Virginia's 2025 Wildlife Action Plan

Prepared by the Virginia Department of Wildlife Resources

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TABLE OF CONTENTS

LIST OF FIGURES 3

LIST OF TABLES 5

FOREWORD BY RYAN BROWN 6

PREFACE 7

EXECUTIVE SUMMARY 9

1. INTRODUCTION 10

Background 10

2025 Wildlife Action Plan Implementation 12

Goals for the Updated Wildlife Action Plan 14

Value of an Updated Wildlife Action Plan 15

Updated Plan Structure 16

2. WILDLIFE ACTION PLAN OVERVIEW 17

Online Website & Tool 18

Species Summary 18

Species of Greatest Conservation Need List Revision 19

3. HABITATS 29

Habitat Summary: Descriptions, Status, Threats, and Conservation Actions 35

Climate of Virginia 108

4. THREATS 121

5. CONSERVATION ACTIONS 143

Priority Research Needs 145

6. MONITORING, EFFECTIVENESS MEASURES AND RESEARCH NEEDS 149

Research Needs 161

7. UPDATE OF VIRGINIA'S WILDLIFE ACTION PLAN 161

8. STAKEHOLDER AND PUBLIC PARTICIPATION..... 162

9. CONCLUSION..... 169

10. REFERENCES 170

APPENDIX 1: SOUTHEAST CONSERVATION ADAPTATION STRATEGY..... 185

APPENDIX 2: WILDLIFE HEALTH 211

APPENDIX 3: RECOMMENDATIONS FOR ENHANCING CONSERVATION OF SGCN AND THEIR HABITATS THROUGH EDUCATION, OUTREACH, AND WILDLIFE VIEWING ... 216

APPENDIX 4: VIRGINIA MARINE MAMMAL CONSERVATION PLAN..... 224

APPENDIX 5: VIRGINIA SEA TURTLE CONSERVATION PLAN..... 390

LIST OF FIGURES

Figure 2.1. SGCN Animal Density 19

Figure 2.2. SGCN Plant Density 20

Figure 2.3. Conceptual representation of the assessment priority (AP) category 21

Figure 3.1. Density of all SGCN Species in Virginia..... 30

Figure 3.2. Conservation Lands of Virginia 31

Figure 3.3. Forest Lands in Virginia 38

Figure 3.4. Open Lands in Virginia 44

Figure 3.5. Glades and Barrens Habitats in Virginia..... 49

Figure 3.6. Caves and Karst Areas..... 52

Figure 3.7. Fresh and Saltwater areas in Virginia..... 65

Figure 3.8. Wetland Habitats in Virginia..... 82

Figure 3.9. Tidal Marsh Structure..... 85

Figure 3.10. Urban/Developed Lands in Virginia..... 92

Figure 3.11. Wildlife Biodiversity Resilience Corridors, Virginia Wildlife Corridor Action Plan, VA DWR..97

Figure 3.12. Six Distinct Climate Regions of Virginia..... 109

Figure 3.13. NOAA Calculated normalized 30-year precipitation & tempetures..... 110

Figure 3.14. Statewide precipitation averages over the past 43 years..... 111

Figure 3.15. Elevation Map of the Central Appalachians..... 112

Figure 3.16. Normalized statewide precipitation map for Virginia..... 113

Figure 3.17. Impervious surface area coverage of Virginia's Richmond area..... 114

Figure 3.18. The Bermuda High Pressure extension scenarios..... 115

Figure 3.19. Satellite view of the powerful January 2018 Nor'easter.....116

Figure 3.20. Statewide windspeed averages over the past 43 years.....117

Figure 3.21. Statewide temperature averages over the past 43 years.....118

Figure 3.22. U.S.G.S. Survey Showing Mt. Rogers.....118

Figure 3.23. Normal mean temperatures in January & July, 1991-2020.....119

Figure 3.24. Average length of frost-free growing season in Virginia.....120

Figure 6.1. Conservation Lands in Virginia……150

Figure 6.2. Virginia Wetlands Catalog.....153

LIST OF TABLES

Table 2.1. Number of SGCN by Taxonomic Group and by Tier.....18

Table 2.2. Reference Guide tool used to generate SGCN predictions.....24

Table 8.1. Wildlife Action Plan Stakeholder groups.....162

Table 8.2. Wildlife Action Plan Tribal Contacts.....164

Table 8.3. Presentation to Organizations/Groups on the Wildlife Action Plan 165

FOREWORD BY RYAN BROWN

The best first step in achieving a goal is to make a plan. Without a thorough plan for action, a goal can prove to be elusive. And with a big goal, such as to conserve Virginia's diverse fish wildlife species, you need a proactive, comprehensive, and thoughtful plan. That's why we at the Virginia Department of Wildlife Resources (DWR) take the lead on and work with partners to create and implement the Wildlife Action Plan. This plan guides our mission to keep the Commonwealth's fish and wildlife species healthy and sustainable as part of the Commonwealth's landscape.

Decades ago, Congress, the White House, the U.S. Fish and Wildlife Service (USFWS), and thousands of stakeholders developed a funding path for keeping fish and wildlife species from declining, with the goal of keeping common species common. The resultant State Wildlife Grants (SWG) program requires that each state and territory develop an Action Plan. The 2005 Wildlife Action Plan, the first iteration, represented a strategy to conserve Virginia's wildlife resources by developing a framework of coordination and cooperation between agencies, communities, and private conservation groups. These partners and the DWR have worked together to identify certain species, identified as Species of Greatest Conservation Need (SGCN), and habitats in need of conservation, and also to implement meaningful, on-the-ground projects and research to address those needs. Working to support and restore wildlife and habitat before they decline is a proactive approach that's more feasible and less expensive than trying to restore imperiled species.

In the 20 years since the Wildlife Action Plan's first writing, the DWR and partners have used the plan's guidance in identifying and implementing research and projects to benefit a wide variety of species across Virginia. The Wildlife Action Plan identifies species in decline, prioritizes them based on their need and the feasibility of work identified to address those needs, and maps out strategies that would help stabilize or grow those SGCN populations. It's a great way to break a big problem down into manageable, specific steps and actions. Many of the projects and actions taken to address the needs of SGCN have improved habitat for other, more common species that use the same resources.

Like most plans, the Wildlife Action Plan should evolve as needs and capabilities change. For 2025, the DWR has worked with partners, including federally and state-recognized Native American tribes, to update the Wildlife Action Plan to guide our work for the next 10 years. We've included many new SGCN, updated the status of others, examined our successes, and charted paths forward for areas in need of improvement. The 2025 Wildlife Action Plan has a strong focus on more specific, place-based efforts to conserve SGCN and includes new conservation education, enforcement, recreation, and engagement actions.

Together, the DWR, partners, and Virginians can have an impact on the wildlife species that make our natural world so interesting, diverse, and colorful. With a renewed, updated Wildlife Action Plan, we have a guidebook to do so.

Ryan J. Brown
Executive Director
Virginia Department of Wildlife Resources

PREFACE

As I started this, my third Virginia Wildlife Action Plan, I began to reflect on how far we've come and what progress we have made since our first plan 20 years ago. Obviously, we have come a long way from massive three ring notebooks holding a thousand pages of narrative and maps, and the GIS technology has also progressed. But how far have we come in making progress on implementing the conservation issues outlined in each of the Plans? As I reviewed the two previous plans, the thing that stood out most was how much better we are getting at describing specific conservation actions that we, our partners and others can take to make a positive impact on the landscape. We still need to do more, but this iteration of the Plan will hopefully improve on the previous two.

There are many changes in the 2025 Plan update. The three biggest changes come in (1) separating out some species that we previously included in the Plan because we don't really have enough information to inform the tier ranking; (2) providing occurrence of Species of Greatest Conservation Need (SGCN) and habitat information on a smaller spatial or geographic scale than in the previous plan; and (3) coordinating with the tribes recognized by the Commonwealth and those who gained federal recognition since 2015. This last point being the most significant part of my learning process throughout this revision. With the help of our partners at the Virginia Department of Conservation and Recreation's (DCR) Division of Natural Heritage (DNH), we have included plants this time. We could not have done this without their expertise and support. In addition, we have included a more complete list of marine species and larger emphasis on climate vulnerability, working lands and outreach and education.

These changes and the complete review of all of our SGCN lists has required significant work on the parts of many people and partners. Most importantly, this revision would not have been completed if it were not for the two Commonwealth Coastal and Marine Policy Fellows, supported by Virginia Sea Grant and the DWR, that worked on this project: Clay Ferguson and Cliff Jenkins. Clay was instrumental in pulling the preliminary SGCN lists together for review by the Taxa teams and then keeping the teams on schedule to complete the reviews. Cliff stepped in as Clay was finishing his fellowship and shepherded our GIS work and defining habitats, threats and conservation actions. I could not have maintained the schedule or handled all of the coordination if it had not been for these two exceptional individuals, and I know they are both headed for great things in the future. Amy Martin, DWR Nongame and Endangered Species Program Manager, helped me add content to the Plan to address several comments from the Stakeholder Advisory Committee and the general Public. Amy's years of experience in the political and environmental services realm provided the insight and direction required for some important additions to the Plan. In addition, Becky Gwynn kept us all on task and provided guidance to better consider how we wanted to approach different parts of this revision. In addition, she enhanced the Plan with her years of wisdom and unmatched writing skills to expand on many parts of the Plan.

Beyond the core team, many others contributed greatly to the 2025 Wildlife Action Plan. They include:

- The staff and administrators from the Virginia Department of Wildlife Resources: Scores of you contributed your time and expertise to help us identify and prioritize the Species of Greatest Conservation Need, understand the habitats those species require, describe the threats impacting those species and habitats, and articulate the actions that can be taken to address those threats and help keep species from declining. Many of you reviewed draft materials, corrected our mistakes, and helped arrange outreach opportunities. Without your efforts and expertise, the updated plan would not exist as a viable conservation tool.

- Scott Klopfer and the staff at Virginia Tech's Conservation Management Institute: You have been invaluable members of this planning team. Your work on developing the GIS tools and online dashboard for future use set the DWR up well for the work ahead.

- Jason Bulluck, Anne Chazal and many other great staff and experts at the Virginia DCR-DNH: Your assistance and collaborative nature have been greatly appreciated. The data, tools, and analyses you provided were critical in identifying and describing conservation priorities and opportunities, and critically, provided the expertise to include the plants and many of the invertebrates in this version of the plan.

- Dee Blanton and others from the U.S. Fish and Wildlife Service's Office of Conservation Investment: Your efforts to help the northeastern states communicate with each other and to coordinate with the Northeast SWAP Coordinators have advanced our planning efforts and will enhance our collective ability to address our regional conservation needs.

- The tribal environmental staffs who provided input and guidance on how best to incorporate the tribal perspectives, culturally important information and generally just helping the Agency navigate a new set of relationships: Dana Adkins (Chickahominy Indian Tribe), Jack Ryan (Rappahannock Indian Tribe), and Joe Capella (Pamunkey Indian Tribe) were particularly helpful in answering many of my very uninformed questions. I'd also like to thank Mike LaVoie and Caleb Hickman with the Eastern Band of the Cherokee for taking the time to educate us on tribal issues and relationships.

- Lastly, the authors would like to thank everyone that reviewed the draft Wildlife Action Plan and provided comments. We appreciated the words of encouragement as well as the constructive criticisms.

This plan is truly the work of many hands and great minds. My part was simply to "herd the cats" and keep us headed in the right direction. I could never have accomplished this without so many taking their time to provide comments, answer questions, and carry the load to bring this to completion. It was well worth sticking around for a couple more years to shepherd the process. I continue to be amazed at the passion of so many great folks working together to achieve the important conservation goals. Keep up the good work and thank you for carrying on the legacy of so many others who came before us!

Sincerely,

Jeffrey B. Trollinger
Wildlife Action Plan Coordinator
Virginia Department of Wildlife Resources
August 31, 2025

EXECUTIVE SUMMARY

Virginia is an incredibly diverse state. While supporting nearly 9 million people, Virginia's landscape provides hundreds of habitat types that support tens of thousands of wildlife species. Throughout Virginia's history, these wildlife and habitat resources have provided sustenance, economic benefits, icons, and recreational opportunities that contribute to community wellbeing, individual quality of life, and cultural identity.

Over the last century, Virginia's habitats have become increasingly impaired, impacting both wildlife and people. While Virginia's conservation community has successfully restored many imperiled species, including white-tailed deer, Canada geese, and bald eagles, many habitats and the species they support continue to decline. At the time of this writing, over 130 species have been classified as being either threatened or endangered in Virginia. Efforts to restore critically imperiled species are often expensive, contentious, and biologically challenging. Limited budgets, habitat loss and change, and an increasingly diverse suite of interests require Virginia's conservation community to reconsider its work; to become more collaborative and proactive. It is no longer sufficient to ask, "How do we restore endangered species?" Rather, the conservation community must ask, "How do we keep species from becoming endangered?" Virginia's Wildlife Action Plan presents a strategy to help restore imperiled and declining species and to keep more common species common, while also providing benefits to Virginia's human communities.

The updated Wildlife Action Plan identifies 1921 Species of Greatest Conservation Need (SGCN) that are ranked by their relative degree of imperilment and an additional 5190ssessment Priority species for which there is not enough information at this time to determine an accurate tier ranking. Habitat loss is the single greatest challenge impacting many of these species. This Plan, through the online tool, presents habitats by twelfth-order watersheds and the SGCN that occur in those watersheds. In addition, threats to species and habitats, including ones of anthropogenic origin (e.g., poaching, illegal trade, light pollution) are identified. Conservation actions are outlined for each watershed, and others that may be applicable to species or habitats regardless of geography have also been included. The Wildlife Action Plan documents existing programs that address threats or define best management practices, as well as data that could be used to document and evaluate the success of conservation actions. Finally, the updated Wildlife Action Plan describes climatic trends that have been projected for Virginia and identifies actions that can be taken to conserve wildlife and habitats under those changing conditions.

Virginia's Wildlife Action Plan was updated with significant input from Virginia's conservation community. Substantial efforts were also made to obtain feedback from the sovereign tribal nations, state-recognized tribes, and the general public.

It is hoped that this updated Action Plan will help Virginians, in all areas, to expand and enhance existing partnerships, develop new partnerships, direct the use of existing conservation resources toward priority areas and problems, bring new resources to bear, and help the Commonwealth acquire or develop new human and financial resources to address these important conservation issues.

1. INTRODUCTION

BACKGROUND

Congress created the State Wildlife Grants Program (SWG) in 2000 and the Tribal Wildlife Grant Program in 2001 to provide critical funding to state, territorial, commonwealth, District of Columbia (D.C.), and tribal fish and wildlife agencies to conserve at-risk fish and wildlife. These programs, administered by the U.S. Fish and Wildlife Service's (USFWS) Wildlife and Sport Fish Restoration Program (now the Office of Conservation Investment), filled a significant void in conservation funding and opened the door to a new era of partnership between governmental and non-government agencies and organizations, communities, businesses and industry. The primary purpose of the State and Tribal Wildlife Grant Program is to help states proactively invest in fish and wildlife conservation strategies to prevent species from becoming endangered and accelerate efforts to restore those already endangered or threatened (USFWS 2020).

As an initial condition for receiving SWG funding, Congress mandated that each state and territory develop a Wildlife Actions Plan (Action Plan; Plan) by October 2005. The Wildlife Action Plans were conceived as an effort to guide states in identifying and addressing the needs of a wide array of wildlife and habitats of greatest conservation need. These Wildlife Action Plans were also used to ensure the effective use of SWG funding. DWR typically receives approximately $1.2M per year from State and Tribal Wildlife Grants for salaries and operational costs associated with work on nongame aquatic species, herpetofauna and to cover costs associated with our environmental service requirements. These are critical conservation actions that are not eligible for funding under other Agency grant programs. To guide development of these Wildlife Action Plans, Congress established eight essential elements that had to be addressed before a Wildlife Action Plan could be approved by the Director of the USFWS (Public Law 106-291). These eight essential elements include:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*

6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and

7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats; and

8. Congress has affirmed through the Wildlife Conservation and Restoration Program and SWG that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

All states and territories submitted their initial Wildlife Action Plans to the USFWS by October 1, 2005. Since being approved, these Wildlife Action Plans have been a guiding force in wildlife conservation. Virginia's 2005 Wildlife Action Plan represented a strategy to conserve Virginia's wildlife resources. Although the Virginia Department of Wildlife Resources (DWR) was the lead agency in developing the Wildlife Action Plan, and its subsequent revision in 2015, it was intended to be a strategy for statewide wildlife and habitat conservation and a framework for coordination and cooperation between governmental agencies, academic institutions, communities, businesses, industry, and non-governmental organizations. The DWR and partners have used the Wildlife Action Plan to prioritize key species and habitats in need of conservation and to implement needed projects and research on behalf of all Virginians.

Virginia's Wildlife Action Plan was updated in 2015 and, with this 2025 document, is now in its third iteration. The DWR and partners view this update process as an important opportunity to reevaluate the status of Species of Greatest Conservation Need (SGCN) and their habitats, review conservation priorities, and reprioritize conservation actions. Furthermore, this update provides a process to review the conservation efforts, research, and projects implemented during the past decade. It also allows the DWR and partners to consider how the Wildlife Action Plan and project prioritization might be improved to enhance efforts that keep species from becoming imperiled.

Based upon discussions with DWR staff and conservation partners, and review of how conservation actions were described in the 2015 Plan, Virginia's 2025 Wildlife Action Plan has been modified to be more dynamic and applicable to smaller landscapes. The updated Wildlife Action Plan adopts greater emphasis on habitat conservation and, with the associated online tool, provides better guidance on how to implement conservation actions in a meaningful way. While single species efforts may be necessary to conserve the most critically imperiled species, scores of other species can be effectively and efficiently conserved via actions that protect and restore the quality of their habitats. While the 2015 Wildlife Action Plan adopted the format used by the Virginia Outdoors Plan that communicates priority actions and needs at the Planning District scale, the new Action Plan provides an overview of the

habitats, impacts from changing environmental conditions and working landscapes, but goes further with the online tool to apply habitat conservation actions at a more local scale. The scope of the printed portion of the Plan addresses those aspects of Virginia's habitats and current knowledge that are less likely to change, while providing flexibility in the online tool to nimbly adjust on-the-ground conservation efforts needed to address quickly changing stressors and current scientific knowledge of those threats. By enhancing its availability, it is hoped the Wildlife Action Plan will be used by a greater diversity of existing and potential new partners throughout the Commonwealth.

The 2025 Plan includes several important additions. Plants were included this time, with extensive review and work conducted by Virginia's Department of Conservation's Division of Natural Heritage (VDNH). In addition, marine species were included to a greater extent and reviewed by a team of marine taxonomic experts from the Virginia Department of Wildlife Resources, Virginia Marine Resources Commission and the Virginia Institute of Marine Science. A more significant emphasis is placed on conservation education and wildlife-related recreation in this Plan, and the DWR's Watchable Wildlife and Outreach staffs ensured that the Action Plan interfaces with the agency's Wildlife Viewing Plan and outreach efforts. Finally, a significant effort was made to incorporate comments from Virginia's Native American tribes who have been federally recognized since the last Plan revision. Virginia is home to seven federally-recognized and four state-recognized tribes. Many of these tribes are signatories to the Treaty of Middle Plantation, which specifically mentions tribal rights to oystering, fishing, and gathering a series of plants including edible roots, wild oats, rushes, and other species. Several tribes participate in natural resources stewardship through cooperative monitoring of fisheries resources, oyster reef restoration activities, and monitoring water quality on tribal lands. Many of these changes resulted in an increase in SGCN but also provided a much more comprehensive perspective of the current state of Virginia's wildlife and natural resource communities.

2025 Wildlife Action Plan Implementation

Over the past two decades, Virginia's Wildlife Action Plan has become an important conservation resource, and significant effort has been expended to address issues identified within its pages. Successful implementation of the Wildlife Action Plan can be categorized into four main areas of work: species research, active resource management, land acquisition, and support and planning.

