's habitat resources. ***Rather, this strategy focuses on actions to restore healthy***

wildlife populations and habitats so they may be better able to respond to climate change and have a greater likelihood of adapting to the new climatic and habitat conditions. The following are actions that could help address the issues, identified above, that are currently impacting Virginia's habitats and help those habitats, and the species they support, become more resilient and better able to respond to climate change.

- Riparian Buffers: Per Virginia's regulation on establishing Chesapeake Bay Resource Protection Areas (9VAC10-20-80), buffers of 100 feet around wetlands, tidal shores, and both sides of any waterbody with a perennial flow are believed to, "…provide for the removal, reduction, and assimilation of sediments, nutrients, and potentially harmful or toxic substances…" before they reach a waterway. If these practices were applied to waterbodies throughout Virginia, many of the most significant threats to 60 percent of Virginia's SGCN could be addressed. Another 15 to 20 percent of Virginia's SGCN would also benefit from the improvement and expansion of riparian habitats.
- Implementation of the *Northern Bobwhite Quail Action Plan for Virginia*: A coalition of agency and organizations have initiated efforts to work with private landowners to conserve and restore early successional habitats for Northern Bobwhites and dozens of other SGCN, including Bachman's sparrows, canebrake rattlesnakes, least weasels, and eastern box turtles.
- Restoration of Pine Savannah Habitats: Members of Virginia's conservation community are actively working to restore and maintain pine savannah habitats used by red-cockaded woodpeckers and several other SGCN.
- Facilitation and Enhancement of Local Land Conservation: Virginia has an active community of agencies, nonprofit organizations, and local land trusts working to conserve lands in their communities and address a variety of social, historic, economic, and conservation goals. With additional funding and support, it may be possible to enhance and more specifically target land conservation towards properties that will have maximum conservation benefit given the likely impacts of climate change (such as targeting upland areas to allow for inland migration of coastal wetlands as sea level rises) within an organization's area of operation. The Department of Game and Inland Fisheries, the Department of Conservation and Recreation, and Virginia Commonwealth University are currently developing a tool to help communities identify priority areas for conservation within Virginia's coastal plain. Once completed, the efficacy of this tool should be evaluated to determine if it could be used to support this effort.

For other habitat types, the way forward is not clear. For example, Virginia enjoys rare and isolated pockets of spruce/fir forests which occur at very high elevations and are remnants of habitats that covered large portions of the Commonwealth during the last ice age. But over the last 10,000 years, these habitats have been restricted to the highest (i.e. coldest) elevations. As the climate warms, it is likely that these isolated locations will become unsuitable for this botanical community and the fauna (e.g. snowshoe hare) these habitats currently support. Until climate models are available to describe the future viability of these habitats under various climatic scenarios (see **Produce climate modeling and associated wildlife threats and vulnerability assessment for Virginia)**, it is unclear if the conservation of these specific habitats and obligate species would be a prudent investment of limited conservation resources.

As with high elevation habitats, Virginia's coastal habitats are likely to change dramatically with climate change, specifically as sea levels rise. Efforts to characterize the potential climatic impacts to Virginia's Eastern Shore are currently being explored by The Nature Conservancy in Virginia and a variety of agency and academic partners. Once likely impacts have been identified, this group will work to develop five conservation strategies that can be implemented locally to enhance wildlife adaptation on the Eastern Shore. When the action plan is updated in 2015, the results of this effort will be reviewed to determine the effectiveness of these strategies in conserving coastal habitats on the Eastern Shore and to determine if those strategies could be adapted to conserve other coastal areas within Virginia.

Invasive species represent a final variable that could have a dramatic impact on efforts to conserve and restore habitats. Historically, invasive species (e.g., phragmites, Asian clams, kudzu, tree of Heaven, nutria) were introduced to Virginia and became established in fragmented and impaired habitats. Once established, the invasive populations further degraded the quality of native habitats and negatively impacted native species. As demonstrated by recent discoveries of Asian species like northern snakeheads (*Channa argus*) and Chinese mitten crabs (*Eriocheir sinensis*) in Virginia waters, it is a near certainty that new species will arrive in Virginia, either from other states or other parts of the world, and establish themselves in areas where they would have been historically excluded by the local climate. As further demonstrated by the limited effectiveness of historic control efforts, once new species become established in open systems, they are almost impossible to eradicate. At the time of this writing, it appears that the best defense against invasive species is to limit their opportunities to establish a foothold by conserving and restoring healthy native habitats, and working to educate the public about the problems caused by the unintended and, sometimes unlawful, introduction of species. However, other opportunities to detect and eradicate invasive species should be explored.