Species-specific research efforts were emphasized between the initial 2005 Plan and the 2015 revision. This work provided more focus for Virginia's conservation community to better understand the distribution, taxonomy, habitat requirements, and life history of a diverse set of SGCN. These data have been critical in helping biologists develop or improve species management efforts. The 2025 Plan builds these efforts; since 2015, State Wildlife Grant resources were used to develop statewide conservation plans for wood and bog turtles, eastern hellbender, Tennessee dace, black-banded sunfish, and eastern tiger salamander. Other notable conservation efforts included building boxes for hellbenders in the Upper Tennessee River watershed in southwest Virginia to provide additional nesting habitat. These efforts were implemented in conjunction with partners from the Smithsonian National Zoological Park, Virginia Tech, the University of Virginia at Wise, Virginia Master Naturalist volunteers and Southwest Virginia Community College. DWR provided start-up funding to a partnership including the Town of

Elkton, VA Department of Environmental Quality and the USFWS, to restore the shoreline of the South Fork Shenandoah River at the Elkton Landfill, which prevented additional runoff of effluent and debris from the landfill. Several dam removal projects provided access for shad and river herring, sea lamprey and American eel and a host of freshwater mussel host species to upstream habitats that have been inaccessible for centuries. Finally, Virginia is a national leader in the propagation of imperiled freshwater mollusks in the Tennessee River and the Atlantic slope watersheds at two mussel propagation facilities. During the past decade, more than 13.6 million mussels, including 23 federal and state listed species, have been propagated at these two facilities, and nearly 400,000 mussels have been released at strategic restoration sites. Of note, these accomplishments included restoring the Appalachian monkeyface and the James spinymussel to their original watersheds for the first time in decades, as well as reintroducing brook floater mussel to three watersheds, including the South Fork Shenandoah, and green floater and yellow lampmussel to the South River. The practices perfected at these propagation and culture facilities have charted new and exciting paths forward for the restoration and conservation of these imperiled aquatic resources.

Important lands were acquired to conserve SGCN and their habitats. The 7,912 acre Coastal Forest Wildlife Management Area (WMA) was acquired through a partnership of the USFWS, The Nature Conservancy, the Conservation Fund, Ducks Unlimited, the National Fish and Wildlife Foundation, Walmart's Acres for America Program, the Wildlife Foundation of Virginia, the American Bird Conservancy and the Virginia Outdoors Foundation and provides a variety of forested and open habitats utilized by SGCN as hemispherically important migratory bird habitat. Active pine-savannah habitat management of the Big Woods WMA resulted in the first pair of nesting red-cockaded woodpeckers at the WMA. This management also provided extensive habitat for other SGCN like northern bobwhite. Likewise, active management of the Highland WMA was successful in providing additional breeding habitat that brought golden-winged warblers onto the property. While these efforts require considerable effort to deliver, they represent a permanent conservation achievement.

The last category of activities involves a range of support and planning services. The original Wildlife Action Plan frequently described how devastating the loss or degradation of habitats can be to species. Often these impacts are caused by human activities. The DWR's Environmental Services Section has incorporated the Wildlife Action Plan into its review and commenting process for construction or development projects. Likewise, the Virginia Fish and Wildlife Information Service (VAFWIS), Virginia's comprehensive wildlife database, has integrated the Wildlife Action Plan into its framework and provides a variety of distribution, habitat, and conservation information about the SGCN. While DWR does not have the authority to regulate land development and use of our natural resources, our Environmental Services Section consults with those entities that do permit such projects. Our role in these consultations is to ensure that impacts upon wildlife and their habitats that may result from these activities are appropriately considered and minimized. One may use VAFWIS, coupled with the guidance and information available through our website to perform citing analysis, project scoping, and initiate consultation with Environmental Services Section staff, as needed. Finally, changing environmental conditions was identified as a significant threat to several SGCN. Since 2008, Virginia has been a leader in working to develop strategies that address the changing environment within the updated Wildlife

Action Plan, including land acquisitions that allow for marsh migration and developing living shorelines that can withstand increased storm impacts.

Undoubtedly, the original Wildlife Action Plan and the 2015 revision have helped Virginia conserve SGCN. However, it is obvious that more work is needed to make the Plan more useable and focused for specific conservation actions on the ground. This updated Wildlife Action Plan will address these issues while facilitating opportunities to evaluate this conservation tool and adapt efforts to meet new needs and challenges.

GOALS FOR THE UPDATED WILDLIFE ACTION PLAN

The primary purpose of this updated Wildlife Action Plan is to identify conservation actions that will benefit a diversity of species and habitats and describe where those conservation actions should be implemented. Based on the extensive work to implement the first Wildlife Action Plan, several key lessons and concerns emerged to inform the update process. First, the original Wildlife Action Plan was organized by ecoregions. Each ecoregion chapter included background information on the ecoregion and more specific details for a selection of SGCN found within the ecoregion (e.g., species life history, habitat description and status, threats, conservation actions, and research and monitoring needs). The ecoregion sections were informative and included relevant information for some species. Unfortunately, none of Virginia's conservation partners manage resources based upon ecoregion boundaries, making the original 2005 Wildlife Action Plan less "actionable" than was desired. The 2015 Wildlife Action Plan, while more focused on Planning Districts, still did not provide specific enough conservation actions that could be easily implemented. Spatial scale and representation of needed actions must be presented in a context that is meaningful and useful to conservation practitioners, communities and businesses, and, in fact, all Virginians.

A second concern involved the prioritization of projects implemented under the auspices of the Wildlife Action Plan and how those efforts related to conservation partners. Much of the initial implementation has focused on single species survey and research efforts. The majority of these efforts focused on species that were already critically imperiled, and this prioritization prevented many DWR programs from aligning work with the Wildlife Action Plan. Likewise, partners that were not specifically focused on threatened and endangered species were less able to identify actions applicable to their work. The 2015 Plan attempted to address some of these issues by directing efforts at the Planning District Commission (PDC) level (groups of counties/cities) but still lacked the degree of specificity needed for local implementation and direction of activities to specific conservation actions. In addition, the online tool, which was unique for 2015, did not have an effective search engine and often gave results, while accurate for the PDC, were not accurate for specific smaller areas within the PDC.

Finally, there were identified concerns over the breadth and depth of the conservation actions identified in the 2015 Wildlife Action Plan. The specific actions included were ones that could be funded largely by the federal State Wildlife Grants program and excluded ones that could be funded by other means (grants, partnerships, etc.). The DWR recognizes the importance of developing a more robust set of

priorities. In the first Wildlife Action Plan, important and necessary actions were outlined but without any specific prioritization. The 2015 Wildlife Action Plan took a much more localized view of conservation actions, but it still lacked enough specific actions. The 2025 Wildlife Action Plan revision provides several improvements to address these concerns:

- *Increased participation by taxonomic experts and other informed partners* – The 2025 Wildlife Action Plan consulted extensively with taxonomic experts, not only in the **complete review of all SGCN species, but also in defining the habitats and threats associated with those species and specific conservation actions that will benefit those species.**
- *Relevance at a more local geographic scale* – The updated Wildlife Action Plan is written to provide resource managers with information about priority species, habitats, threats, and conservation actions in their area of focus and influence at the HUC12 level. A secondary effort, planned for a future addition, will include potential partners and additional funding sources for complementary conservation efforts.
- *Habitat approach and focus to address threats and conservation* opportunities – The revised Wildlife Action Plan focuses conservation efforts by habitats to address threats and conservation actions for a broader array of SGCN.
- *Prioritization of species and actions* – This version of the Wildlife Action Plan continues a focus on prioritizing both SGCN and some of the conservation actions at a local level. In this way, conservation within Virginia can be carried out in areas in the most need of action or areas where efforts are most likely be successful and beneficial. In addition, the addition of Assessment Priority species provides for the inclusion of a host of species that may need conservation efforts, but for which there is little or no information concerning what those efforts might look like.
- *Representation of an array of partners* – The contents of this Wildlife Action Plan focus on SGCN and habitats that are managed by a diversity of federal, state, and local agencies as well as private organizations, tribal nations and individuals that implement conservation efforts throughout Virginia. Whenever possible, relevant tools and priorities developed by these partners have been incorporated into the Wildlife Action Plan.
- *Emphasis on effectiveness* – The Wildlife Action Plan includes specific procedures that will allow the DWR and others to measure the effectiveness of conservation actions implemented from the Wildlife Action Plan.
- *Online dashboard for conservation actions* – This revision is primarily delivered in an electronic online format that allows interested entities to search at a finer geospatial scale and determine SGCN presence in the area, what habitats occur in the area and what conservation actions are associated with those SGCN and their associated habitats.

VALUE OF AN UPDATED WILDLIFE ACTION PLAN

Virginia has a vast array of species and habitats from the coast to the mountains. Natural resource conservation in Virginia, as in most states, is a collaborative effort by government agencies, non-governmental organizations, businesses, communities, private institutions, and citizens. In addition, each of the Sovereign Nations have conservation goals of their own. This broad community partners

across the Commonwealth to maximize the opportunities for conserving wildlife and habitats. Virginia's Wildlife Action Plan provides a statewide and local blueprint for conservation actions needed to keep species from becoming endangered. Information regarding these resources is provided at multiple levels, ranging from single species needs to habitats and watersheds. The Wildlife Action Plan is designed to help all conservation sectors understand species and habitats priorities at a state and local levels and the types of actions needed within their area of responsibility or even backyard. The Wildlife Action Plan includes 1921 SGCN and 519 Assessment Priority species; it covers 11 major habitat types representing 32 sub-habitats; and is searchable at the HUC12 level for priority SGCN and threats and conservation actions by habitat. Some species locations are buffered due to the ease of identification, sensitive nature of very specific habitat associations, size of some hydrologic units, and the risk of collection or poaching. In addition, there is a specific section on Working Lands and how lands specifically managed for human activities still provide habitat for many SGCN.

In addition to these changes, the 2025 Plan has been organized and described according to the Northeast Lexicon (Crisfield, NEFWDTC 2022) to facilitate multi-jurisdiction and regional coordination among the northeast state fish and wildlife agencies. Described habitats, threats and conservation actions are described according to the definitions and coding scheme developed by the Northeast Association of Fish and Wildlife Agencies' Fish and Wildlife Diversity Technical Committee (NEFWDTC) and its partners. Ultimately, data from the Virginia Wildlife Action Plan will be added to the Northeast State Wildlife Action Plan Database so that regional projects will be easier to develop.

Using a regionally shared Lexicon (language) to describe species, habitats, threats and actions has many benefits, as described above. However, it does not allow for nuance and detail related to specific conservation goals for any given species. DWR and its partners must lean on species-specific conservation, recovery, and or management plans to provide that level of detail. Where possible, these plans are referred to and integrated within the Wildlife Action Plan.

The process of updating this Wildlife Action Plan allowed federal, state, and local agencies, as well as nonprofit organizations, academic institutions, state and federally recognized tribes, tribes with a cultural presence in Virginia, and other entities, to identify common goals and actions that will help all entities work more efficiently at achieving conservation success. This Wildlife Action Plan is meant to build upon existing partnerships, foster new partnerships, enhance and prioritize programs, build support for the identified priorities, and lay the foundation for effectively and efficiently implementing conservation actions throughout the Commonwealth.

UPDATED PLAN STRUCTURE

The updated Wildlife Action Plan is organized primarily by the "Eight Essential Elements" required by Congress. Most of the actionable and specific information has been loaded into an online database and is searchable through an online dashboard. This approach provides an easier-to-use format and allows for more accurate species distribution information and associated habitat information. The Plan, while only required to be updated every 10 years, should be dynamic and be updated as new information becomes available. While this tactic may require additional coordination with the U.S. Fish and Wildlife

Service, utilizing the defined processes for major and minor changes, it should provide for a more readily useable Plan until the next revision is due.

- *Introduction* provides background information and an overview of the Wildlife Action Plan.
    - Purpose of Wildlife Action Plan
    - Implementation of 2025 Wildlife Action Plan
    - 2025 Wildlife Action Plan Goals
    - Wildlife Action Plan Value
    - Plan Structure
- Overview
    - Description of the online dashboard and database
    - Summary of Species of Greatest Conservation Need
    - Criteria for SGCN species (Element 1)
- Habitats, Threats, Conservation Actions, Monitoring (Elements 2, 3, 4, 5)
    - Habitat descriptions and status (Element 2)
    - Statewide threats to species and habitats, including changing environmental conditions (Element 3)
    - Research needs (Element 3)
    - Conservation actions (Element 4)
    - Monitoring and research needs (Element 5)
    - Effectiveness measures (Element 5)
- Revision Process and Timeline (Element 6)
- Stakeholder and Public Participation (Elements 7 & 8)
- *Appendices*
    - Wildlife Health Issues
    - Conservation Education & Outreach Efforts to Implement the WAP

2. WILDLIFE ACTION PLAN OVERVIEW

Virginia's revised Wildlife Action Plan utilizes a habitat approach to address threats and conservation actions for the state's fish and wildlife resources where feasible. In addition, anthropogenic impacts (e.g., poaching, illegal trade) have been included, along with relevant conservation actions to address these threats. This approach helps ensure that conservation actions benefit a diversity of species within the Commonwealth. A habitat approach also allows for more species potentially to benefit by any single conservation action and for the more efficient use of limited resources. Additionally, this Wildlife Action Plan is designed to facilitate implementation at a scale where conservation most often occurs – the local level.

Throughout the process, DWR administrators and the Wildlife Action Plan's authors worked with the understanding that an effective Wildlife Action Plan could only be created with input and guidance from DWR staff, partner agencies and organizations, tribal nations, communities, businesses, and the public.

Online Website & Tool

This revision of the Plan will include delivery of a significant portion of the information through an online website and tool. To make the Plan more executable at a local scale, users will be able to click on a 12th-order watershed, or a place on a map, and be able to look at habitats that exist within that watershed. Users will be able to view a list of SGCN that occur in that area, along with associated habitats, stressors, and conservation actions likely to help conserve those species. In the future, the DWR hopes to include links to resources and partners able to assist with implementing those conservation actions.

The online portion will supplement the information required for submission to the U.S. Fish and Wildlife Service in a printed document and will facilitate making onsite conservation decisions. The text portion will provide the overview of how the Plan was developed, descriptions of the habitats and threats to SGCN and their associated habitats, and a description of some ongoing monitoring occurring between 2025 and the next revision in 2035. In addition, there will be appendices, online links, and information providing additional information on the Plan, such as conservation education and wildlife-related recreation efforts, and links to a variety of associated documents, especially in the Northeast region.

Species Summary

Virginia's 2025 Wildlife Action Plan includes a list of 1921 SGCN and 519 Assessment Priority species. *Rather than simply revise the 2015 WAP, staff chose to refresh the entire review of potential species.* All criteria for inclusion and ranking of SGCN have been incorporated into this document for reference. While most habitat associations, threats, and conservation actions were known, taxa teams reestablished these linkages according to the NE Lexicon as developed by the NEFWDTC.

The 2025 Wildlife Action Plan includes a more extensive suite of plants (some were amended into the 2015 Plan in 2024) and more extensive inclusion of marine species. The number of species within each taxonomic group and tier are identified within Table 2.1.

Table 2.1. Number of SGCN by Taxonomic Group by Tier.

Taxonomic Group	Tier I	Tier II	Tier III	Tier IV	Total
Amphibians	9	5	12	9	35
Reptiles	8	3	12	7	30
Freshwater Fishes	17	18	22	29	86
Marine Fishes	1	1	15	8	25
Birds	21	14	26	28	89
Mammals	8	3	6	14	31
Aquatic mollusks	29	15	9	9	62
Aquatic crustaceans	3	4	5	4	16
Aquatic insects	16	63	44	32	155
Other aquatic invertebrates	15	18	7	8	48
Terrestrial insects	33	35	64	34	166

Other terrestrial invertebrates	45	78	44	40	207
Plants	623	145	69	134	971
Total	**830**	**403**	**338**	**359**	**1921**

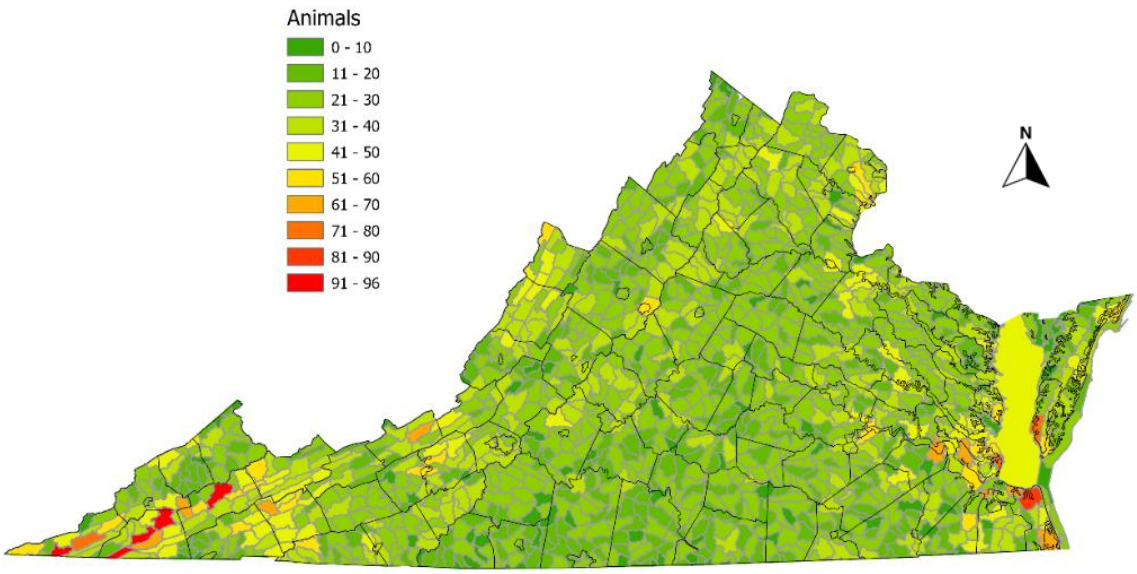


Figure 2.1 - Density of SGCN Animals across Virginia

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 page 15). This prioritization scheme helps managers focus attention on species with specific management needs and opportunities. Of the 1921 SGCN identified within the 2025 Wildlife Action Plan, 21 percent are classified as Category A, indicating that managers have identified on-the-ground strategies to address the needs of the species or its habitat. Another 45 percent of the 2025 list of SGCN are classified as Category B, indicating that specific research is needed to facilitate on-the-ground action or that identified actions cannot be implemented at this time due to a lack of resources. The remaining SGCN (34 percent) are classified as Category C or not given a Conservation Opportunity Rank at all, indicating that managers have not identified on-the-ground strategies or specific research needs that will facilitate those actions or that there is not enough information to determine a specific ranking or tier. Species also were assigned to Category C when available conservation opportunities have been exhausted. It should be noted that life history and distribution data are lacking for many of the SGCN.

Species of Greatest Conservation Need List Revision

Due to the inclusion of additional taxa (plants, marine species) and the extensive updating of bird and freshwater mussel distribution data, the DWR chose to re-evaluate the status of all SGCN in this revision rather than just amend the 2015 list. The complete list of SGCN can be found here. The assessment of all SGCN was begun by creating a list of all possible species that could be considered, based on their inclusion on one or more of the following established assessment lists:

the 2015 Virginia list of SGCN, Federally-listed Virginia species, Northeast and Southeast Regional SGCN, NatureServe-ranked species, Virginia listed species, and IUCN-ranked species.

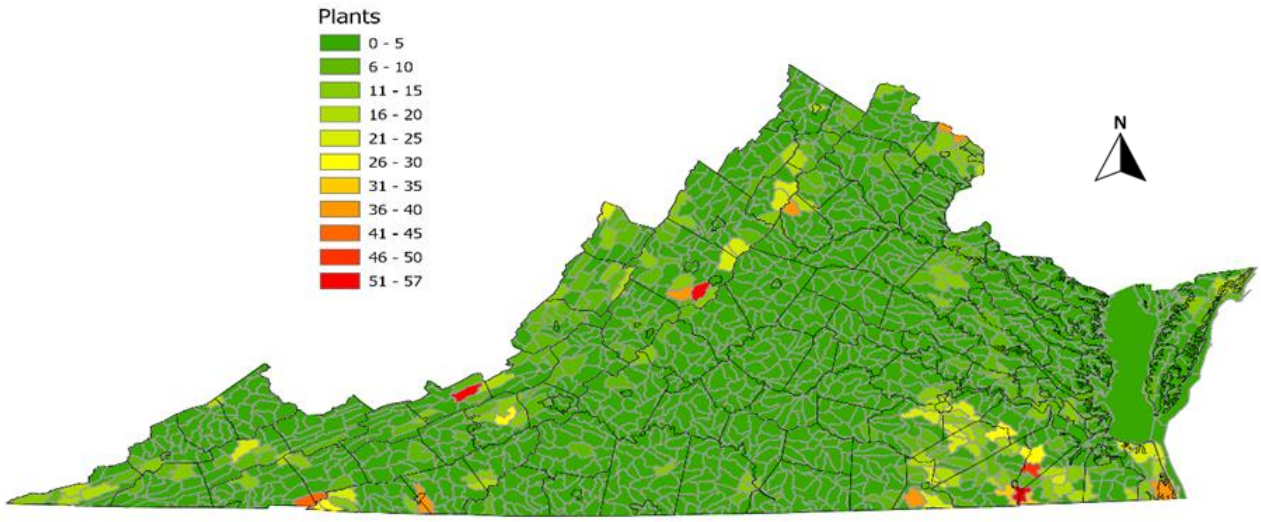


Figure 2.2 - Density of SGCN Plants across Virginia

The DWR identified categories of potential SGCNs to assist in the prioritization of them:

a. *Leaning in:* a species not included in the 2015 SGCN list that qualified for consideration in the 2025 SGCN review process, as it was found on at least one of the established assessment lists. "Leaning-in" species were recommended for inclusion in the 2025 SGCN list and included if their respective TAC supported inclusion or if no justification could be provided for removal.
b. *Low- qualifying:* a species that barely qualified for inclusion on the potential SGCN list. Species received the "low qualifying" label if they were only included on the potential SGCN list because they met one or more of the following intertaxa criteria ranks:

    - ESA, At-Risk Species, petition withdrawn (PW) or not listed (NL)
    - RSGCN watchlist (WL), proposed watchlist (pWL), or proposed moderate concern (pMC)
    - NatureServe G5 or S5, G4-S3, G3-S4, SNR, SU, SH, SNA, or equivalent ranks
      Although "low-qualifying" species received heightened scrutiny for inclusion, they were by default included on the proposed SGCN list if TAC teams could not justify removal.

c. *Leaning-out*: a species recommended for removal because it did not meet at least one of the criteria above and removed if the respective TAC concurred or if no justification could be provided for inclusion.

An important new component added to this Wildlife Action Plan was an assessment priority (AP) category. Synonymous to a "data-deficient" category, the AP category was created to flag "species for which more information is needed to fully understand status and trends to determine the level of conservation concern or SGCN status" (2022 Northeast Lexicon for State Wildlife Action Plans, Crisfield, NEFWDTC 2022). The intended outcome of the new AP list was three-fold: 1) refine the SGCN list down to that which accurately reflects the reality of what is known or can safely be inferred about Virginia's

biota; 2) ensure that Virginia species most in need of basic life history, population size and distribution, and threat assessments are identified in a discrete category ; and 3) catalyze the pursuit, acquisition, and allocation of funding to address taxa- or species-specific knowledge gaps. The definition adopted for AP species in this Wildlife Action Plan was:

> AP species are species for which more contextual information is needed to justify assignment of a conservation status, population trend, and subsequent SGCN ranking, if warranted. Contextual information may include both direct data and indirect inferences concerning, for example, the condition of the species habitat(s), likely ecology and habitat preferences, and trends in known threats or stressors. The list of AP species can be found here.

While AP species are categorically not considered SGCN in this Wildlife Action Plan, they remain eligible for State Wildlife Grant funds (D. Blanton, USFWS, personal communication) or other grant funds. In this way, proper assessments could be adequately funded for many poorly studied species, with the strategic goal of shrinking the AP list over time.

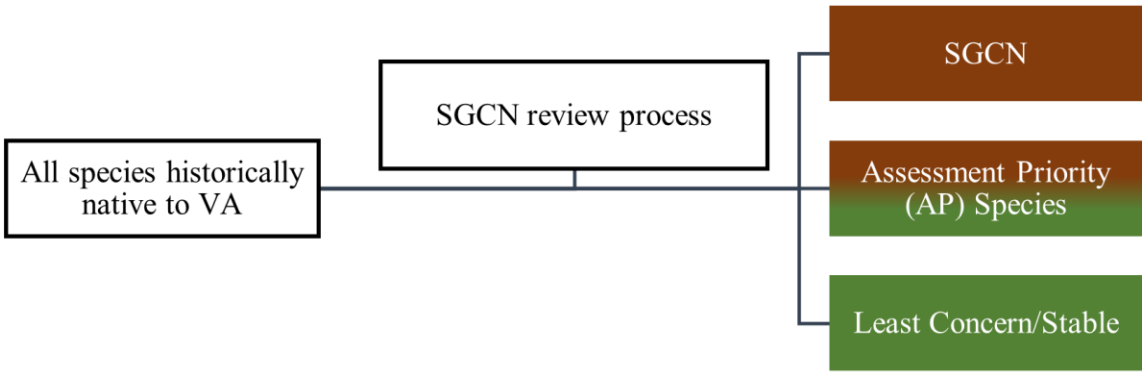


Figure 2.3. Conceptual representation of the assessment priority (AP) category, new to the second revision of the Virginia Wildlife Action Plan. The split-color gradient of the AP box acknowledges that SGCN, perhaps even some of VA's most imperiled species, will fall into this category along with species that do not presently need conservation attention (i.e. least concern/stable).

Species were added to the AP list in a few ways (Figure 2). Undescribed species were first flagged as likely candidates for listing as an AP; TAC teams then either confirmed or denied AP assignment. Similarly, each species suggested for removal from the potential SGCN was considered for goodness-of-fit on the AP list (i.e. is it being recommended for removal as an SGCN because of insufficient information). Species with NatureServe ranks of GU/GNR or SU/SNR were recommended to the TAC for AP assignment. Ultimately, each TAC reserved the authority to migrate any potential SGCN over to the AP list if it could justify that more research and assessment was needed to establish an actual conservation status.

Guidelines were prepared and shared with the TACs to better direct application of the newly-formed AP category. This document was crafted following a literature review of relevant peer-reviewed journal articles. Best practices were identified, as were model examples of what type of information gaps might qualify a species for inclusion on the AP list. One exception was made to the AP process. The Invertebrate TAC asked to add 30 species of isopods as SGCN after that list had been finalized and put out for stakeholder review. Most of these species are not well understood, so rather than drop them completely, or try to rush defining their habitats and conservation actions and then put them out for SAC review a second time, these animals were added to the AP list.

Potential SGCN not categorized as leaning in, leaning out, low-qualifying, or AP were considered likely SGCN. As such, these species received a less rigorous, but nonetheless complete review for inclusion/exclusion. Indeed, a handful of "likely SGCN" were recommended for removal by TAC. Subsequently, all species that made the initial list of SGCN were subjected to a more extensive review to determine their relative imperilment status, and to what degree, if any, viable conservation opportunities exist for slowing or reversing observed population declines.

Each species recommended for SGCN inclusion by a TAC was subjected to a robust status assessment, resulting in the assignment of imperilment tier ranks and conservation opportunity ranks.
As the name implies, SGCN imperilment tier ranks (Tiers) help indicate the relative status of species, and the level of conservation effort needed to slow and reverse the decline. A primary aim of Tiers is to help inform the use of resources and funding for specific species. The tiers and included species and habitats in the Wildlife Action Plan provide guidance on where to direct limited resources and ensure efforts inspired by the Wildlife Action Plan are applied somewhat proportionately to species needs.

> **Tier I.** Critical Conservation Need. Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed.
>
> **Tier II.** Very High Conservation Need. Has a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.
>
> **Tier III.** High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, or are restricted in range. Management action is needed to stabilize or increase populations.
>
> **Tier IV.** Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend, or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations.

Conservation opportunity ranks (COR) were retained from the first revision, accompanied with minor clarifications to better distinguish them from the AP category. The goal of the COR is to help managers

focus attention on species with already - identified management needs and viable opportunities for delivering those needs. In other words, COR help distinguish the species for which fundable, ready conservation actions have been identified from the species for which knowledge gaps or resources preclude abatement of population and/or habitat declines. The COR also indicates viability of recovery under current resource constraints. Species and/or habitats flagged relatively early in their declines (as indicated by lower Tier assignments) tend to be viewed as more cost-effective opportunities for conservation. While these ranks help guide more fiscally responsible expenditures, they also help in the identification of species-specific knowledge gaps in need of filling. By focusing research efforts on "B" and "C" species, the proportion of SGCN classified as "A" should increase with every revision.

> **A –** Managers have identified "on the ground" or immediately implementable species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.
>
> **B –** Managers have only identified research needs for the species or have only identified conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.
>
> **C –** Managers have yet to identify actions or specific research needs beyond additional surveys that could benefit this species or its habitat or all identified conservation opportunities have been exhausted. However, there is enough known about this species to determine a tiered conservation status.

Beyond the definitions provided for each ranking category, the TAC considered species and habitat status, existing and projected threats, adaptive capacity to threats, and other pertinent factors when assigning ranks. This process is inevitably a subjective one, but fittingly reflective of experts' informed opinions. Since an AP category was not used previously, species that should not have been designated SGCN often received a low-Tier rank (III or IV). The process used for the 2025 revision is more reflective of actual status, trend, and related information.

To support the work of the TAC, a tool was developed to predict Tiers for all proposed SGCN (TABLE 2.2). This tool leveraged the intertaxa criteria already collated for the potential SGCN. The tool was developed by associating the ranking categories of all six intertaxa criteria previously noted to the four SGCN Tiers, as best they could be aligned. In all cases, the highest-ranking intertaxa criteria for a given species served as the automatic Tier predictor. For example, the following intertaxa criteria species profile would have resulted in a predicted Tier I only because of the NatureServe G2-S1 and the State Threatened + S1 ranks:

> IUCN vulnerable (VU), ESA candidate, RSGCN moderate concern (MC), State Threatened, and NatureServe G2-S1

If the NatureServe and State listing ranks were removed from the example intertaxa-criteria profile, the ESA candidate rank would become the next highest Tier-qualifying predictor, at Tier II. Remove that ESA rank, and the remaining intertaxa criteria ranks would have resulted in lower-predicted SGCN Tier ranks.

Table 2.2. Reference guide tool used to generate SGCN Tier predictions.

Priority Tier	Definition	Reference Criteria Qualification
Tier I	Critical Conservation Need. Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed.	IUCN critically endangered (CE) or endangered (EN) ESA federally endangered (FE) ESA federally threatened (FT) or candidate **and** S1 RSGCN very high concern (VHC) State endangered (SE) State threatened (ST) **and** S1 NatureServe G1 NatureServe G2-G3 **and** S1
Tier II	Very High Conservation Need. Has a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.	IUCN vulnerable (VU) **and** S1 ESA federally threatened (FT) or candidate (CD) ESA discretionary review (DR) or under review (UR) RSGCN high concern (HC) **and** S1 RSGCN proposed very high concern (pVHC) State threatened (ST) NatureServe G2 NatureServe G3 **and** S2-S3
Tier III	High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, or are restricted in range. Management action is needed to stabilize or increase populations.	IUCN vulnerable (VU) IUCN near threatened (NT) **and** S1 ESA petition withdrawn (PW) or not listed (NL) RSGCN moderate concern (MC) **and** S1 RSGCN high concern (HC) NatureServe G3 NatureServe G4-G5 **and** S1
Tier IV	Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend, or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the	IUCN near threatened (NT) RSGCN proposed high concern (HC) RSGCN moderate concern (MC) RSGCN watch list (WL) NatureServe G4-G5 **and** S2-S3 or SX/SH

	foreseeable future. Long-term planning is necessary to stabilize or increase populations.	
Assessment Priority (AP)	Species for which more information is needed to justify assignment of a conservation status or population trend, thus SGCN ranking.	Typically, will not meet any of the above intertaxa criteria. However, exceptions are possible and should be briefly justified. SU/SNR rank qualifies.

Note that not every possible NatureServe ranking (e.g., T ranks, GNR, GNA, etc.) was accounted for in Table 2.2. Omitting these rarer ranks helped reduce clutter. Generally, these ranks were considered comparable to their most closely related rank listed in Table 2.1. For example, a species labelled T5, S3 would have been considered comparable to G5, S3 – and predicted as a Tier IV if that was the highest scoring rank for the species under review. GNA species were typically predicted as "R" (removed). GNR species were predicted as AP/R.

With guidance from regional wildlife diversity working groups, the tool was iteratively tailored until intertaxa criteria rankings aligned reasonably well with Tiers across taxa groups. The tool appeared especially helpful to those TAC charged with assigning first-time Tiers to hundreds of relatively data-poor species (e.g., plants, invertebrates). Although the predicted Tiers served as default Tier assignments when the TAC had no other data from which to base a Tier assignment, this tool merely served as a guide to Tier ranking. In all cases, the TAC reserved the authority to override the predicted Tier, citing expert opinion and data that is more localized to Virginia than that which fed into the various intertaxa criteria ranking processes.

In addition to assisting the TAC with Tier assignments, the predicted Tiers helped reviewers keep close tabs on species with comparable intertaxa criteria profiles that might have otherwise been assigned disparate Tier ranks. If, for example, an ESA endangered (FE) species and a RSGCN very high concern (VHC) species were proposed as Tier I and Tier IV species, respectively, with both being predicted as Tier I, the tool would flag the Tier IV species as a three-step discrepancy from the predicted tier, triggering a second review to ensure all relevant data were considered and that the discrepancy was defensible. In all cases, discrepancies of two or more steps prompted a second review to ensure the proposed Tier was more appropriate for Virginia conditions than the predicted Tier, accompanied by a brief justification. Justifications were also provided if a species Tier rank differed between the first and second Plan revisions. All such justifications were made available to the SAC throughout the formal feedback process.

Criteria for Avian SGCN

It should be noted that the Bird TAC used slightly different criteria for including species in the SGCN list. Based on the immense datasets available for this taxon, and the addition of data from the Second Virginia Breeding Bird Atlas (VABBA2) and associated population models, this TAC felt it necessary to use a different set of selection criteria.

Birds are a well-studied taxonomic group that have benefitted from extensive research, surveys and population monitoring at various geographic scales. Although these efforts have not been implemented evenly across all species, they have produced information that allow for a data-driven approach to selection of SGCN. In 2024, the Bird TAC followed the SGCN selection and Tier-assignment process for birds that has been in place since the first Wildlife Action Plan in 2005, although some modifications were made to the process. Both the process and the modifications are outlined below.

In addition, data displayed for bird SGCN in the new online dashboard are from actual occurrence data, primarily from the Second Breeding Bird Atlas for breeding birds and from the Virginia Fish and Wildlife Information System for wintering species. When the Second Breeding Bird Atlas is published in the fall of 2025, distribution data will be based on modeling developed to provide occurrence data that more comprehensively displays where some of these species may occur based on survey effort and available habitat. To maintain consistency across taxa groups, only actual occurrence data was used for the Plan online dashboard.

Breeding Species

Selection of breeding SGCN for the first two Plans was based on three criteria: population trends, population size, and Virginia Area of Importance. The first two variables were retained for SGCN selection in 2024, while the TAC took a more organic approach to the last variable. The TAC considered all species known to breed in Virginia.

Population Trends:
Data sources include the North American Breeding Bird Survey (BBS) for 1966-2021, Virginia waterfowl surveys conducted as part of the Atlantic Flyway Breeding Waterfowl Survey, Virginia upland game bird surveys, Virginia Colonial Waterbird survey (conducted every five years in coastal Virginia), Virginia Shorebird surveys (plovers and American oystercatcher), Saltmarsh Habitat and Avian Research Program (SHARP, for marsh birds), other Virginia marsh bird surveys, and Virginia-based surveys for individual species (eastern black rail, peregrine falcon, red-cockaded woodpecker).

The credibility of Virginia BBS trends was evaluated based on sample size (number of routes where detected), relative abundance, and precision (ability to detect 3-5% annual change in the long-term). Trends with credibility issues (low sample size, low relative abundance, and/or inability to detect 3-5% annual change) were not used. The TAC decided to retain Virginia BBS trends where relative abundance at the mid-point of the span of survey years was > 0.1 birds/route but < 1.0 birds/route, if the trend was statistically significant. If this condition was not met, or if the trend had credibility issues related to any of the other listed variables, then regional trends were considered as a proxy for the Virginia trend. Regional trends were based on Bird Conservation Regions (BCRs). Virginia falls within four such regions: Southeast Coastal Plain, New England/Mid-Atlantic Coastal Plain, Piedmont, and Appalachian Mountains. The TAC considered regional trends based on a species' distribution within the state (e.g., for a species breeding west of the Blue Ridge Mountains, the Appalachian Mountains BCR trend was considered). If a BCR trend also had credibility issues, the trend for the Atlantic Flyway, the Eastern BBS region or the United States was considered instead. These broader-scale trends were also evaluated by

the TAC for credibility, as well as for applicability to Virginia (i.e. whether the TAC thought that the trends were representative of the status of the species in Virginia); data from the VABBA2 were used when needed in order to help with this assessment. In cases where trends for a species had credibility issues or were not representative of Virginia at any geographic scale, the TAC attempted to assign a qualitative value to the trend (increasing, stable, decreasing) based on professional opinion.

Following the above process, numerical trends were translated to the following trend categories:

- significant decrease (< -50 % over time period for which data are available [1966-2021 for BBS, variable for other surveys],
- moderate decrease (-49 % to -15 %), population stable (> -15 to < +15%),
- moderate increase (+15 to +49 %),
- significant increase (> +50 %), or uncertain trend (not statistically significant).

Virginia Population Estimates:
Data sources include the Partners in Flight (PIF) Population Estimate database, Atlantic Flyway Breeding Waterfowl Survey, Virginia upland game bird surveys, Virginia Colonial Waterbird survey (conducted every five years in coastal Virginia), Virginia Shorebird surveys (plovers and American Oystercatcher), Virginia-based surveys for individual species (eastern black rail, peregrine falcon, red-cockaded woodpecker), VABBA2 population estimates, published literature, and expert opinion.

Population estimates were translated into the following breeding pair categories: < 100, < 500, < 5,000, > 5,000 and > 100,000. As there are measures of error around many population estimates, the assigned categories were reviewed for all species and modified if the TAC felt that the category did not reflect the species' population size in Virginia.

Virginia Area of Importance:
The avian SGCN selection process for the 2005 and 2015 Plans considered Virginia Area of Importance (AI). This metric is based on the proportion of the global or US/Canada population of a species that occurs in Virginia. Species with low AI scores were eliminated from consideration. While this was an imperfect system, some species with low AI scores were still included as SGCN if they were historically well-established in Virginia (e.g., red-cockaded woodpecker) or if the current Virginia population was small relative to the global population as a result of population declines (e.g., golden-winged warbler). In addition, calculation of AI scores relied on population estimates from different sources in cases where both a Virginia and a global population estimate derived from the same source was unavailable; mixing estimates from different sources can be problematic as those estimates can be based on different methods of calculation.

Rather than calculating and using AI scores in 2023-2024, the TAC instead opted to omit from consideration as SGCN those species that fell into one or more of the following categories: introduced non-native species, species with recent range expansions into Virginia, occasional/casual/not established breeders, and species that never bred in abundance/were never significant breeders in Virginia.

Combining Factors into Tiered SGCN:
Following omission of particular species in the last step above, species were assigned to SGCN tiers based on the following criteria:

- Tier I: extremely small populations (<100) and small populations (<500) with significant decreases.
- Tier II: small populations (<500) with moderate decreases and medium populations (<5,000) with significant decreases.
- Tier III: all remaining small populations (<500); medium populations (<5000) with moderate decreases; large populations (>5000) with significant decreases.
- Tier IV: large populations (>5,000) with moderate decreases; very large populations (>100,000) with significant decreases.

Once a draft list was assembled, it was reviewed by the TAC and changes to Tier assignments made if it was felt that the Tier that a species was placed in through the above formulas did not properly reflect the level of conservation concern for that species.

Assessment Priority Species:
The TAC categorized as Assessment Priority those species for which a population trend could not be determined, and which were not omitted from consideration as SGCN based on their breeding status in Virginia (see "Virginia Area of Importance"). The former include species whose population trends had credibility issues or were not representative of Virginia at any geographic scale and for which the TAC could not assign a qualitative value to the trend (increasing, stable, decreasing) based on professional opinion.

Nonbreeding Species

As in past iterations of the Wildlife Action Plan, the TAC considered nonbreeding (wintering, transient) species for inclusion in the SGCN list. Because fewer/less reliable data are available for many species outside of their breeding season, the selection process for these species was less data-driven than it was for breeders.

The TAC considered nonbreeding species from two different sources: those that had been included in the 2005 or 2015 Virginia SGCN lists, as well as those on current Regional SGCN lists for the northeastern or southeastern United States. In addition, the TAC consulted with the DWR's Waterfowl Biologist regarding all wintering waterfowl species. Generally, species selected by the TAC from these lists were identified as regional conservation targets and occur in high enough abundance in Virginia that conservation in the Commonwealth could contribute to conservation of the species at a broader scale. Species that were not selected tend to be rare and irregular in their occurrence in Virginia. The Tiers assigned to nonbreeding SGCN were not based on quantitative metrics as they were for breeding species; rather, they reflected the level of conservation concern that the TAC felt was appropriate for the species. Species were also selected for inclusion on the AP list if the TAC felt that they might qualify as SGCN, but there were questions about their status in Virginia.

3. HABITATS

Throughout Virginia's original Wildlife Action Plan, habitat loss and degradation were identified as the most critical issues hindering SGCN conservation (DGIF 2005). Over the past two decades, water quality degradation, habitat fragmentation, and habitat loss have become more acute and widespread. Since the 2015 Plan revision, the NEFWDTC developed an extensive lexicon to define Regional SGCN (RSGCN), their habitats, threats to those habitats and species, and conservation actions that could be taken. Virginia, as part of this team, used the Northeast Regional Conservation Synthesis to define the habitats for the 2025 revision.