2. <u>The identification, conservation, and creation of habitat corridors linking geographically isolated populations of SGCN and facilitating the natural expansion of species' ranges toward higher elevations and more northerly latitudes, as well as inland from the coast.</u> Virginia's action plan identifies habitat fragmentation as an issue affecting most habitat types and hundreds of SGCN. When large habitats are broken into smaller parcels and robust wildlife populations are reduced to small isolated groups, those populations must often contend with new physical factors (e.g., invasive species, habitat edge effects) and genetic factors (e.g., founders effects, demographic bottlenecks, and inbreeding) that minimize their opportunities for long-term survival. Many of Virginia's SGCN, such as the canebrake rattlesnake, eastern box turtle, and wood turtle, often occupy isolated habitat patches as a result of land fragmentation. These populations would likely benefit from a series of habitat connections, improving opportunities for genetic exchange with other isolated populations. Increasing genetic diversity should help populations become more robust and increase the likelihood that they will be able to withstand impacts of climate change. Similarly, when large habitat patches are connected by linear habitat corridors, at least some species should have the opportunity to redistribute themselves as the climate changes.

Ultimately, efforts to address this issue will involve:

- Identifying which of Virginia's SGCN will need to move or migrate for populations to remain viable;
- Determining the types of connectivity and habitat features required to facilitate the movement of those species;
- Identifying where (or if) appropriate habitat connections currently exist;
- Identifying the factors that either fragment the landscape or limit the use of potential corridor habitats;
- Determining the physical, legal, social, and economic requirements for protecting these areas and the circumstances hindering their protection; and
- Developing capacities to manage and maintain corridor habitats once they are created.

Articulating detailed responses to all of these issues is well beyond the scope of this document. However, until a more thorough and comprehensive study of these issues can be implemented, the following ideas are offered to identify immediate opportunities to implement "on the ground" conservation and initiate more comprehensive discussions on these issues.

Of all linear landscape features, Virginia's rivers are the most easily recognizable corridor habitats. Historically, the majority of Virginia's rivers facilitated mass migrations of anadromous fish from sea level to higher elevations. It is feasible that as climatic conditions change, nonmigratory aquatic species will be forced upstream by altered water conditions (e.g., temperature increases, salinity changes). Some of the most expeditious means of conserving aquatic SGCN will be to expand and enhance existing programs that establish riparian buffers, remove obsolete dams and culverts from waterways, and restore stream and shoreline morphology. As indicated earlier, all of Virginia's major rivers would benefit from the creation of riparian buffers. However, the action plan also indicates the Clinch/Powell, Pee Dee, Potomac, and Roanoke systems would benefit from the removal of impediments and the restoration of river channels and shorelines to more natural conditions. Although not universal, these actions should facilitate aquatic species adaptation to climate change.

For terrestrial habitats, initial work is being completed to help identify possible habitat corridors and inform management decisions regarding habitat and corridor conservation. Virginia Department of Conservation and Recreation Division of Natural Heritage has completed the "Cores and Corridors" project which analyzed Virginia's landscape and identified large contiguous patches of vegetation that could serve as core habitats. Likewise, this analysis revealed linear patches of vegetation that may serve as corridors to facilitate the movement of some wildlife between the potential core habitats. DGIF personnel have mapped the distribution of Virginia's vertebrate, mollusk, and crayfish SGCN, based upon 6^{th} order watersheds, and the action plan provides known habitat associations to identify suites of species that likely share the same habitats and are likely to be impacted by the same conservation issues. Finally, the Northeast Association of Fish and Wildlife Agencies is developing a new land cover map to describe the location and composition of Virginia's vegetative communities. When available to be reviewed collectively, these tools should

provide the foundational pieces to support a broader discussion of SGCN and the habitat linkages they may require.