Northeast Regional Conservation Synthesis (Terwilliger Consulting, Inc. 2023) – This 2023 Northeast Regional Conservation Synthesis updates the original 2013 synthesis for State Wildlife Action Plans (Terwilliger Consulting Inc. [TCI] and the Northeast Fish and Wildlife Diversity Technical Committee [NEFWDTC] 2013). Its purpose was to support the 2025 State Wildlife Action Plan revisions. Further information about the Northeast Synthesis can be found at www.northeastwildlifediversity.org.

This Regional Conservation Synthesis provides a summary of available information on habitats for RSGCN and Watchlist species and the condition of those habitats at the regional and national scale.

The Regional Overview describes habitat classification systems and tools, spatial datasets of habitat, and habitat prioritization resources available for the Northeast region. In addition, it provides the best available information describing each of 24 regional habitat types, known distribution and level of protection, condition, management tools and resources, and monitoring programs and projects. Conservation partners protecting, managing, or restoring each habitat are listed. Citizen science projects and programs that engage the public in conservation of each habitat are described. Information, research, and monitoring needs for each habitat are identified.

After significant review of the habitat types outlined in the Northeast Regional Synthesis, the DWR decided to simplify the listing to better fit what could most accurately be defined for Virginia SGCN. These will be discussed in-depth later in the chapter, but they do align with the Northeast Lexicon.

Virginia Tech, Conservation Management Institute (CMI) data - The 2021 version of the National Land Cover Dataset (NLCD) was used as a base layer for the habitat map. Several of the base NLCD classes translate directly to the target classes in the Northeast Lexicon. Forests were defined as "[t] terrestrial habitats characterized by woody vegetation at least 5 m tall with > 25% tree canopy cover." The coarse classification divides forests into two major classes: Boreal Forests, and Forest and Woodland. The primary factor differentiating these types is the dominant species comprising their canopies, with cold-tolerant deciduous and coniferous species comprising the Boral Forest class. Elevation is the proximate driver for distribution of these types in Virginia. Deciduous, coniferous, and mixed forest types were separated in the NLCD by elevation (map class):

Deciduous

Northern Hardwood Forest – deciduous forests above 900 m elevation (411)

Boreal Hardwood Forest – deciduous forests above 1070 m (412, 413)

Coniferous

Spruce – coniferous forests between 1070 and 1300 m (422)

Spruce – Fir – coniferous forests above 1300 m (423)

Mixed

Boreal Hardwood-Spruce – mixed forests above 900 m (432, 433)

Any of the three NLCD forest types lower than 900m in elevation were classified as Forests and Woodlands, but were maintained as separate codes for deciduous, coniferous, and mixed stands.

Water and Wetlands were represented in two ways. Large water bodies, such as big rivers, lakes, and estuaries, are included in the Plan's landcover map and are based on the NLCD "water" class. National Wetlands Inventory (NWI) data were used to identify lakes, ponds, and rivers and to assign them separate classifications in the Plan's habitat map. The NWI data were used to identify herbaceous, wooded (i.e. shrub and forested) and open water wetlands and to classify those as either estuarine or palustrine, or tidal/non-tidal. The attribute information from the NWI was used to identify tidal water regimes, then coded to those wetlands in the Plan's habitat map.

The Steep Slopes/Cliff habitat feature was developed from a slope layer from the same elevation dataset used to classify forests. Slope values were investigated at various locations to determine what the threshold slope should be for steep slopes and cliffs. Slopes greater than 35% were classified as "steep/cliff."

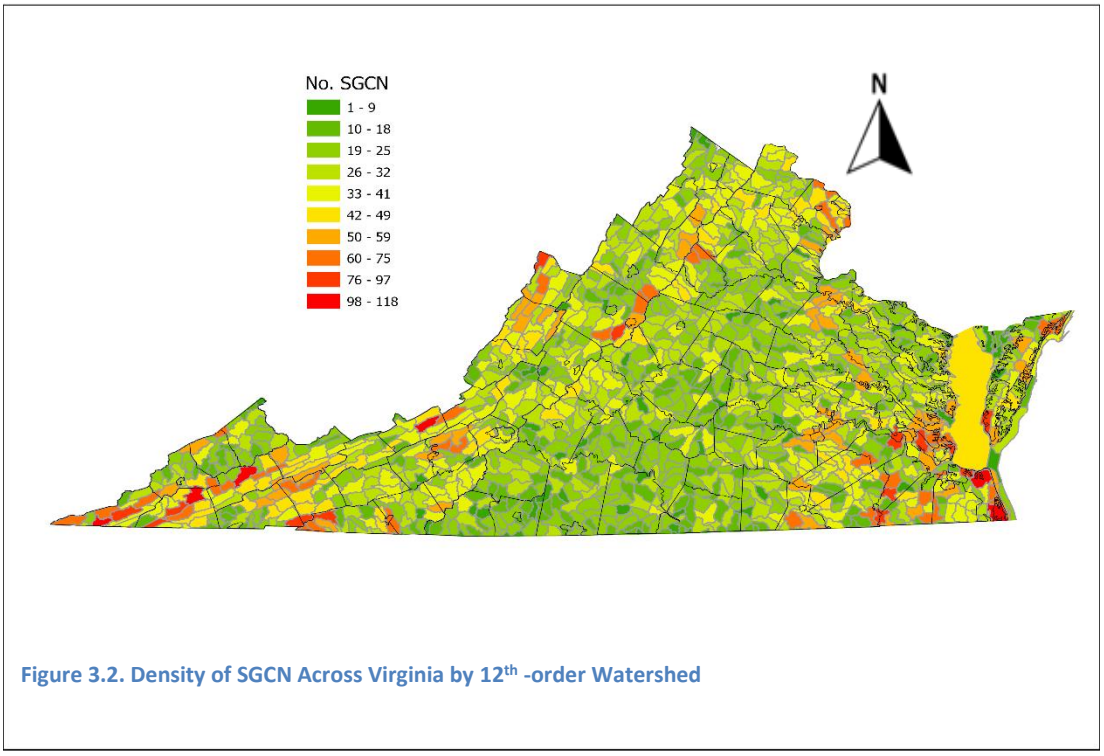


Figure 3.2. Density of SGCN Across Virginia by 12th -order Watershed

SGCN Watershed Distribution Maps – Within Virginia's 2005 Wildlife Action Plan, authors provided distribution maps for the most critically imperiled SGCN. These maps include buffered point locations where individual animals had been documented as well as areas designated as potential habitat. While these maps were informative, they were limited in their ability to inform multi-species conservation actions. In 2009, DWR staff developed new distribution maps for each SGCN identified within the original Wildlife Action Plan for which distribution information was known. These new maps were based on fine-scale watersheds referred to as HUC12 watersheds (Weary and Doctor 2014). Virginia's HUC12 watersheds range in size from approximately 15 square miles to 70 square miles. Each of Virginia's counties typically encompasses 10 to 15 HUC12 watersheds. Species with known distributions were included and were demonstrated in each HUC12 chosen during a search. The majority of these were vertebrates, freshwater mollusks, terrestrial and aquatic invertebrates, crayfish and plants. By mapping SGCN distributions within HUC12 watersheds, the 2025 Wildlife Action Plan is able to identify areas that support multiple SGCN (Figure 3.1). Likewise, HUC12 maps provide information at a spatial scale with enough detail to identify priority areas within a county or planning region, but at the same time are coarse enough to hinder illegal collections or identifying private landowners. Marine species, in general, were shown for the Chesapeake Bay and off-shore marine environments, in total, because there are no defined HUC12 units in this part of Virginia's geography.

Land conservation in Virginia is affected by many governmental and non-governmental organizations and entities. The DWR owns and manages more than 250,000 acres of lands and waters for fish, wildlife, and the habitats that support them. In total over 4.7 million acres are under some type of conservation status in Virginia.

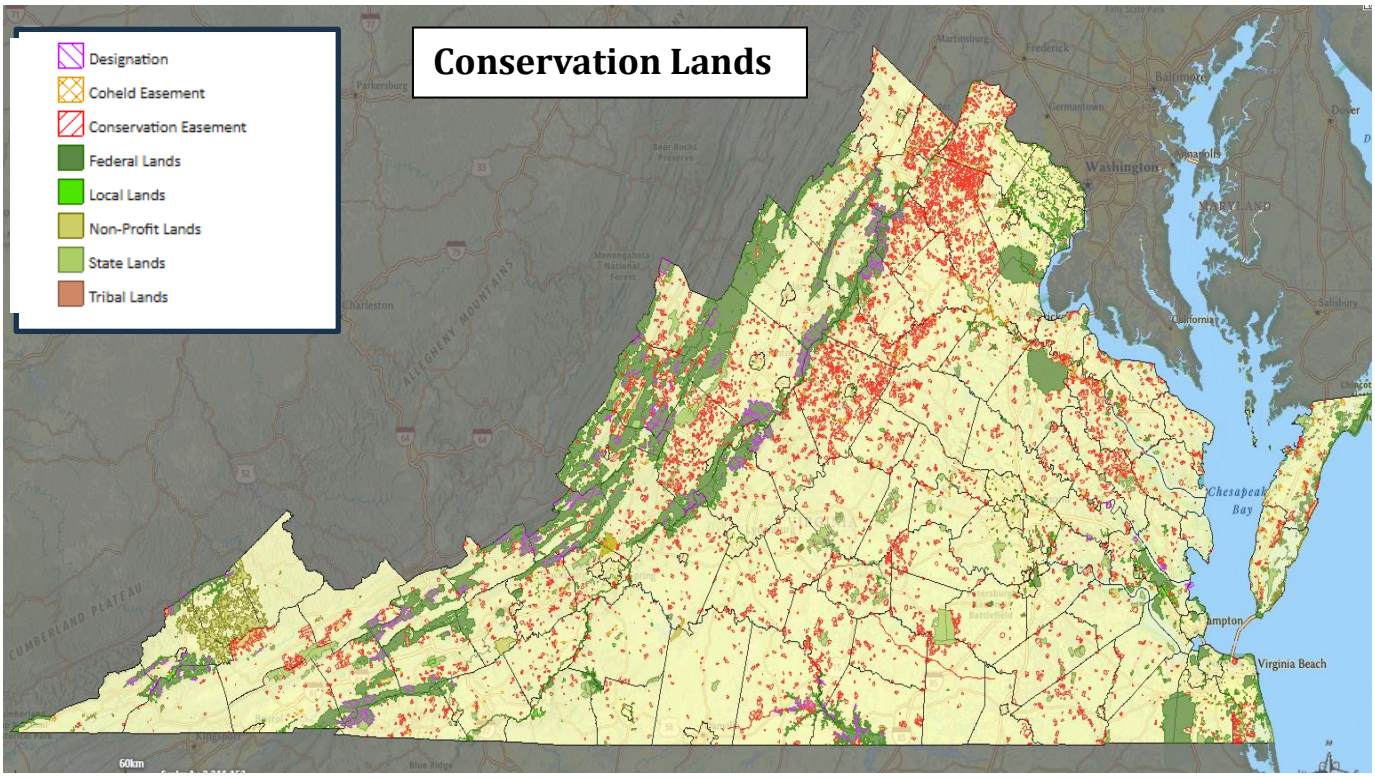


Figure 3.2. Conservation Lands in Virginia

Management-Based Habitat Categories

Identifying the habitat types occupied by Virginia's SGCN is critical for any meaningful conservation strategy. Congressional mandates for identifying SGCN distribution, coupled with Virginia's multitude of geographies and ecosystem types, has resulted in a large number of habitat summaries, condition reports, and distributions included in previous iterations of the Wildlife Action Plan. Since habitat protection or restoration are often some of the most crucial conservation measures for vulnerable wildlife, SGCN have historically been paired with their respective habitat category. This approach is replicated in the 2025 revision, with a stronger focus on regional collaboration, the recognition of effects of changing climatic conditions, and the understanding of human impacts on naturally-occurring habitats across the landscape. The habitat descriptions listed below are derived from several regional resources which have sought to standardize conservation practice and terminology across states, most notably the Northeast Lexicon. Virginia's geographic location at the edge of multiple regional organizations required a synthesis of multiple best practices documents to appropriately reflect the particularities of this state. Additionally, attempts to highlight the prevalence of artificial landscape types has led to the creation of a robust series of habitat descriptions detailing areas such as reservoirs, urban settlements, and working lands in which certain SGCN live.

Terrestrial

1. Forested Upland – Terrestrial habitats characterized by woody vegetation at least 5m tall with ≥25% tree canopy cover
    a. Forests and Woodlands - forested upland with structurally and compositionally diverse ecological community groups (oak, pine, hickory, maple, beech, birch, poplar). Includes woods that have been thinned or logged (working forest). May include tree farms and plantations.
    b. Boreal Forests – forested upland (generally above 3000 ft in elevation) whose structure is influenced by shallow soils, increased precipitation, and severe weather and is rich in northern boreal species. Includes forests and woodlands that have been thinned or logged (working forest). May include tree farms and plantations.

2. Open Upland – Terrestrial habitats characterized by <25% tree cover
    a. Grasslands - habitat dominated by herbaceous vegetation with few, if any, trees. May include perennial pastures, hayfields, yards, or crop fields (corn, rye).
    b. Shrublands – habitat composed of shrubs (many stemmed woody plants generally less than 5m tall). May include brushy pastures or crop fields (cotton, peanuts).
    c. Glades, Barrens, Savannas – Habitat composed of sparse, low, and open vegetation with some tree cover. May include silvopastures.
    d. Alpine – Barren substrate or herbaceous and low shrubby vegetation above mountain timberline
    e. Cliff & Talus – Expanses of bedrock or broken rock generally lacking vascular plants, including vertical or nearly vertical rock outcrops

3. Subterranean – Habitats below the soil surface
    a. Caves and Karst – naturally occurring air-filled spaces, ranging in size
    b. Other Subterranean – all other habitats below the soil surface

4. Land-Water Interface – The zone where terrestrial and aquatic habitats meet and interact, with a boundary that shifts in space, over time, and under different weather conditions
    a. Riparian and Floodplains – A zone of habitats directly associated with stream sides that may be periodically flooded
    b. Shorelines – Non-beach and dune habitat bordering large waterbodies where vegetation is limited by fluctuating water levels, waves, and/or tides
    c. Beaches & Dunes – Habitat dominated by sand deposits where wind, tides, and/or waves (current or historical) shape substrate; vegetation is often sparse or absent

Freshwater

5. Riverine –
    a. Headwater Streams – Small order (I or II) tributaries to larger creeks and rivers that may be ephemeral, intermittent, or perennial, depending on precipitation patterns
    b. Creeks and Rivers – Perennial tributaries to big rivers
    c. Big Rivers – The largest channels, characterized by large perennial flows, large quantities of nutrient and organic matter, high turbidity, and fine sediments
    d. Tidal Rivers and Streams – Lower reaches of flowing water with tidal influence that expand in size when precipitation is high and retract during periods of drought, due to salt-wedge intrusion.

6. Lacustrine – Perennial bodies of water
    a. Lakes – Large (depth, acreage, turbidity) naturally occurring bodies of fresh water
    b. Ponds – Small (depth, acreage, turbidity) naturally occurring bodies of fresh water, including vernal pools, beaver dams, and surface springs.

7. Palustrine – Areas where water either covers the soil or is present at or near the surface of the soil for at least some portion of the year
    a. Non-tidal Wetlands – Ecological community groups of alluvial habitats with overland, non-tidal flooding regimes. Structurally and compositionally diverse vegetation is represented. Includes seeps, bogs, fens, and pond margins. Also includes forested and scrub wetlands (cypress, tupelo, buttonbush, etc.).
    b. Tidal Wetlands – Ecological community groups of regularly or irregularly flooded lunar tidal wetlands and irregularly flooded wind-tidal wetlands. Structurally and compositionally diverse vegetation is represented. Within the defined community types, the terms “high” and “low” marsh refer to the relative elevation of stands within the intertidal zone.

Marine

8. Estuarine –
    a. Tidal Rivers and Streams – Lowest reaches of flowing, tidally influenced water beginning where brackish water starts and ending where the river mouth dumps into an estuary
    b. Tidal Wetlands – Ecological community groups of regularly or irregularly flooded lunar tidal wetlands and irregularly flooded wind-tidal wetlands. Structurally and compositions diverse vegetation is represented. Within the defined community types, the terms “high” and “low” marsh refer to the relative elevation of stands within the intertidal zone.
    c. Estuaries – Subtidal (continuously submerged) open brackish water, excluding river mouths. Includes open-water aquaculture leases.

9. Marine – Chesapeake Bay; Atlantic Ocean
    a. Marine Nearshore – coastal subtidal marine habitats, extending outward as far as wave action and light penetration to the bottom.
    b. Marine Offshore & Oceanic – pelagic and abyssal zones of open ocean waters

Novel

10. Novel Ecosystems – Areas that have been developed, modified, converted, or otherwise manipulated by people into conditions mostly or entirely different from the original state and that now operate under human management.
    a. Urban Lands - Impervious buildings, structures, and their immediately adjacent semi-impervious surfaces (yards, lawns). May include, but not limited to:
        - Residential
        - Commercial
        - Industrial
        - Military
        - Other institutions
    b. Transportation Networks – Impervious or semi-impervious pathways that exist either in a constant or frequent state of ecologically incompatible disturbance, with the primary goal of provisioning societal needs and activities. May include, but not limited to:
        - Roads/roadsides
        - Railroads
        - Airports
        - Powerlines
        - Shipping lanes
        - Canals, dredged channels
    c. Artificial Impoundments – Human impounded creeks, rivers, or wetlands
        - Reservoirs
        - Ponds
    d. Mines – Human created air-filled spaces below the natural land surface, whether open to daylight or not

Working Lands

11. Working Lands – Lands that are managed or manipulated for agricultural or industrial uses or human development purposes.
    a. Working Forests and Woodlands – Forests and woodlands managed and manipulated for a variety of purposes, many of which support fire-dependent species
    b. Working Grasslands, Savannas and Early Successional Shrublands - Agricultural pastures and hayfields, both of which are directly or indirectly managed to produce livestock.
    c. Working Estuaries and Marine Nearshore Habitats – Marine habitats that support extractive activities as well as bay and offshore aquaculture

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

Virginia is home to an incredibly rich abundance of habitats. From the shorelines of the Atlantic Coast and mouth of the Chesapeake Bay to the high alpine forests of its western mountain ranges, the Commonwealth enjoys a physiography supportive of abundant and varied wildlife. Though the separation of a necessarily interconnected, holistic landscape into discrete types will always involve some degree of simplification and abstraction, the 2025 Wildlife Action Plan team has constructed a habitat Lexicon which integrates both state and regional-level concerns.

Previous versions of the Plan have relied upon several models which successfully identified habitat types and their conditions, albeit differently than our current approach. The 2015 Plan relied on a combination of resources pulled together internally by DWR (then DGIF) staff and their conservation partners, including USEPA ecoregional descriptions (Griffeth *et at.* 1999), Natural Communities of Virginia: Classification of Ecological Community Groups (Fleming *et al.* 2013), National Land Cover Dataset (Fry *et al.* 2011), and The Nature Conservancy's Northeast Terrestrial Habitat Map (Anderson *et al.* 2013). This approach successfully modeled Virginia's major habitat types by utilizing a combination of national- and state-level conservation tools to accurately reflect the Commonwealth's ecological conditions. Some of these major habitat types have, in fact, been transferable to our current approach, and their 2015 definitions have served as the basis for the 2025 update. However, in an effort to align the 2025 Plan with regional conservation efforts, and to take advantage of an accessible and available series of sophisticated habitat models, the 2025 Plan habitat types have been primarily based on definitions provided by Terwilliger Consulting's Northeast Regional Conservation Synthesis.

This habitat synthesis serves to "identify the extent and condition of wildlife habitats and community types essential to conservation of species identified" (Element 2) on a regional scale and provide a framework for interstate consistency to support regional conservation efforts. As such, landscapes and seascapes of the Northeast U.S. were determined by using the NatureServe Biotics 5 habitat classifications and tailoring them to regional physiography. This work was undertaken by Terwilliger Consulting Inc. and the NEFWDTC, which ensured that certain ephemeral and subterranean habitat types would be captured in the main classification system. Habitat modifiers, also developed by Terwilliger Consulting Inc. and the NEFWDTC, supplement the broader habitat types by communicating

specific species requirements for land managers. These include, but are not limited to, habitat niches ("features"), vegetative species composition ("type"), and land management practices ("no-till" or "till agriculture").

The basic structure laid out in the Northeast Lexicon was retained in this version of the Plan. The three-level hierarchy was left unchanged, with a Habitat Type (the SGCN pairing-unit) nested within a Habitat Category (the broad ecosystem category) nested within a Habitat Class (Terrestrial, Freshwater, Marine, or Novel). However, in employing this classification tool for Virginia, modifications were made to tailor habitat types to the Commonwealth's physiography and to simplify the pairing process for the TAC. Habitat types were added, deleted, and edited from the Biotics 5 definitions. "Headwater Streams" and "Savannas" were added; "Open Alpine Upland," "Great Lakes," and "Vernal Pools" were deleted; and changes were made to the definitions and hierarchical classification of several others. All habitat types considered "working lands" (see page 90) were pulled out of Natural Habitat Categories and considered in a parallel definition process. This effort will be articulated later in this Plan. Additionally, habitat modifiers were altered to provide details on life-stage usage of habitat types by SGCN. The SGCN were paired with habitat types if they bred, developed their young, fed, wintered or hibernated, or stopped over (during migration) in them. This excludes using habitat types that wildlife used simply as corridors, or just to navigate between preferred habitats. This should not be interpreted to mean the wildlife corridors are not important. Many wildlife habitat corridors provide important migratory, dispersal, and movement habitats, and when a corridor is functionally of high ecological integrity and of a large size, habitats in these corridors may be providing essential habitat for major life stages for a species. For more information about wildlife habitat corridors and their importance, see section "Wildlife Habitat Corridors and Connectivity (Page 97.)"

These habitat type definitions serve as the basis for the Virginia online tool habitat layer and the habitat summaries included later in this Plan. They have also been used to provide aggregate statistics on critical SGCN habitats which inform broader conservation efforts. It was our intent to create a system which is usable at multiple landscape scales.

Habitat Advisory Committees (HACs), modeled after the TAC, were formed to supply robust summaries for each habitat type listed above. Like the TACs, the HACs were composed of both internal and external experts. Beyond engaging DWR staff, who provided substantial authorship, individuals from the Virginia Department of Conservation & Recreation's Division of Natural Heritage, Virginia Department of Forestry, and The Nature Conservancy developed summaries. In some cases, a single individual was responsible for one or more habitat type summaries with which they had a deep knowledge. However, the development of descriptions of some habitat groups, such as "Riverine," required more intensive coordination among an array of several authors due to less clearly defined boundaries of the included habitat types.

Each of these habitat summaries includes a general description, current extent, historic extent, habitat threats, and potential conservation actions. Additional requirements were introduced, where appropriate, including (but not limited to) sections detailing species relationships to urban or agricultural development, age class descriptions, hydrologic regimes, and use as a working land. The

information gleaned from these summaries, particularly that which explicitly concerns conservation threats and actions, does not serve as the basis for their SGCN analogues, which were supplied by the TACs and are required elements of every Wildlife Action Plan. Instead, these habitat threats and actions focus on landscape-scale challenges which may be the most pressing issues for SGCN, but which are potentially managed by different individuals or entities. Any Wildlife Action Plan would be remiss to exclude a landscape perspective from its conservation recommendations, both in the immediate implications of carrying out that conservation work and for the broader purpose of conceptualizing the current status of Virginia's wildlife.

Twenty-seven habitat summaries are listed below, along with CMI-produced maps which roughly display their distribution throughout the commonwealth. Every summary lists its primary author or group of authors, whose work has been invaluable to the 2025 Wildlife Action Plan.

Habitat Descriptions

Forests & Woodlands

Jean Lorber, The Nature Conservancy

Forested uplands represent a large majority of natural cover across the state. Upland forest cover steadily expanded during the first half of the 20th century, as abandoned farmland turned into successional forestland. However, this expansion soon peaked, with forest loss from urban/suburban expansion beginning to outpace the aforementioned forest gain. Total forest acreage in Virginia has stabilized in the last several decades at around 16 million acres.



Forest Lands - Rapidan WMA

There is a great diversity of upland forest communities in Virginia. Broadly speaking, the easternmost Coastal Plain contains significant managed and natural loblolly pine stands, while the westernmost Appalachian Mountains are dominated by natural mixed oak stands, with the central Piedmont representing a transition between the two. While 118 species of trees have been found on forested uplands in Virginia, only 15 species represent the great majority of the forest canopy.

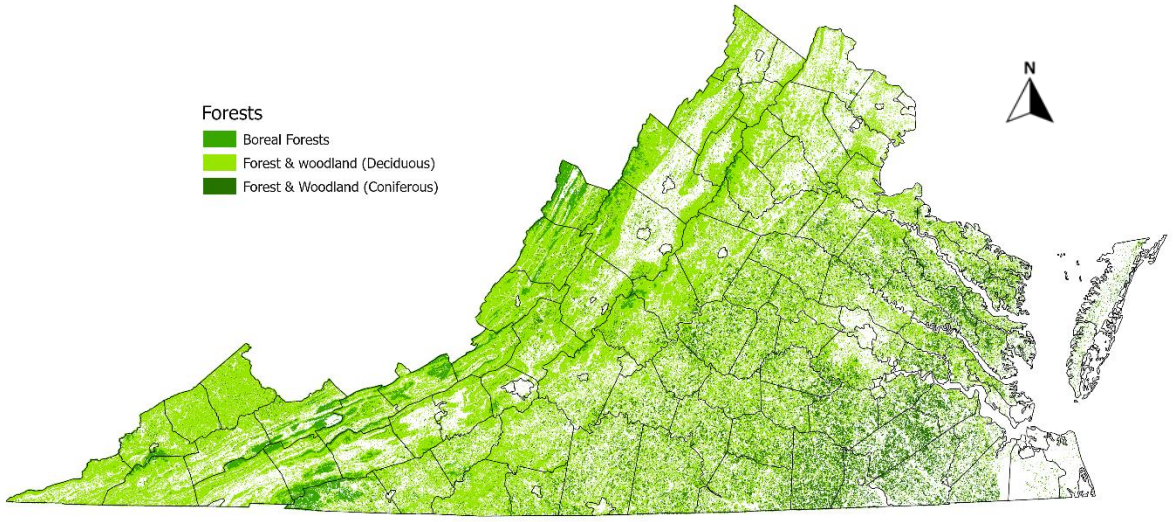


Figure 3.3. Forest Lands in Virginia

The Coastal Plain's uplands contain significant amounts of loblolly pine plantations, typically managed on a 30–40-year rotation. However, natural pine/hardwood stands represent over half of upland acreage and are fairly evenly distributed in age, ranging from 0-100 years old. In the plantations, loblolly-focused management results in little room for other species; it is over 80% of forest volume. In the natural stands, tulip poplar is numerous, followed closely by oaks, then sweetgum. There is still a sizeable component of loblolly pine, with numerous other hardwood species like red maple, American beech, swamp tupelo filling out the remaining growing space.

The Piedmont's uplands contain an overall lower percentage of loblolly pine plantations, with the Southside subregion home to much of it. The pine plantations here are dominated by loblolly, managed on the same 30–40-year rotation. The natural stands the Piedmont's uplands are fairly evenly distributed in age, with more acreage in the 20–100-year range, and lesser amounts either older or younger. In the natural stands, oaks and yellow poplar are equally dominant, each representing ~30% of forest volume. The remaining growing space is occupied by loblolly and Virginia pine, with smaller amounts of hardwoods, like red maple, hickories, and sweetgum.

The Mountain region's uplands are almost exclusively dominated by natural, mixed-oak and hardwood stands, with yellow pines relegated to drier and otherwise marginal sites. Virginia's single largest land ownership is found here: the George Washington and Jefferson National Forest, representing about a third of the region's forests at 1.8 million acres. Upland forest in the Mountains is weighted heavily towards older age classes (80-120 years), especially on public lands; young forest makes up just 3% of acreage on public lands and 10% of private lands. True old-growth forest is relatively rare, but much of the public lands are approaching the age threshold for old-growth. Oaks represent close to 50% of forest volume, with other hardwoods like tulip poplar and red maple, as well as white pine, occupying smaller (but increasing) amounts of growing space, especially on more productive sites. Pitch, Virginia,

shortleaf and table-mountain pines are found on less productive sites, while subcanopy tree species like blackgum and sourwood persist throughout.

The design of timber harvesting in Virginia's uplands is dictated more by forest type than by geographic region. In both the Coastal Plain and Piedmont, pine plantations are typically managed with a regular series of thinnings, culminating with a final clearcut around age 30. That said, more recent changes in markets have caused landowners to shorten their rotations due to increasing pulpwood prices, and stagnant sawtimber prices make shorter rotations attractive. This trend has slowed during the past year. In all three regions, natural oak and hardwood stands are typically harvested using diameter-limit or selection methods, a practice that is believed to be harmful to the long-term viability of the forest resource.

Many of today's conservation challenges in the forested uplands stem from management, or lack thereof, that leaves out dynamics which shaped these forest ecosystems. For millennia, fire was an ever-present force across Virginia, curating the assemblage of species that could thrive and persist in the forest. Indigenous burning and natural ignition were regular occurrences, giving rise to a mosaic of forests, woodlands and savannas, each providing a distinct habitat type. Fire also favored oaks and longleaf pine, which have been proven to serve a foundational role in their respective ecosystems. These foundational species harbor and enable higher levels of biodiversity by their presence, creating richer and more resilient ecosystems. After a century of fire suppression, the structural mosaic and foundational species described above are declining, along with the animal species that thrive with them.

The specifics of this conservation challenge vary by region. In the Coastal Plain, young forest is still abundant due to actively managed pine plantations. However, a shift to more chemical-intensive site preparation practices has reduced the ecological value of that young forest habitat. The lack of old pine stands represents its own challenge to high conservation value species like the Red-cockaded Woodpecker. That said, loblolly pine is fire-adapted, and compatible with many of the fire-related conservation practices common to longleaf pine savanna management. In the Mountains, young forest is relatively rare. Even more pressing is the lack of open woodland conditions; woodlands are believed to have been several times more common than early successional forest. Additionally, red oak species are rapidly approaching an age where natural mortality increases. Furthermore, the next generation of oak seedlings is not present, outcompeted by maples and poplars in the absence of fire. The same is true for yellow pine species, albeit for slightly different reasons. In the Piedmont's mix of oak and pine forests, all the challenges described in the Coastal Plain and Mountains are relevant.

The likelihood of rapidly changing climatic conditions also represents a threat to the uplands of all three regions. Future projections show a hotter climate with more drought. While overall annual precipitation will remain steady, rainfall will be concentrated in fewer, larger events, leading to more runoff and less water available to vegetation. All regions will therefore experience more heat and drought stress, leading to decreased productivity and higher tree mortality. In the hardwood-dominated regions, the trajectory of the current forest is misaligned with the future climate. Mesic species like red maple and tulip poplar are on the rise, enabled by the previous century of fire suppression and moist climate. Over the next few decades, these species will continue to gain dominance at the expense of

oaks. However, they will eventually begin to suffer under the future climate and recede. Unfortunately, a generation of oak seedlings will have been lost during that time, and the remaining, aging oak canopy will be ill-equipped to produce a new generation. What species fill the vacuum is up for debate.

While the conservation challenges vary by region, two types of actions would address many of them: **protecting priority blocks** of high-functioning forestland and **enhancing forest management** within those blocks. There are existing prioritization exercises that could be utilized, based on ecology (e.g. Resilient Land Mapping Tool) or ecology paired with socio-economic factors (e.g., VaNLA). The resourcing of voluntary land protection tools like conservation easements would secure the continued existence of the working forest landscape. To improve the condition of that protected forest landscape, a comprehensive advocacy and landowner assistance campaign could be established (e.g., DOF's Hardwood Initiative). Many of the challenges listed above can be addressed with practices found in existing cost-share programs. Ideally, both of these steps would be conducted in collaboration with forest industry and localities and informed by strategic planning and visioning to create maximum awareness and engagement by all parties.

Boreal Forests

Greg Estoll, Virginia Department of Forestry

Evidence suggests red spruce grew over a larger range before widespread logging and wildfires in the early 1900s. Northern hardwood species, and associates, claimed many areas – including those below 3500'. Boreal forest comprises approximately 136,000 acres (~56% of forest above 3500'). Two large areas (Mt. Rogers/Whitetop and northwest Highland County) contain most of the two primary subtypes, spruce/fir (~12,000 acres total) and northern hardwoods (~40,000 acres total). Multiple associate subtypes, such as eastern white pine, northern red oak, and mixed hardwoods, are found nearby and scattered along ridgetops from Wise County to Shenandoah National Park in the Appalachian Plateau, Blue Ridge, and Ridge and Valley provinces.



Boreal Forest - Mt. Rogers NRA

Boreal forests, defined as forested high-elevation (>3500') uplands with structure influenced by shallower soils, increased precipitation, and severe weather that are rich in northern latitude species, vary in structure, age, size, species composition and productivity. Cool, moist sites with organic rich soils differentiate from other high elevation forests. Red spruce dominates highest elevation areas with nearly pure stands (occasionally mixed with balsam or Fraser fir). Most larger trees are ≥100 years old, yet younger trees exist, including seedlings and saplings. Both gradations and hard edges exist between spruce and hardwood trees. Virginia northern hardwoods contain sugar maple, American beech, and yellow birch, along with black cherry, black birch, red maple, American mountain-ash, striped maple and mountain maple.

Associate boreal species include eastern white pine, eastern hemlock, northern red oak, white oak, yellow buckeye, serviceberry, pin cherry, mountain magnolia, and basswood. Predominant species are shade tolerant, with a fringe of other species that regenerate solely in gaps. Productivity varies from good to poor based on soil, primarily depth, and exposure to wind, with short trees indicative of harsh growing conditions.

Structure is often uneven-aged, or uneven-sized, from small-scale disturbances and tree mortality often induced by extreme cold temperatures, wind, snow and/or ice. Most species include trees within each appropriate size class; oaks, black cherry, and basswood are exceptions with insufficient replacement trees – without greater canopy modification, these portions of the boreal forest will shift toward shade tolerant species. Eastern hemlock also has inadequate small trees due, in part, to impacts of hemlock woolly adelgid. Understory vegetation is usually lush, except in the shadiest areas, and includes species uncommon elsewhere. Forbs, sedges, grasses, brambles, and mosses are common, along with deciduous shrubs and patches (sometimes very large) of evergreen rhododendron and/or mountain laurel shrubs.

Springs, seeps, small streams, and occasionally bogs are commonplace. Boreal forests provide valuable ecosystem water service with infiltration and filtration. In addition to fully forested areas along slopes and ridges, boreal forests also include boulderfield areas usually dominated by yellow birch, and shrub or open balds (mostly small acreage openings) often with hawthorn on the edges. For further descriptions, the Virginia Department of Conservation and Recreation's Natural Communities of Virginia Classification of Ecological Groups and Community Types includes five forest types and two balds or barrens.

Invasive plants, invasive pests, native pests, competitors, and potential climate shifts each pose a risk for boreal forests. Invasive plants are minimal due to limited human use and disturbances and unsuitable climatic conditions. However, some invasive plant species will push into the boreal forest especially where disturbances occur. The invasive pest emerald ash borer will continue to eliminate white ash as a component; hemlock woolly adelgid continues to weaken or kill eastern hemlock; balsam woolly adelgid has caused massive declines of native firs in other areas; spongy moth creates periodic widespread disturbance and mortality; beech leaf and bark diseases may cause declines in a primary species. The native southern pine beetle occasionally causes mortality in red spruce, hemlock, and white pine. New York, hayscented, and bracken ferns are present in some areas, and evergreen wood fern is common.

These species are aggressive competitors that can impede tree regeneration especially when coupled with high white-tailed deer density.

There is limited evidence that higher elevations may be more resistant to warming temperatures; nevertheless, under the scenario of warmer summer temperatures and similar precipitation, the boreal forest will likely shrink as summer temperature and moisture stress push suitable conditions to higher elevations; for example, red spruce maximum mean monthly temperature is ≤68°F. Red spruce and firs may be prone to increased winter damage from periods of intense cold especially if mean fall, winter and spring temperatures are higher (which will otherwise aid growth). Genetic diversity is also low, indicating low phenological variation possible. As spruce and fir are only present at high elevation sites (a few at ~2700'), this already rare resource may be diminished. Most other boreal forest species have greater plasticity and occur at lower elevations; however, their geographic and elevation range will likely decrease. Oaks, as a component, face a challenge as there is little advance regeneration present to allow for movement. Warming temperatures may also lead to increased pest issues and susceptibility to wildfire.

The majority of boreal forest is government-owned or is protected by a conservation easement; however, there are unprotected private lands, including some Fraser fir Christmas tree farms. Grazing of balds and clearing for additional pasture are potential threats as are new homes fragmenting and reducing (albeit small) sections of forest. Invasive plant species spread increases with grazing and home building.

Many animals are associated with boreal forests and a number are dependent upon the habitat provided, especially the spruce/fir component. These include northern flying squirrel, snowshoe hare, northern saw-whet owl, hermit thrush, magnolia warbler, golden-crowned kinglet, red-breasted nuthatch, winter wren, pigmy salamander, and Weller's salamander. In addition, brown creeper, mourning warbler, and yellow-bellied sapsucker breed only in the northern hardwood subtype. Proper forest management can improve forest and/or wildlife habitat conditions. Generally, total harvesting is unsuitable. Planting red spruce seedlings to increase range, and genetic diversity, is possible and has occurred recently. Prime locations are cool, moist, fog-shrouded, snow-laden sites with some shade. Road or trail construction and maintenance should utilize best management practices to minimize erosion, water quality impacts, and invasive plant species introductions. Additional acres could also be protected with conservation easements.

Grasslands

Ron Hughes, Virginia Department of Wildlife Resources

Grasslands are plant communities dominated by grasses, sedges, and non-woody forbs that, through various factors (such as soils, grazing, fire, weather) remain in an open condition. Grasslands can vary tremendously in size, structure, function, and species assemblages, from natural prairies and high-elevation grassy balds to human-influenced old fields, pastures, and hay fields. They can range in size from a few acres to hundreds. Grasslands provide important ecosystem services beyond wildlife habitat.

World-wide, grasslands sequester approximately 34% of the global terrestrial carbon stock, help mitigate soil erosion and minimize run off and improve water quality (Colvig 2024).



Maintained Grassland - C.F. Phelps WMA

Grasslands are one of the most imperiled ecosystems in North America. Natural grasslands in the East were open, grass-dominated areas interspersed with trees (Hanberry and Noss 2022). The historical extent and distribution of natural grasslands in Virginia is unclear. During early colonial settlement (ca. 1630), it was purported that Virginia was 96% forested (Weakly et al. 2012). The remaining 4% (~2,000,000 acres) was in other cover types. How much of the 4% was grasslands is unknown. Historical records, local demographics, and the fossil record suggest natural grassland ecosystems in the East may have been more extensive than once thought. Fossils of specialized grassland birds, such as the greater prairie-chicken, Henslow's sparrow, and savannah sparrow found in the East indicated grasslands were important components of eastern North America.

The post-settlement period (1630-1860) is considered the most far-reaching period of human influence affecting changes in the distribution and abundance of Virginia's native flora and fauna (Weakly *et at.* 2012). Further, land use changes over the sixty years following the Civil War caused major ecosystem changes that includes loss of more than 90% of the grasslands in the United States (Colvig 2024). In the East, natural grasslands were often converted to agriculture and other uses, causing significant loss of this habitat and associated wildlife. Non-native plants were established for grain and hay, and development expanded. By the 1920s, most of the natural grasslands were lost, and populations of associated wildlife species were at all-time lows. During this period, though, modern conservation values emerged concurrent with a period of farm abandonment. Fallow pastures and fields became old field habitat that functioned as "artificial" grasslands. However, over time, major developments in agriculture resulted in a shift toward habitat loss again as fallow fields and open lands were converted to agricultural use. These uses emphasized maximum use of space, highly mechanized machinery, genetic engineering of crop plants, and the advent of chemical pesticides and fertilizers. By the 1980s, land managers realized the plight of grassland habitat and wildlife loss and targeted open land for conservation across Virginia. Consequently, grassland conservation on both public and private l ands began, slowing the decline of this imperiled habitat and associated wildlife species. Grasslands serve as

vital wildlife habitat for 274 Species of Greatest Conservation Need (SGCN) identified in the Virginia Wildlife Action Plan.