3. Revisions to Virginia's Endangered Species Act
   Several of Virginia's SGCN, such as the blackbanded sunfish and the eastern tiger salamander, occur in isolated locations separated by wide expanses of unsuitable habitat. Both are protected by Virginia's Endangered Species Act (ESA). Their current habitats are not secure and, as the climate changes, some biologists do not think that either species will be able to redistribute themselves naturally to new areas. The long-term conservation of these species, and possibly others affected by climate change, will likely require biologists to physically move populations into new habitats; most likely on private lands. However, it is understandably difficult to recruit landowners to willingly accept responsibility for an endangered species without the Commonwealth providing some legal protections to limit the landowner's liability if the transplant fails or an accident occurs.

   The Federal Endangered Species Act allows the U.S. Fish and Wildlife Service (Service) to protect landowners by declaring a transplanted population to be "experimental." Additionally, when a federally protected species occurs on private land, landowners may negotiate "Safe Harbor" agreements with the Service which, barring a dramatic change in land management, will limit the landowner's legal responsibilities toward the species in question. Virginia's ESA provides no similar opportunities, and efforts to recover some state listed species (e.g., blackbanded sunfish) have been hampered by these legislative limitations.

   DGIF personnel will explore opportunities to enhance existing legislation so a greater assortment of public/private partnerships can be implemented to conserve species protected under Virginia's Endangered Species Act.

4. Work to develop new public and private resources to implement conservation actions.
   Virginia's Wildlife Action Plan identifies over 900 SGCN. Existing and future threats, including climate change, will affect these species and their habitats statewide. Although the DGIF is responsible for species conservation, the agency has little authority to influence land management on properties the agency does not own. Likewise, the amount of work needed to address these impacts far surpasses the personnel and financial resources available from the Commonwealth's natural resource agencies. Therefore, to successfully implement the action plan and safeguard Virginia's wildlife from the effects of climate change, new resources and partnerships will have to be created and nurtured.

   In addition to historic agency, academic, and organizational partners, new conservation opportunities are being explored. For example, there may be opportunities to create early successional habitats on mitigated mining lands. If successful, these habitats could provide significant opportunities for conserving loggerhead shrikes, northern bobwhites, eastern box turtles, eastern hog-nosed snakes, American woodcocks, and other SGCN found in the south western portions of Virginia. By restoring these habitats, the SGCN listed above should have more habitat opportunities and be better suited to cope with rising temperatures and other climatic changes.

At the time of this writing, the DGIF is working to establish an external advisory council to provide support and insight on wildlife conservation issues. Given the breadth of individuals and organizations invited to participate, this council may be an excellent venue for identifying opportunities and facilitating implementation of multi-party habitat conservation efforts. DGIF personnel will explore opportunities to work with this council in this way.

5. Expand the use of captive breeding and reintroductions to augment populations and expand distributions of SGCN.
   As Virginia's climate changes, species with healthy, wide ranging, populations are likely to have more opportunities to adapt to changing conditions. It is also believed that many of the aquatic species identified within Virginia's action plan can tolerate warmer water conditions than they currently encounter. Unfortunately, many of these heat-tolerant SGCN, such as the blackbanded sunfish, golden darter, spotted darter, sharphead darter, greenfin darter, bluebreast darter, wounded darter, notched rainbow, creeper, triangle floater, eastern lamp mussel, eastern pond mussel, Tennessee heelsplitter, and the spiny river snail occupy small isolated habitats and have few opportunities to naturally expand their range. Using technology that supports commercial and sport fisheries, and once a variety of species-specific protocols (e.g. species selection, collection of brood stock, conditions for release) are created, it should be possible to expand existing nongame propagation programs and breed these and other warm water SGCN in captivity and release them into currently unoccupied habitats.

   At the time of this writing, DGIF personnel are exploring these opportunities and working to overcome legal issues associated with these types of projects (see **Revisions to Virginia's Endangered Species Act**).

Strategy 2: Address Data and Modeling Needs Related to Climate Change
Throughout both workshops, participants described a wide variety of data and research that would help Virginia's conservation community prepare for climate change. There was no shortage of good ideas or opportunities for research. However, not all suggestions were equally applicable to the long-term conservation of Virginia's SGCN. Likewise, limited human and financial resources put some projects beyond reach at this time.

However, three projects described during the first workshop would both immediately enhance climate change adaptation efforts and could be achieved by 2015, when the update to the action plan will be completed. These projects include:

- Producing climate modeling and associated wildlife threats and vulnerability assessment for Virginia;
- Collecting public attitude information to inform outreach efforts related to wildlife conservation and climate change; and
- Incorporating action plan information into the Ecosystem Services Toolkit being developed by the Virginia Department of Forestry and the Conservation Management Institute.

As indicated previously, this list of activities is not meant to be a comprehensive set of research needed to address climatic impacts likely to impact Virginia's SGCN. This is, however, a place

to start. Undoubtedly, these efforts will inform future adaptation discussions and elicit new research questions.

1. Produce climate modeling and associated wildlife threats and vulnerability assessment for Virginia

   To date, the majority of climate modeling has focused on continental or hemispheric geospatial scales. While these maps have advanced theoretical discussions regarding the future intensity of climate change, they do little to inform local or state management actions. During both the October 2008 and the March 2009 workshops, participants discussed the need for more refined models to indicate how Virginia's climate will likely change in coming decades and what those changes will mean for Virginia's human and natural communities.

   To address this need, the DGIF and NWF will contract with Virginia Tech's Conservation Management Institute (CMI) to predict future climatic conditions within Virginia. Once climate models have been completed, additional resources (e.g., natural history information, predictive models from agency and academic sources, expert opinion) will be applied to predict how a subset of Virginia's SGCN and their habitats are likely to respond to the predicted conditions. Once completed, the NWF and DGIF intend to make these products available to Virginia's conservation community. As appropriate, the DGIF will work to incorporate these findings within the next version of Virginia's action plan and develop longer-term conservation strategies.

2. Collect public attitude information to inform outreach efforts related to wildlife conservation and climate change

   During both climate change workshops, participants indicated a need for new and expanded outreach programs related to climate change. However, any outreach effort must be supported by an understanding of the target audiences. Currently, no data exist to quantify how adult Virginians consider climate change impacts on wildlife or their opinions on the various management actions that could be taken to address climate-related impacts on human communities and wildlife habitats.

   The DGIF, NWF, and, possibly, other partners will work with a survey contractor to collect public attitude information from Virginians related to climate change and specific adaptation strategies. Once collected, this information will be used to develop an outreach toolkit that will support action plan implementation and the Commonwealth's efforts to mitigate and adapt to the future impacts of climate change. (see **Outreach Needs**)

3. Incorporate action plan information into the Ecosystem Toolkit being developed by the Virginia Department of Forestry

   During both climate change workshops, participants indicated that the conservation community needs to develop a new strategy when discussing the value of wildlife and habitat conservation. Instead of only discussing the intrinsic value of a species or habitat, conservationists need tools that describe the economic value of wildlife and the social and economic benefits wildlife and wildlife habitats provide to human communities.

A collection of Virginia's agencies, being led by the Virginia Department of Forestry, are working with personnel from Virginia Tech's Department of Forestry and Environmental Conservation to create an ecosystem toolkit for Virginia. Once completed, this toolkit will provide landowners and communities with a wide array of information related to land, water, and wildlife resources and the social and economic benefits these resources provide to Virginians. Eventually, it is hoped this toolkit will enhance the creation and operation of clean water markets, carbon sequestration markets, and mitigation banking efforts.

DGIF personnel are currently working with the partner agencies to incorporate the action plan's species and habitat information into the ecosystem toolkit framework. Once completed, this effort will allow Virginia's conservation community to consider and discuss wildlife-related information in a broader management and economic context. This assessment will also provide a mechanism to demonstrate the importance of protecting functioning ecosystems, which will be especially important as the habitats, and the species they support, are affected by climate change.

Strategy 3: Expand Outreach and Education Efforts

The need for new and more effective outreach was discussed extensively during both climate change workshops. Almost universally, participants felt that Virginians were not informed about climate change or the impacts climate change will have on Virginia's human and wildlife communities. Interestingly, participants also indicated that the conservation community does not understand public attitudes toward wildlife or the actions that can be taken to mitigate climate-related impacts. Two outreach efforts will be initiated. Each of these actions are described below.