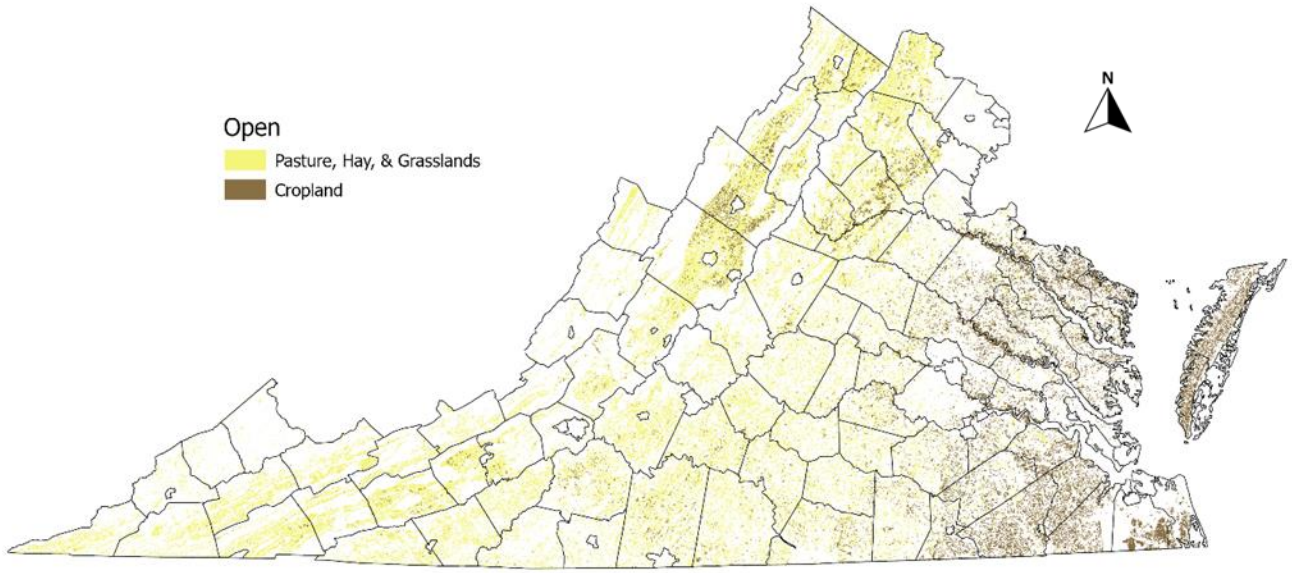


Figure 3.4. Open Lands in Virginia

Natural grasslands are rare in Virginia. The DNH lists the few known natural grasslands found in Virginia. Not only grasslands (prairies), but Piedmont woodlands and savannas — open forest communities dominated by grasses and forbs —are included in this listing. Most of the natural grasslands listed are human-influenced and found only within Virginia's Piedmont military base training grounds (e.g., Marine Corps Base Quantico, Fort Barfoot, and Fort A. P. Hill) (Weakly et al. 2012). These habitats are disturbed by random incendiary round fires that are of the size, intensity, and frequency comparable to pre-settlement fire regimes; thus, perpetuating healthy ecosystems (Fleming et al. 2013). Only one natural high-elevation grassy bald, spanning roughly 200 acres, exists in Virginia on Whitetop Mountain in Grayson County (Weakly et al. 2012). More information regarding Virginia's natural grassland ecosystems can be found in the VDCRNH Natural Communities Classification of Ecological Groups and Community Types for Piedmont Oak-Hickory Woodlands, Savannas, and Grasslands as well as Southern Appalachian Shrub and Grass Balds.

Approximately 30% of Virginia's land base is in agricultural use. Of that, a much smaller portion (not known) is in agricultural use that functions as grassland (some hay and pasture) yet are not managed directly to benefit wildlife (e.g., haying fields during the breeding and nesting season). An even smaller portion of Virginia's functional grasslands are protected and managed on public lands (e.g., parks, battlefields, natural area preserves, military installations). Some private landowners manage their lands as grasslands, mainly with the help of Federal cost share programs. These habitats are important to a variety of Virginia's SGCN, such as the eastern meadowlark, grasshopper sparrow, and northern bobwhite as well as seven SGCN bumble bees, monarch butterfly, and other native pollinators. In addition, these habitats are important to a variety of transient and wintering bird species, such as the short-eared owl and dickcissel.

Two primary issues threaten the existence and quality of Virginia's grassland habitats: development and lack of disturbance factors and regimes. Open land is attractive to humans for development and agriculture and is easily converted to those uses. The lack of disturbance factors and regimes hinder ecological succession and natural processes that keep grasslands in an open and functional state. Given the Commonwealth's climate, latitude, and soils, Virginia's landscape can support a diversity of open habitats including grasslands. During pre-settlement, influences such as natural and anthropogenic fires, floods, hurricanes, thunderstorms, tornados, ice storms, large herbivores (e.g. elk, bison) and insect outbreaks created and maintained large areas of open habitat within the larger forested landscape (Oehler et al. 2006). However, in modern times, several disturbance factors are controlled (e.g., fire suppression). Grasslands must be kept in open state and managed using fire or other tools that control establishment and encroachment of woody species. Further, the scale to which grasslands are established and managed is challenging yet is important to consider in management decisions.

Shrublands

Marc Puckett, Virginia Department of Wildlife Resources

As Virginia transitioned from a rudimentary farming economy in the early 1900s to an industrial economy after World War II, open lands acres began to be reforested or developed. Though it is difficult to assess, shrublands likely peaked in Virginia in the late 1800s to early 1900s. In 1900, it is estimated



Shrubland, Virginia Piedmont

that 80% of Virginia was in open farmland of some kind. And many of the remaining forests were in early successional stages due to excessive logging. At that time, methods of maintaining fence lines, field edges and uncropped openings were crude. Common equipment like large rotary mowers and modern herbicides did not exist. Therefore, shrubby fence lines and shrubby areas around crop fields were common. It is hard to estimate the acres of shrubland then, but it would have likely dwarfed the acres of modern times. Using a rough estimation of 80% of Virginia's total land area yields 20,400,000 acres. If only 10% of that farmed land was in shrub habitat, there would have been over 2,000,000 acres of shrub habitat surrounding farmed lands alone, not including young forests in regeneration. Virginia at that

time was an early-successional species wonderland. However, it was also at a time when soil erosion and stream sedimentation likely were at an all-time high.

Loss of shrubland continued with large scale reforestation after World War II. The development of more intense farming methods, feeding more people on far fewer acres, modernization of forestry and conversion of many farmed acres to pine plantations, coupled with human population growth and development, greatly reduced early successional acres. Today, about 34% of Virginia's land mass is in farmed land, consisting largely of row crops and pasture and hay land. These modern farmed acres are managed with effective herbicides and brush control techniques, making shrubland less common now than a century ago. The question remains, though, what did Virginia's pre-European settlement landscape consist of? Are today's shrublands substantially different from those of pre-colonization times? Considering that aboriginal people practiced rudimentary farming for centuries, often relying on prescribed fire to set back plant succession, it is likely that a significant component of shrubland existed during pre-colonial times. Historical accounts of large expanses of switch cane dominated lowlands and hunting grounds written about by eastern bison hunters, and valleys described as consisting of native grasses and forbs suggests that shrublands may have been common. Since Virginia's climate is largely a mesic one, and soils are fair to good in many areas, the natural tendency here is for open lands to revert to older forests over time. It is hard to assess what a purely natural landscape in Virginia would look like. Shrublands would exist due to natural occurrences like hurricanes, tornadoes, and wildfires, along with some grazing by large ruminants, but to what extent is speculation.

A better analysis is to look at the last twenty years, recognizing that the shrublands category includes clearcuts, or young forests in regeneration. Whether they are naturally regenerating hardwoods or pine plantations of some type, these lands still provide the majority of shrublands in Virginia. Depending on location, soil type and site index, clearcuts may exist in a shrubland structure from two to ten or more years post-harvest (transitioning from forb- and brier thicket-dominated areas to those dominated by low growing saplings and shrubs and pines in many cases). National Land Classification Data from the last twenty years show an increase in shrubland in Virginia from approximately 760,000 acres in 2001 to 992,000 acres in 2021. There was a substantial dip in the acreages following the 2008 economic crisis, but a recovery of timber harvesting followed over the last fifteen years. The NLCD does not break down these acres by those attributed to timber harvest versus those occurring from other activities. Current data suggest shrubland comprises about 4% of Virginia's landscape. If new methods for making paper, cardboard or building construction materials are not developed that outpace the use of wood, the amount of timber harvest and, thus, shrubland in Virginia should stay consistent into the foreseeable future.

The DOF tracks timber harvests annually. On average between 200,000 and 250,000 acres of timber harvest occurs in Virginia each year. This effort consists of clear-cuts, and timber thinning cuts of various intensities. Clear-cutting creates the best opportunity for shrublands, but thinning also increases shrub levels in the forested understory. Conducting annual surveys for northern bobwhite and songbirds provides some insights into species that rely on shrubs for at least some component of their life cycles. When observing near clear-cuts in their early years, shrubland bird species such as bobwhite, yellow-breasted chat, white-eyed vireo, indigo bunting, rufous-sided towhee, field sparrow, and prairie warbler

are commonly heard. It could be argued that these clear-cut derived shrublands do not have the quality or plant diversity of more naturally occurring shrublands, or field borders and hedgerows developed specifically with planted shrubs, and this is likely true. But the sheer volume of the shrublands provided by timber harvest dwarfs all other types. It appears that some of these shrubland species are adapting quite well to modern forestry practices that, while they are not perfect in their provision of habitat, prove adequate for many species.

While timber harvests will likely maintain substantial acres of shrublands into the foreseeable future, it remains critical that those managing state, federal, or private lands recognize the value of and create or maintain shrublands where it makes sense to do so. In addition to clearcuts, shrublands can occur on rights-of-way, in old pastures and fields, around wetlands, on restored mined lands, and in other odd areas. It takes active management to maintain shrublands through time. Some sort of disturbance or selective management must occur or many of these shrublands will transition to mature forest. Multiple federal incentives programs exist that financially support establishing shrublands such as field borders and hedgerows, heavy thinning and burning of thinned pine stands, patch clearcuts and others. The key is to increase the awareness of the value of shrublands and other early-successional plant communities in the eyes of landowners and the public.

Savannas

From Virginia's 2015 Wildlife Action Plan

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



Pine Savanna - Big Woods WMA

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 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, or in close proximity to, existing savanna habitats.

Savannas historically were related to fire-maintained longleaf pine (LLP) ecosystems in Virginia which is at the northern extent of the LLP ecosystem range that stretches from Texas to Virginia. Eighteen Longleaf Implementation Teams (LIT) are organized through the Longleaf Alliance, including the Longleaf Cooperators of Virginia (LCOV). LCOV is a collaboration of public and private land managers that plans and implement conservation actions to benefit longleaf and its species components. Throughout the range, connectivity, and conversation of corridors of species movement is important. Species are increasingly moving north and west in response to changing environmental conditions. According to The Nature Conservancy (TNC). Species are moving 11 miles north per decade. Wildlife corridors identified in the Virginia Wildlife Corridor Action Plan (see page 97 for further discussion on wildlife corridors) identify these natural pathways that will be used in conservation action. Six conservation lands comprised of longleaf pine savanna habitat owned by DWR, the Virginia Department of Forestry (DOF) and the Virginia Department of Conservation and Recreation (DCR) and private landowners fall within the identified corridor that runs along the Nottoway River (Chub Sandhill, Big Woods WMA, Flippo Gentry, Piney Grove, Racoon Creek, and Nottoway Arch). Corridors identified in ConserveVirginia along the Blackwater and James River contain four other LLP conservation areas owned by state and federal managers (Old Dominion University's Blackwater Ecological Preserve, DCR's Antioch Swamp and South Quay NAPs and the James River National Wildlife Refuge). These conservation lands will benefit from conservation actions that provide connectivity to ensure resiliency of preserved lands over time as well as allowing pathways for species movement.

Glades & Barrens
From Virginia's 2015 Wildlife Action Plan

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 that 40% of tree cover) as well as patches of moss and lichen (Anderson *et al.* 2013; Fleming *et al.* 2013; Comer *et al.* 2003). Open rocky areas can also be predominant (Comer 2003). Glade and barren habitats are found in the central and western portions of the state.

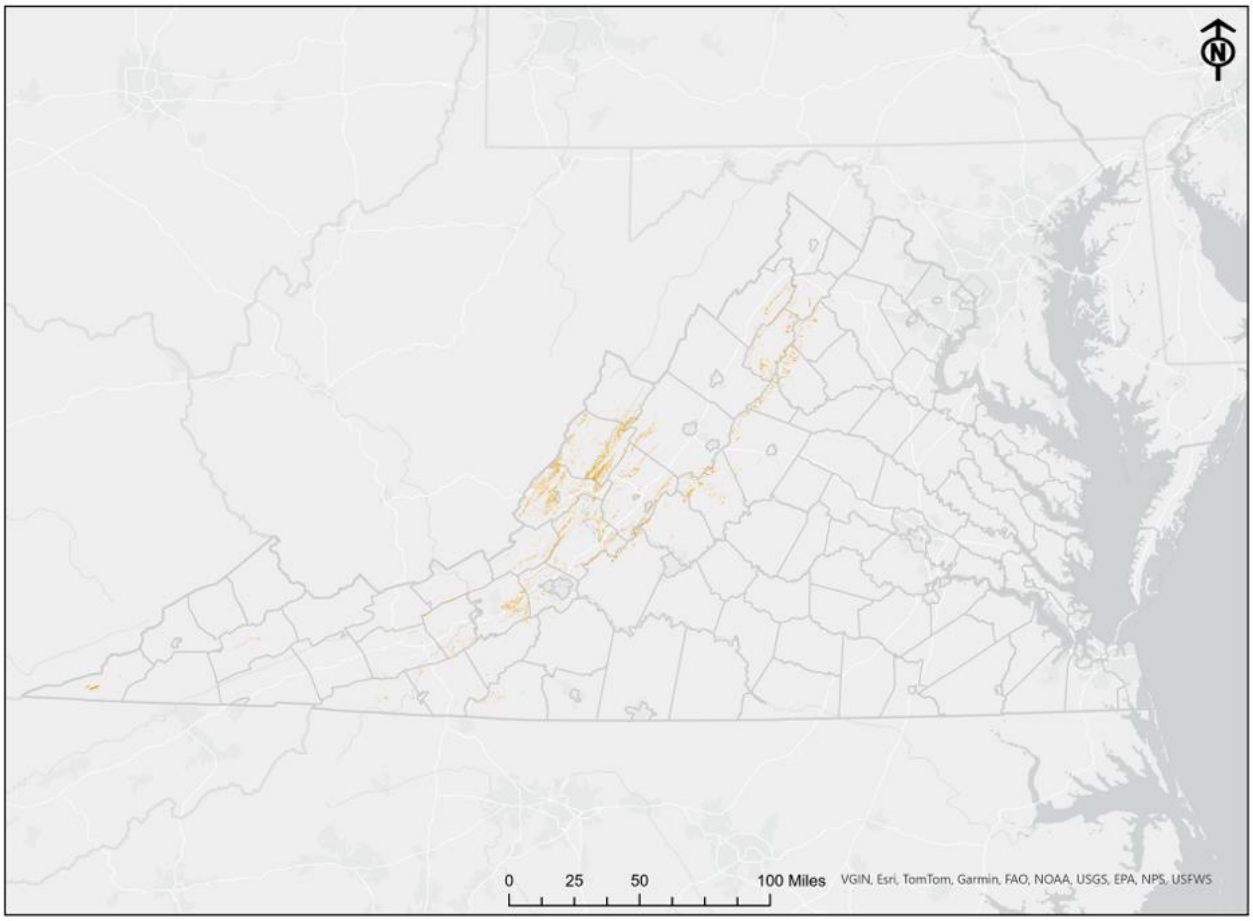


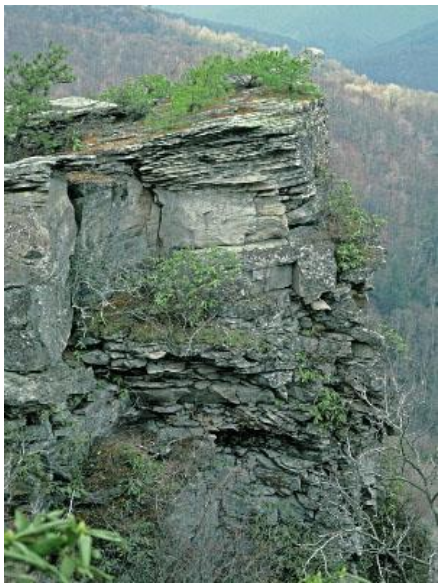
Figure 3.5. Glades and Barrens Habitats in Virginia

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 of glades and barrens can eliminate these botanical communities. Because these habitats tend to be geographically isolated, once a community is eliminated, it may be impossible for many species to reoccupy 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).

Public and private land conservation is vital, through easement, acquisition, or agreement. As agencies and organizations consider land acquisitions, they should consider giving greater priority to conserving this unique habitat. 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).

Cliff & Talus

From DCR's Natural Communities of Virginia Classification of Ecological Groups and Community Types - Mountain/Piedmont Cliffs



Cliffs - Photo credit: DCR-DNH, Thomas J. Rawinski

Cliff and talus plant communities consist of woodlands, shrub, herbaceous communities and/or nonvascular vegetation, such as lichen and bryophytes. Vegetation is often sparse and occurring on very steep or precipitous bedrock faces. Many habitats are the result of periglacial phenomena. Both calcareous and acidic cliff habitats may be formed by incision of high-order streams. Acidic bedrock communities can also occur on erosion-resistant mountain ridges or domes. Communities where vegetation is entirely dominated by lichens and bryophytes generally occupy exposed, minimally weathered, massive cliffs and boulder fields in the mountains of western Virginia. Habitats vary with aspect and other environmental conditions. Local zones or ephemeral seepage may be present.

On south- and west-facing cliffs of carbonate formations, the surficial bedrock, hot microclimates, and associated chemical and physical stresses limit overall vegetation cover, woody growth, and species richness. Scattered scrub growth is typical. On north-facing limestone or dolostone cliffs, habitats are open but sheltered, with limited direct solar exposure. Local zones of ephemeral seepage are frequent. Woody vegetation of these more mesic calcareous cliffs in comparatively diverse and often achieves larger size than on similar xeric sites. Cliffs on metamorphic and non-carbonate sedimentary rocks are poorly documented and known from relatively few siltstone, metasiltstone, and metabasaltic cliffs in the western Piedmont and Blue Ridge. Ordovician red mudstone/shale cliffs of the Ridge and Valley Province also support communities of this group. All require additional investigation. Habitats probably vary with aspect and other microhabitat conditions. Vegetation is generally dominated by umbilicate, foliose, and/or crustose lichens, with relatively sparse representation of vascular plants.

The vegetation of acidic cliffs is generally dominated by lichens, with the umbilicate "rock tripe" species especially prominent. Vascular plants are confined to crevices and humus-covered shelves. On drier,

south- to west-facing cliffs, vascular species may be very sparse and consist of stunted pines, heathery shrubs, and occasionally herbaceous lithophytes. Sheltered, north- to east-facing cliffs often support more diverse shrub and herbaceous flora.

Cliff communities are generally considered state-rare, but their conservation status needs further investigation. Because of inaccessible locations, stands seem immune from many types of anthropogenic disturbance. Scattered individuals of non-native weeds sometimes find footholds on xeric cliffs, but are largely excluded by the hot, rocky substrates.

Caves & Karst

Will Orndorff, Division of Natural Heritage, Virginia Department of Conservation and Recreation

As of the spring of 2023, the Virginia Speleological Survey has documented 2,953 caves over 10 meters in length in Virginia. Ten meters is the international convention for minimum length of passages needed to qualify as a cave. Nearly 600 miles of passages have been surveyed within these caves. All but a small handful of these caves occur in the Ridge and Valley physiographic province west of the Blue Ridge. Biological sampling has been performed in approximately 800 of these caves, resulting in identification of over two hundred cave-limited invertebrate species, mostly endemic to Virginia and new to science when initially discovered. Two-thirds of these species are considered globally imperiled or critically imperiled with primarily to extremely restricted ranges (G2 or G1 Natureserve Conservation Status Rank), with many known from only a single cave or karst system. These accessible and documented caves underlie a small portion of a much more vast landscape developed across western Virginia by the dissolution over geological time of limestone and dolostone, resulting in a largely internally drained landscape called karst. Karst is characterized by sinkholes, disappearing streams, relatively few surface streams, large springs, and caves. Over four thousand square miles (> 2.6 million acres) of western Virginia is underlain by karst topography, according to mapping by the Virginia Department of Energy.

The vast majority of Virginia's karst and caves lies west of the Blue Ridge, in the Ridge and Valley province either on valley floors or along the lower slopes of mountain ridges. While a systematic land use analysis is beyond the scope of this document, it is clear that the vast majority of Virgina's karst has been subjected, since European colonization, to major land conversion from forests, woodlands, and grasslands to anthropogenic agricultural landscapes characterized dominantly by grazing and row crops, with widespread interspersed and upslope silviculture. In parts of the state, land application of chemical fertilizer, poultry litter, and biosolids is widespread, as is the use of pre-emergent herbicides and pesticides.