1. <u>A Communications Plan to Support the Implementation of Virginia's Wildlife Action Plan and Emphasizing Actions to Safeguard Wildlife from the Impacts of Climate Change.</u>
   Virginia's Wildlife Action Plan was created as part of a national effort to keep species from becoming endangered. Since its completion in 2005, segments of the public have remained interested in the program, but the DGIF has never developed a coordinated outreach effort to explain how the program's goal can be achieved or to promote achievements in implementing the action plan. To address this need, DGIF personnel and partners will develop a concise outreach plan to build public and legislative support for the action plan and promote conservation achievements, including climate change adaptation.

2. <u>Draft Action Plan Summaries to Support Local Conservation</u>
   Despite the conservation community's support in developing the action plan, it is increasingly apparent that the action plan is unable to sufficiently support local conservation efforts. Using species distribution maps and other resources developed to support the action plan, DGIF and partners will create summary reports at the scale of a Planning District Commission (PDC) – organizations that coordinate multi-county planning efforts within Virginia. These reports will identify the SGCN that occur within each 6^{th} order watershed within each PDC's boundaries and the types of habitats those species require. The individual reports will also identify issues impacting the health of those species or their habitats, discuss conservation actions that would address those issues, and highlight resources that might be available to help implement conservation actions. Each summary will be electronically

updated as new resources (e.g., climate modeling, terrestrial land cover, measures of environmental quality) can be incorporated.

Next Steps

During the review of the draft adaptation strategy (see **Process**), several individuals indicated the resource management agencies, academic institutions, and nongovernmental organizations should engage in the creation of a longer-term climate adaptation strategy. The actions described within this document are offered as a starting point to facilitate the adaptation and resiliency of wildlife and habitats to climate change. While these actions may help secure species from further short-term declines, they are not offered to preclude a more robust planning process to resolve the myriad of biological, climatic, economic, social, legal, and administrative issues that must be addressed if Virginia is going to successfully create and implement a long-term climate adaptation strategy. If future versions of the action plan are to address climate-related threats to wildlife conservation, it will be imperative for Virginia's resource management, academic, and nongovernmental communities to collaborate to more fully define the climatic threats to wildlife species and habitats and develop mechanisms to address those threats.

One step in developing the next climate change adaptation strategy will be to organize a Climate Change Adaptation Committee:

Develop a Wildlife Climate Change Adaptation Committee to Develop the Next Version of Virginia's Climate Change Adaptation Strategy.

At the time of this writing, the Director of the DGIF is creating an external advisory council for that agency. Over 60 organizations, representing the broad spectrum of agency stakeholders, have been invited to participate. Once established, members of this council will be asked to help articulate a process to develop the next generation of climate change adaptation strategy. Committee members will also be asked to identify individuals and resources that can help inform discussions on climate change and long-term adaptation planning. With this input, DGIF personnel will work to establish a formal climate change committee and initiate efforts to develop the next version of the adaptation strategy and incorporate that information into Virginia's action plan in 2015.

Conclusion

Virginia's wildlife faces daunting challenges. Even before climate change was considered, Virginia's Wildlife Action Plan identified over 900 SGCN, of which 529 could either become extinct or be extirpated from the Commonwealth. The principal cause of this imperilment is the loss or degradation of habitats. Unfortunately, climate change is likely to add another suite of stresses to Virginia's habitats, exacerbating the existing issues, and making it that much more difficult to preserve Virginia's wildlife heritage. Conservation will be difficult, but not impossible.

Throughout the nation's history, those that care about wildlife resources have led the way in creating adaptive solutions to community problems. During the 19th century, after many wildlife species had been decimated by centuries of unregulated harvest, conservationists worked to establish state wildlife agencies to manage species both for current use and the use of future generations. In the 1960s when people realized the country's unprecedented economic progress

was having an equally deleterious effect on wildlife, conservationists worked to establish legislation that helped secure our wildlife heritage by preserving and restoring the quality of the nation's land, air, and water resources. Now, the threat of climate change offers an opportunity for the conservation community to again declare that our wildlife, their habitats, the recreation they support, and the services those resources provide are important to our civilization and must be conserved for our posterity.

During the first climate workshop, a participant said, "We need to do more than change our light bulbs." The preceding document describes the first steps that Virginians can take to make our wildlife and wildlife habitats more resilient to climate change. Although not specific enough to guide conservation efforts for decades, it describes actions we can implement until the nature of our future climate is better understood, the effectiveness of our ongoing efforts is evaluated, and a more comprehensive adaptation strategy is developed.