There are few cave- or karst-specific regulations in Virginia, although general environmental regulations provide varying degrees of protection. The Virginia Cave Protection Act of 1979 established the Virginia Cave Board, which provides guidance as requested to citizen and agency stakeholders and maintains a list of caves designated as "significant." Many significant caves are so designated primarily because of the species that live in them. The Cave Protection Act also establishes a research permit system for scientific studies in caves, prohibits the sale of speleothems (cave formations such as stalactites and stalagmites), and exempts landowners from liability should someone be injured in a cave on or beneath

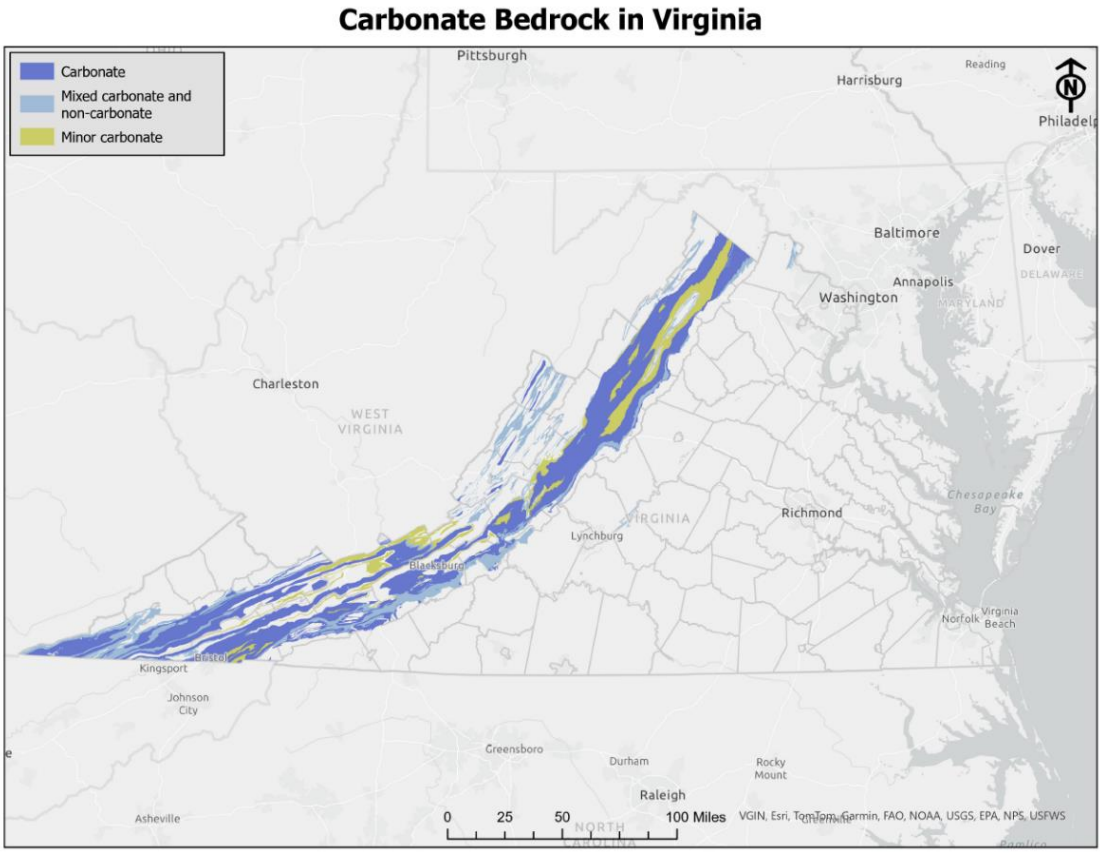


Figure 3.6. Caves and Karst

their property, provided no fee is charged for entry. Solid waste management and stormwater management laws regulated by the Department of Environmental Quality contain karst-specific provisions, as do septic system siting standards regulated by the Department of Health. Guidelines for certified nutrient management plans approved by the Department of Conservation and Recreation contain karst specific provisions.

In a broad sense, all subterranean communities share a fundamental dependence on a combination of heterotrophic and chemotrophic/chemoautotrophic sources of energy. Around the world, there are subterranean communities based on both kinds of systems. However, most of the food base for the ecological groups seen in Virginia appears to be derived from material produced in an autotrophic environment and subsequently transported into the subsurface.

The designation and definition of subterranean invertebrate natural communities in Virginia only exists to the ecological group level, performed by Dr. David Culver (American University biology professor and long-term member of the Virginia Cave Board) under contract to The Nature Conservancy in 1991. While Culver (1991) describes these as six “cave community types,” the level of detail is clearly more consistent with their designations as ecological groups, and his descriptions lack characteristic taxonomic associations necessary for delineation to the community level. Slightly updated and simplified descriptions of these habitats appear in “The Invertebrate Cave Fauna of West Virginia, second Edition” by Fong *et al*. 2007 and include lists of species associated with each habitat based on

sampling. "The Invertebrate Cave Fauna of Virginia," (Holsinger *et al*. 2013) is an annotated list of cave-limited species known from Virginia but does not provide any habitat pairing.

Aquatic versus terrestrial habitats, combined with the physical habitat and associate sources of food, form the basis of Culver's six cave habitats common in the Appalachians, all of which occur in Virginia. These habitat types, with names slightly modified from Culver's, are:

- Aquatic Cave Stream
- Aquatic Cave Drip Pool/Epikarstic
- Aquatic Karst Phreatic Zone
- Terrestrial Riparian Cave
- Terrestrial Edaphobitic/Epikarstic Cave
- Terrestrial Dung/Transitory Organic Matter Cave

Aquatic Cave Stream Habitat

Cave streams are streams that flow through cave systems. They may have a variety of physical structures (e.g., pool/riffle) and substrate (gravel, cobbles, bedrock, hardpan or cemented gravel and clay). In general, they are dominantly vadose in nature (above the water table) and commonly exhibit turbulent flow. Some cave streams are very dynamic in response to precipitation events, while others remain more constant. Cave streams in Virginia are, in many cases, parts of integrated subterranean basins that may, in some cases, exceed 100 square miles in area.

There are three sources of water for cave streams. **Allogenic** water is derived from precipitation that landed in nonkarst areas and typically enters the cave as channelized flow captured into the subsurface after flowing onto carbonate bedrock. **Autogenic** waters are derived from precipitation falling on carbonate bedrock and may reach the stream through flow into sinkholes, channelized surface flow captured by the subsurface, or quite often by slow, mostly vertical movement through the soil and epikarst (the upper portion of the bedrock between cave passages and the overlying soil/bedrock interface). A third source is **phreatic** water, where water upwells or spills over from the deeper aquifer, forming an underground spring that feeds a cave stream. Any particular cave stream represents a combination of one or more of these three sources.

Water in cave streams can vary in terms of "hardness" based on its source, but most cave stream water qualifies as alkaline (bicarbonate water), with dissolved calcium, magnesium, bicarbonate, and carbonate ions. Cave streams fed by mostly autogenic sources are commonly saturated and deposit calcite in the stream bed, while allogenic-dominated streams are generally unsaturated and do not deposit minerals in their beds.

Nutrients in these systems generally flow into cave streams with the water, although nutrients may be introduced within the cave (e.g., bats roosting over water). Culver (1985) considered particulate organic matter as the main source of organic carbon in caves, but substantial carbon may also enter as dissolved organic carbon. In both cases, microbial communities may play a role in converting this carbon into

forms more usable by higher taxa. In many cave streams, feeding trails can be observed across microbial deposits on the stream substrate.

Cave stream habitats are sensitive to degradation of water quality through introduction of chemical contaminants, excess nutrients (Holsinger, 1966), and/or sediment. Cave stream habitats can be resilient, especially in case where there are underground tributaries that serve as refugia hydrologically connected to impacted portions of the stream. Cave stream habitats can also be degraded by changes in stream flow, both in terms of rate and volume. Human activities likely to negatively impact cave stream habitats include land development, agriculture, water withdrawals, and logging activities. In all of these cases, there are best management practices that may be followed to avoid or reduce impacts to cave streams. However, the implementation of such practices in inconsistent at best and should be encouraged.

Fong *et al.* (2007) list the following faunal orders that, in West Virginia, contain cave-limited taxa associated with cave stream communities: amphipods (Amphipoda), asellid isopods (Isopoda), crayfish (Decapoda), hydrobiid snails (Mesogastropoda), and flatworms (Tricladida, Lecithoepetheliata). All but cave-limited crayfish are known from cave stream communities in Virginia. Troglophilic fauna may include crayfish, salamanders, and small fish, none of which have cave-limited species documented in Virginia. Larvae of epigean insects are locally common.

Terrestrial Riparian Cave

Terrestrial Riparian Cave habitats form adjacent to cave streams, within and immediately adjacent to the volume of the cave impacted by frequent flooding of the cave streams. The particulate organic matter introduced into the habitat during flood events is the major source of food in these systems (Holsinger and Culver, 1988). These habitats occur along flood prone perennial cave streams and also along intermittent cave streams that flood after storm events. The habitat is commonly (but not always) characterized by significant deposits of fine-grained sediment, rich in organic matter, much of it coarse and particulate in nature. In some cases, coarse organic matter may be deposited in the riparian zone with a relative dearth of fine, inorganic sediment.

Terrestrial Riparian Cave habitats in Virginia are in many cases parts of integrated subterranean basins that may, in some cases, exceed 100 square miles in surface recharge area.

There are three sources of water for the cave streams that support terrestrial riparian cave habitats. **Allogenic** water is derived from precipitation that fell on nonkarst areas and typically enters the cave as channelized flow captured into the subsurface after flowing onto carbonate bedrock. **Autogenic** waters are derived from precipitation falling on carbonate bedrock, and may reach the stream through flow into sinkholes, channelized surface flow captured by the subsurface, or quite often by slow, mostly vertical movement through the soil and epikarst (the upper portion of the bedrock between cave passages and the overlying soil/bedrock interface). A third source is **phreatic** water, where water upwells or spills over from the deeper aquifer, forming an underground spring that feeds a cave stream. Any cave stream represents a combination of one or more of these three sources. Allogenically

dominated cave stream systems are typically more flood prone and introduce more and coarser particulate carbon into the riparian cave terrestrial habitat than do other stream types.

Microbial communities almost certainly play a role in converting the coarse particulate carbon into forms more usable by higher taxa. Extensive bioturbation of fine-grained sediments in the riparian habitat is common, and the presence of oligochaetes is nearly ubiquitous. Taxa occupy the surface and interior of and areas adjacent to these riparian surface deposits.

Terrestrial riparian cave habitats are sensitive to degradation of water quality through introduction of chemical contaminants, excess nutrients, and/or sediment, but less so than cave streams themselves. Terrestrial riparian cave habitats can also be degraded by changes in stream flow, both in terms of rate and volume, especially when these changes impact flood frequency and severity. Terrestrial riparian cave habitats can be resilient, especially in case where there are underground tributaries that serve as refugia hydrologically connected to impacted portions of the stream. Human activities likely to negatively impact terrestrial riparian cave habitats include land development, agriculture, and logging activities. In all of these cases, there are best management practices that may be followed to avoid or reduce impacts to cave streams and associated riparian terrestrial habitats. However, the implementation of such practices is inconsistent at best and should be encouraged.

Fong *et al.* (2007) list the following faunal orders that, in West Virginia, contain cave-limited taxa associated with terrestrial riparian cave habitats: mites (Acari), spiders (Araneae), springtails (Collembola), pseudoscorpions (Pseudoscorpionida), bristletails (Diplura), millipedes (Chordeumida), and beetles (Coleoptera). These are also the faunal groups represented that occur as cave-limited species in Virginia's terrestrial riparian cave habitats. Harvestmen (Opiliones) may also include cave-limited species associated with terrestrial riparian cave habitats in Virginia.

Other Subterranean

Will Orndorff, Division of Natural Heritage, Virginia Department of Conservation and Recreation

Aquatic Cave Drip Pool/Epikarstic Habitat

The cave drip pool/epikarstic habitat is characterized by water moving vertically (or subvertically) into the cave (Culver, 1991), following multiple pathways and at various rates. The majority of epikarstic habitat may not be directly accessible from the cave, consisting of water stored in and flowing through inaccessible cracks, fissures, and solution pockets between the cave and the bedrock-soil interface or land surface. Animals observed in or collected from drip pools likely in many cases represent "wash-outs" from the primary, overlying habitat.

Cave drip pool/epikarstic waters are typically bicarbonate (alkaline) waters rich in dissolved calcium, magnesium, bicarbonate, and carbonate. In most cases and at most times, they are saturated with respect to the mineral calcite and deposit speleothems near the bottom of the epikarst and at the interface with underlying cave passages. Dissolved oxygen levels are generally neither saturated nor anoxic.

In the case of the epikarst and cave drip pools, there is less energy input from particulate matter and more from dissolved organic carbon and organisms. This habitat is characterized by much lower resource levels than cave streams, and the associated fauna has adapted to this low energy environment. Introduction of excessive carbon and/or nutrients into this system can be very damaging and lead to invasion of the habitat by organisms accustomed to higher nutrient levels (Culver, 1986; Holsinger, 1966).

Drip pool/epikarstic habitats are sensitive to degradation of water quality through introduction of chemical contaminants, excess nutrients, and/or sediment, which can clog flow paths in the epikarst. Epikarstic habitats can be resilient, especially in cases where impacts are localized and not extensive across the overlying land surface. The key is ability for fauna to move laterally to and from unimpacted refugia within the epikarst. Epikarstic habitats are easily degraded by changes in recharge volume and patterns. Any activity that increases surface runoff and reduces or focuses recharge is likely detrimental to this habitat. Human activities taking place above or nearly above the epikarstic habitat and likely to cause negative impacts include land development, agriculture, septic systems, water withdrawals, and logging activities. In all of these cases, there are best management practices that may be followed to avoid or reduce impacts to cave streams. However, as in the case of cave streams the implementation of such practices is inconsistent at best and should be encouraged.

It should also be pointed out that epikarstic habitat may extend laterally well beyond the area overlying humanly accessible cave passages. Delineation of habitat extent in such cases is difficult and must be inferred from the distribution of bedrock and geomorphology/surface topography. Continuous areas of similar bedrock and surface morphology between caves likely are underlain by contiguous epikarstic habitat, and extensive epikarstic habitat most likely exists even in karst areas that are not near known caves. Protection of the land surface overlying epikarstic habitat is the overriding strategy for protection of epikarst habitat.

Fong (2007) states that this habitat is dominated by copepods and also lists several associated amphipod species. In Virginia, the characteristic fauna of aquatic epikarstic/drip pool habitats include amphipods (Amphipoda), asellid isopods (Isopoda), and planaria (Triclada), as well as numerous copepods (Cyclopoida and Harpacticoida) and a variety of other microcrustacea.

Aquatic Karst Phreatic Zone Habitat

Karst phreatic zone habitat occurs below the water table (zone of saturation) and consists of waterfilled solution conduits (caves), chambers, fissures, and fractures. It is accessible to sample and monitor at the intersection of the phreatic and vadose (unsaturated) zones in cave lakes (Culver, 1991) and cenotes, through groundwater wells, and indirectly through discharge of phreatic water through springs. The habitat extends to unknown depth, and crustaceans have been observed to occupy the habitat to depths in excess of thirty meters in the Shenandoah Valley.

Phreatic waters are comparable to drip waters in that they are generally bicarbonate (alkaline) waters rich in dissolved calcium, magnesium, bicarbonate, and carbonate. In many cases they are saturated with respect to the mineral calcite. Dissolved oxygen levels are low compared to cave streams, but not anoxic.

Energy input and distribution in the karst phreatic zone is highly irregular. While the bulk of the water in the phreatic zone is typically low in dissolved organic carbon, both dissolved organic carbon and carbon from particulate matter are high near intersections with the vadose zone or the land surface (e.g., beneath sinkholes or sinking streams). Much of the phreatic zone fauna is free-swimming and can migrate laterally and vertically through the aquifer to feed or to escape impairments.

Water in the phreatic zone comes from a variety of sources and has a much longer residence time in the system than in cave streams or cave/pool epikarstic habitats. The recharge areas for the karst phreatic zone are large, complex, and not easily delineated. A simple description of the karst phreatic zone is a vast network of interconnected underground "lakes" occupying caves, chambers, fissures, and fractures below the water table. Water quality in the phreatic zone can change quickly on a local scale in response to contamination events, and slowly on a more regional scale because of land use practices over decades and centuries. Protection of groundwater quality and groundwater levels is critical to the protection of karst phreatic zone communities (Culver, 1991). Promotion of practices at the land surface that encourage dispersed infiltration of clean water to recharge the karst aquifer are essential and must be widespread to be effective.

Fong *et al.* (2007) only specified a single Cirolanid isopod (*Antrolana lira)* as characteristic of phreatic karst habits in West Virginia. However, Virginia taxa commonly collected from the phreatic karst habitat include amphipods (Amphipoda), planaria (Triclada), copepods (Cyclopoida and Harpacticoida), and isopods (Isopoda). While nonmarine representatives of the isopod family Cirolanidae are restricted to cave-limited karst phreatic habitats in Virginia, they are not the only taxa present in or common to this habitat.

Terrestrial Edaphobitic/Epikarstic Cave Habitat

This habitat consists of a network of small, air-filled cavities in the epikarst, between the cave and the surface. It is the terrestrial equivalent of the STK2 described above. Because this habitat is difficult to directly sample, much of what is known about the animals that live there is from specimens that fall or are flushed into an underlying cave from above, particularly during storm events.

As the case of the epikarst/cave drip pool habitat (STK2), there is less energy input from coarse particulate matter and more from dissolved organic carbon and organisms, including plant roots and associate microbial communities. This habitat is characterized by lower resource levels than cave streams, and the associated fauna has adapted to this low energy environment. Introduction of excessive carbon and/or nutrients into this system can be very damaging and lead to invasion of the habitat by organisms accustomed to higher nutrient levels (Culver, 1986).

The environmental sensitivity, resilience, and potential sources of impacts to aquatic epikarstic/cave crip pool habitat also apply to terrestrial edaphobitic/epikarstic cave habitat. Terrestrial edaphobitic/epikarstic cave habitat may extend laterally well beyond the area overlying humanly accessible cave passages. Delineation of habitat extent in such cases is difficult and must be inferred from the distribution of bedrock and geomorphology/surface topography. Continuous areas of similar bedrock and surface morphology between caves likely are underlain by contiguous terrestrial edaphobitic/epikarstic cave habitat, and extensive terrestrial edaphobitic/epikarstic cave habitat most likely exists even in karst areas that are not near known caves. Protection of the land surface overlying and adjacent to terrestrial edaphobitic/epikarstic habitat is the overriding strategy for protection of terrestrial edaphobitic/epikarst habitat.

Fong *et al.* (2007) does not identify a characteristic fauna associated with this community in West Virginia but does cite two Coleoptera as examples. In Virginia, samples from cave formations and drip pools, and in drip collectors, suggest that the terrestrial edaphobitic/epikarstic habitat likely may include representatives from many of the same faunal orders as the terrestrial riparian cave habitat, in some cases even to the species level.

Terrestrial Dung/Transitory Organic Matter Cave Habitat

Fong *et al.* (2007) describes this habitat as being within a few hundred meters of a cave entrance (though not necessarily large enough for a human to fit). The resource (food) base is derived primarily from the activities of animals (e.g., bats, raccoons, cave rates, crickets, salamanders), such as troglophiles and trogloxenes that migrate in and out of caves regularly. Organic matter, such as leaves and woody debris falling into the entrance, may also contribute. Bodies of animals that fall into the cave but cannot escape, or that fall in dead, comprise significant sources of food as well. Note that habitat associated with extensive accumulations of bat guano are rare (and poorly documented) or absent in Virginia, though they are well-documented in several southern states and Texas (Culver, 1991).

Culver (1991) points out that the protection of this habitat requires protection of the foraging areas of the associated species outside of the cave entrance. Taylor *et al.* (2005) showed that cave crickets regularly forage at distances up to 100 meters from a cave entrance. Protection of this habitat requires maintenance or restoration of a natural buffer of at least 100 meters radius from any entrance associated with a cave. In addition, if cave gates are installed for security or conservation purposes, only designs that do not adversely impact foraging behavior and access to foraging animals should be used (Culver, 1991). In general, bat-friendly cave gates are also friendly to the foragers associated with the terrestrial dung/transitory organic matter cave habitat.

Note that in cases where terrestrial dung/transitory organic matter cave habitat is adjacent to cave streams, it may well contribute food to both the aquatic cave stream and terrestrial riparian cave community habitats.

Fong *et al.* (2007) list the following faunal orders that, in West Virginia, contain cave-limited taxa associated with terrestrial dung/transitory organic matter cave habitat: mites (Acari), spiders (Araneae),

springtails (Collembola), pseudoscorpions (Pseudoscorpionida), millipedes (Chordeumida), beetles (Coleoptera), and flies (Diptera). These are also the faunal groups represented that occur as cave-limited species in Virginia's terrestrial riparian cave habitats. Harvestmen (Opiliones) may also include cave-limited species associated with terrestrial dung/transitory organic matter cave habitat in Virginia.

Of the six cave-associated habitat types, the terrestrial dung/transitory organic matter cave habitat is the one with the highest concentration and diversity of troglophilic species, those commonly found in but not limited to caves. Many of these troglophiles do depend on the cave for parts of their life cycle but move freely in and out as part of their ordinary behavior. Common troglophiles include Alleghany woodrats, bats (eight species in Virginia are known to use caves), racoons, eastern phoebes, owls, salamanders, crickets, fungus gnats, millipedes, spiders, and harvestmen.

Ecological Zonation

One traditional way of looking at cave habitats was ecological zonation (Fong *et al*. 2007) based on proximity to light and/or a cave entrance. The "threshold zone" consists of the entrance to the extent of light penetration. The "transition zone" is completely dark, but where the microclimate changes rapidly in response to surface changes. The "deep zone" is, ideally, a part of the cave characterized by extreme climatic stability and where climatic fluctuations on the surface have little influence. Several of the six habitat types occur in more than one of these ecological zones, introducing yet another element of complexity to understanding or generalizing cave habitats. Over time, the fauna have evolved to occupy a wide array of habitats, many of them occurring in geologically isolated karst areas making migration between them difficult. The net result is a high number (over two hundred) of cave-limited invertebrate species documented in Virginia.

Riparian & Floodplain
Ben Sagara, Virginia Department of Wildlife Resources

Riverine floodplains are all the low-lying areas adjacent to any size stream that can be inundated with non-tidal floodwaters. When a watershed receives enough water to top a stream channel bank, the water begins to flow into the adjacent floodplain. Flooding can be caused by precipitation, snowmelt, storm surge, opening of dam gates, or dam breech/failure. Bottomland and floodplain forests, swamps, riverside prairies, impoundments, beaver ponds, and adjacent floodable forest, agricultural, and developed lands are all located within riverine floodplain ecosystems. Lower elevation areas are inundated more frequently, whereas higher elevation areas require greater hydrologic inputs and flood less frequently. Unaltered floodplains account for the dynamic inundation regime of riverine ecosystems and serve as critical natural infrastructure by attenuating floodwaters and allowing natural sediment transport. In doing so, they protect human communities and improve water quality and groundwater recharge. However, these flat and fertile floodplains, particularly those adjacent to large navigable waterbodies, were some of the first areas to be developed and farmed in Virginia. Many floodplain areas are still often considered prime real estate. Berms, levees, dams, and other infrastructure have been created to help protect developed areas from catastrophic flooding disasters. Development along

river corridors has significantly altered floodplain functions, leading to more frequent and severe floods, extensive loss of fish and wildlife habitat, and a greater risk to water supplies.

Floodplain habitats are distributed across the landscape along nearly every stream channel. Virginia has about 2.3 million acres of mapped Special Flood Hazard Areas which represents 9% of Virginia's land. Natural floodplains often contain valuable fish and wildlife habitat and support 248 SGCN identified in the Virginia Wildlife Action Plan. Vegetative composition is driven by differences in frequency of flooding, groundwater hydrology, watershed size, landscape position, geomorphology, soil composition, underlying geology, climate, and historic disturbance regime. Low elevation floodplains that are near permanently inundated generally maintain herbaceous and shrub dominated communities, while seasonally flooded and temporarily flooded areas are largely forested habitats. Shorelines and other depositional bars maintain bare or herbaceous-dominated habitats. Historic fire regimes in floodplains are highly dependent on the surrounding forestland community and could have a nearly annual return interval to an over 1,000-year return interval (LANDFIRE 2007). More information on Virginia's alluvial floodplain communities can be found here in the Virginia Department of Conservation and Recreation (DCR) Natural Communities of Virginia Classification of Ecological Groups and Community Types in Palustrine Systems.



Riparian-Floodplain - Hardware River WMA

Conversion to developed lands and associated habitat fragmentation remain the greatest threat to riverine floodplain habitats. Levees separate rivers from their floodplains and inhibit their ability to attenuate water during floods, which reduces the health and function of floodplain ecosystem. Dams block the natural flow of sediment and nutrients to downstream areas and impede natural fish and wildlife movement. Other threats include changes in flood frequency and intensity in rapidly developing watersheds, stormwater, agricultural, and industrial pollutants, intensive silvicultural practices,

conversion to open water through damming, and the colonization of aggressive invasive species. Changing environmental conditions are expected to cause more frequent and severe storms and droughts, which will increase the risk of severe flooding. The average 100-year floodplain is projected to increase by 45% by the year 2100. Changes in the timing and extent of hydrologic inputs affects biogeochemical processes and negatively impacts habitat and water quality services.

Floods are the most common and costly natural disaster. Development within floodplains is now federally regulated by the Federal Emergency Management Agency (FEMA). The DCR Virginia Floodplain Management Program and local jurisdictions pose further regulation and oversite over development in floodplains. Although these regulations do protect some floodplain habitats, many were created to establish guidelines to enable development within floodplains. The federal government does encourage states and local governments to establish more restrictive floodplain regulations [44 CFR 10.1(d)] and rewards these "higher standards" through premium discounts for locality participation in the voluntary Community Rating System Program (CRS). The CRS incentivizes smart floodplain management, preservation of open space, and retention or restoration of natural floodplain functions. Twenty-six communities in Virginia participate in the CRS. Other conservation actions include reconnecting streams to floodplains through stream restoration or enhancement, maintaining and planting forested buffer zones around streams, removing unnecessary dams, and limiting upstream point and non-point source pollution through regulation and incentive programs.

Riparian buffers are critical for the conservation of many aquatic species. In general, it is recommended that a buffer of at least 100 feet on both sides of all intermittent or perennial streams, a buffer of at least 200 feet on both sides of all perennial tributaries to waters known to support listed aquatic species, and a buffer of at least 300 feet on both sides of waters known to support listed aquatic species be maintained to sustain water quality, provide wildlife habitat, and ensure the stability of the stream structure and function. (Hawes, et. al, 2005)

Shorelines

Ruth Boettcher, Virginia Department of Wildlife Resources

The Shorelines habitat for the Northeast includes shorelines on lakes and ponds, estuaries and the marine nearshore but excludes Beaches and Dunes, Non-Tidal Wetlands, Tidal Wetlands and Flats. These Shorelines tend to be rocky throughout most of the Northeast United States but also include intertidal bedrock or rocky shores of estuaries or the Atlantic Ocean, maritime bluffs and headlands, peat outcrops in tidal zones or lakeshores without beaches. These habitats are often utilized by wading birds and small sandpipers and can often suffer from wind-driven and wake-created erosion.



Shoreline - Ragged Island WMA

Beaches & Dunes

Ruth Boettcher, Virginia Department of Wildlife Resources

Virginia has 8,916 miles of tidal shorelines that abut sandy beaches and marshes, of which 7,858 miles are natural or unmodified and 1,058 miles are artificially defended by bulkheads, revetments, breakwaters or living shorelines (VACoastalResourcesTool). Beaches are comprised of unconsolidated



Beaches and Dunes - First Landing SP Photo Credit: Virginia Tourism Corp.

sandy material that is exposed to the forces of erosion, sediment transport and deposition that extends from the low water line landward to a physiographic feature such as a dune, bluff, or marsh, or to the effective limit of storm waves, or the nearest impermeable human structure, such as a bulkhead, revetment, or paved road (CCRM, VIMS 2009).

Virginia's coastal beaches are found primarily along ocean shorelines (hereafter referred to as offshore beaches) and within the Chesapeake Bay estuary (hereafter referred to as inshore beaches). They perform a host of ecological services that benefit wildlife, adjacent ecosystems and human interests. Virginia's southeastern offshore beaches adjoin the mainland and extend from the North Carolina/Virgina border to the Joint Expeditionary Base-Fort Story. The beaches under the ownership and management of the City of Virginia Beach support extensive commercial and residential development whereas the beaches on Back Bay National Wildlife Refuge and False Cape State Park are under conservation ownership. A small portion (< 5 miles) of the southeastern offshore beaches is under state and US military ownership. The Commonwealth's remaining offshore beaches are on 14 transgressive barrier islands located on the seaward fringe of the lower Delmarva Peninsula. These islands are largely owned and managed by The Nature Conservancy – Volgenau Virginia Coast Reserve, the USFWS, the Commonwealth of Virginia, and the National Atmospheric and Space Administration (NASA). Only NASA-owned Wallops Island has significant infrastructure on the beach; the remaining islands are undeveloped and maintained as naturally functioning ecosystems. Virginia's inshore beaches are found throughout the Chesapeake Bay Estuary and are under the ownership of the USFWS, the Commonwealth of Virginia, non-governmental conservation organizations, municipalities, the US military, private citizens and commercial businesses. Within the Chesapeake Bay, concentrated beaches occur around isolated Bay islands, along barriers within the lower Western Shore, around the mouths of large tributaries where the long-shore transport of sand is disrupted, and along the outer edges of extensive marshes. Although not as extensive as along the outer Atlantic Coast, dune systems do occur within the Chesapeake where historic or current wave and wind energies are high (Watts 2013).

Virgina is the northern extent of the US Atlantic Coast loggerhead sea turtle nesting range, and the southeastern offshore beaches continue to support the majority the species' nesting activity in the Commonwealth. A few Kemp's ridley and green turtle nests have also been documented on these beaches (see Appendix 5.) The southeastern offshore beaches also provide nesting habitat for a small portion of the state's northern diamondback terrapin breeding population. While these beaches do not support any breeding shorebirds or seabirds, the intertidal and supratidal habitats do provide foraging and roosting habitats for several SGCN during the non-breeding season, including common terns, least terns, laughing gulls, herring gulls, red knots, dunlin, piping plovers, sanderlings, black-bellied plovers and willets.

Virginia's barrier island offshore beaches provide important breeding habitat for many shorebirds and seabirds, several of which are SGCN. They include piping plovers, Wilson's plovers, American oystercatchers, gull-billed terns, common terns, least terns and black skimmers. These beach-nesting species rely on natural coastal processes to form and maintain expansive sand/shell flats on which to successfully breed. One hundred percent of the state's piping plover and Wilson's plover breeding populations occur on these dynamic barrier beaches. They typically select nesting areas with unimpeded access to backside mudflats where young broods can forage on a variety of invertebrates. Low sparsely vegetated dunes provide additional breeding habitat for American oystercatchers, common terns, gull-billed terns and an occasional piping plover. Low densely vegetated dunes provide breeding habitat for two additional SGCN; herring gulls and laughing gulls. While laughing gulls are generally considered a marsh-nesting species, subsidence and frequent flooding of saltmarshes have forced them to seek

higher-elevation nesting areas on the barrier beaches. Lastly, all barrier island beaches provide important nesting habitat for diamondback terrapins and a few islands have documented an occasional loggerhead sea turtle nest. Assateague is the only island where loggerheads nest almost every year.

Barrier island supratidal habitats (areas above mean high-water) are important non-breeding roosting sites for the following SGCN: black skimmers, common terns, red knots, dunlin, piping plovers, American oystercatchers, sanderlings, black-bellied plovers, willets (western race) and marbled godwits. Finally, barrier island shorelines and intertidal zones provide critical foraging habitat for breeding, migrating and wintering SGCN, including the red knot, dunlin, piping plover, American oystercatcher, sanderling, black-bellied plover, willet (western race) and marbled godwit.

Virgina's inshore beaches also support a variety of SGCN throughout the year but not to the same extent as the barrier island offshore beaches. Beach-nesting American oystercatchers, common terns, least terns, black skimmers, and herring gulls are known to breed on inshore beaches along with diamondback terrapins and, on very rare occasions, loggerhead sea turtles. Inshore intertidal shorelines, supratidal beach habitats and artificial structures (*e.g.,* groins and seawalls) are important foraging and roosting sites for several SGCN during the non-breeding season, including purple sandpipers, sanderlings, red knots, dunlin, willets (western race), black-bellied plovers, Forster's terns, herring gulls and laughing gulls.

Riverine Overview

Louise Finger; John Odenkirk; Tim Owen; Margi Whitmore; Jason Hallacher; Brad Fink; and Kristen Chestnut-Faull, Virginia Department of Wildlife Resources

The Commonwealth of Virginia includes a range of physiographic regions from the Appalachian Plateau in the far southwest, through the Valley and Ridge, over the Blue Ridge Mountains, across the Piedmont, and into the Coastal Plain that meets the Chesapeake Bay and the Atlantic Ocean. These physiographic regions contain freshwater systems that range from narrow, steep, mountain streams to more sinuous, moderate-size channels with flatter valleys to larger rivers with expansive floodplains. The habitat conditions that occur in these various stream types are driven by the elevation, topography, geology, surrounding land use, vegetative cover, and point and non-point inputs to the water body from a variety of sources. For example, habitat characteristics associated with geomorphology, chemistry, and physical conditions that may be present in a headwater stream in the Allegheny Plateau of westernmost Virginia will likely differ significantly from the characteristics of a headwater stream in the Piedmont region. Though these streams may fall into the same stream-order category as delineated in this planning document and have multiple overlapping habitat characteristics, recognizing their inherent differences is crucial to understanding the ecological systems and species that they support, and the actions that are necessary to conserve, protect, or restore them.

While recognizing this extensive variability across the Commonwealth, this portion of the Wildlife Action Plan describes in very general terms the habitat conditions likely to be present within the waterbodies as broken out by stream order and tidal versus non-tidal influence. Although this categorization can be useful for planning purposes on a general scale, it is important, if not critical, to recognize that an overly

generalized description of aquatic resources has drawbacks and limitations. The following categorical descriptions of freshwater habitat should be viewed in this context as such. When making decisions about protection, enhancement, or restoration of freshwater systems, the specifics of any given

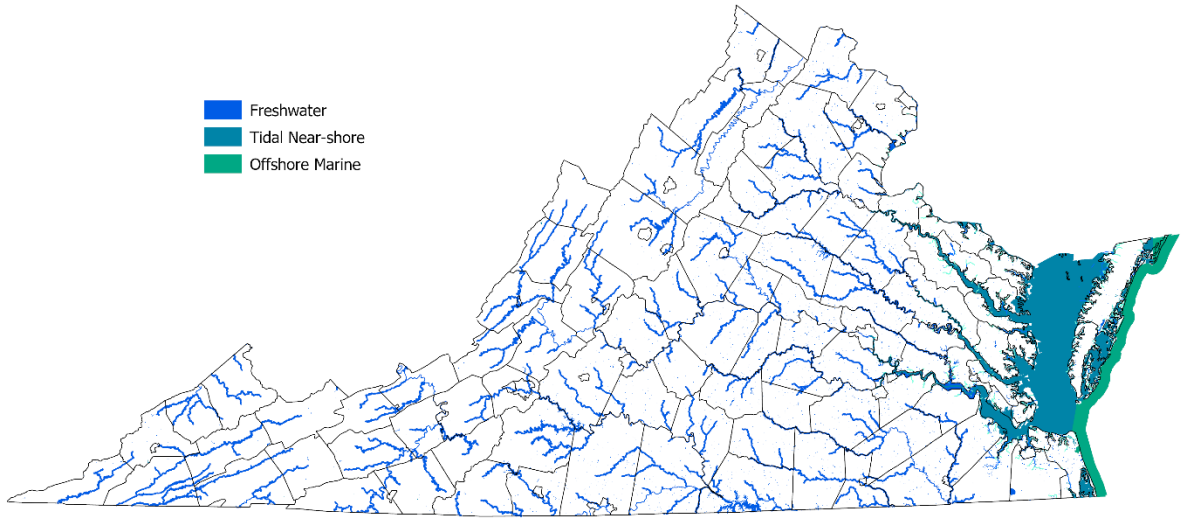


Figure 3.7. Fresh and Saltwater in Virginia

waterway need to be fully examined and considered. Habitat variability in nature is extensive, and it is valuable to recognize this when considering management objectives and associated actions.

Programs that offer assistance in implementation of conservation practices for freshwater systems overlap in many cases for the below habitat types, whereas others have very site-specific focus. The qualification requirements of such programs tend to be based on either past or current land-use (e.g., mining, agriculture, or urban development), the presence or absence of a particular species or aquatic community (e.g., eastern brook trout (*Salvelinus fontinalis*), candy darter (*Etheostoma osburni*), or James spinymussel (*Parvaspina collina*), or the receiving stream or waterbody (e.g., the Chesapeake Bay or an impaired stream with a Total Maximum Daily Load plan. Non-governmental agencies and local, state, and federal government agencies provide a range of funding opportunities and technical-assistance programs to facilitate conservation actions across Virginia. For example, the Chesapeake Bay Foundation supports BMP implementation in the Bay watershed; local governments assist with implementation of urban-stormwater BMPs; Virginia DOF supports a riparian-buffer easement program; Virginia DEQ coordinates the Coastal Zone Management Program; NRCS has a multitude of programs that address agricultural practices to protect water quality; Virginia DWR, the Chesapeake Bay Program, USFWS, and NOAA all have programs that support fish passage and other aquatic-connectivity efforts, including barrier removal, aquatic-organism passage construction, and road-crossing retrofits. Additionally, many of the rivers in Virginia have very active "Friends of . . ." groups that promote and facilitate conservation in their respective watersheds. Depending on the particular watershed, land use, species present, and a variety of other factors, there are likely to be opportunities available for technical assistance and/or funding to implement conservation practices on any given waterway. The best initial step to obtaining such information is to seek contact information online for these non-governmental, local, state, or

federal government organizations, based on proximity to the site, species present, or on the nature of the issue or the land use.

Headwater Streams



Headwater Stream - Rapidan WMA

Headwater streams in Virginia are diverse in both physical and chemical attributes depending on the geographic region (mountain, valley, or Piedmont) from which they originate. These diverse habitat features lead to various communities of aquatic species that inhabit Virginia's headwaters.
Virginia's geographic mountain ranges (Blue Ridge, Ridge and Valley, and Appalachian Plateau) are home to headwater streams often inhabited by coldwater to coolwater species. These streams originate at higher elevations as freestone streams with highly erosion-resistant geologies (including granite, quartz, and greenstones) in the Blue Ridge and sedimentary sandstone for the Appalachian Plateau and ridges of the Ridge and Valley. Streams are confined laterally by steep, narrow valleys and dissipate energy longitudinally resulting in stair-step plunge pools intermixed with short rapids and runs. Large, course substrates of boulder, cobble, gravel, bedrock are dominant with some finer sediments in low-velocity areas. Gradient is typically steeper than most other lotic systems in Virginia ranging from 2% to 5% but can exceed 10% in some instances. Summertime water temperatures range from cold (<20°C) to moderate (>20°C to <24°C). The lack of carbonate rocks results in nutrient-poor, low-conductivity water (i.e. soft water), low buffering ability, and a pH that is slightly acidic. Because sunlight is limited due to the heavily forested canopy, the base of the food web in headwater streams is allochthonous input from plant material (i.e. leaves and woody debris). Many of the headwaters in the mountains of Virginia are located on federal and state lands where conservation practices are likely to be implemented; therefore, most have healthy canopy cover and riparian areas. However, some headwater stream reaches on private lands may be exposed to practices that could be detrimental to stream processes and aquatic organisms.

Headwater mountain streams contain species that are specifically adapted to this type of environment. Because headwaters are highly dynamic systems prone to catastrophic disturbances, species inhabiting them are excellent at recolonizing habitats compared to many lowland species. For instance, the fusiform shape and behavior of the eastern brook trout (*Salvelinus fontinalis*) allows it to negotiate upstream over small cascades and falls to reach unoccupied stream reaches. The winged adult stage of many aquatic insects can fly to new upstream reaches regardless of barriers. Because headwaters are

low-productivity systems, species are especially adapted to survive on low-quality and low-quantity food items, which is accomplished by having slower metabolisms and smaller sizes than lowland species. Colder water conditions throughout the year contribute to this metabolic state.

Two main sources of pollution, point and nonpoint, occur in Virginia. Point-source pollution originates at a known, specific location, such as an outlet pipe entering a stream. In contrast, non-point source pollution can originate from disperse locations across the landscape, including stormwater from roads, sediment from logging or development, and nutrients from livestock farming. While headwater streams can be altered by both of these, non-point source pollution is more common and can usually be attributed to land use practices. Without the effective implementation of BMPs, logging and road development can significantly alter stream habitat and, in turn, impact aquatic organism populations. Although recent research has indicated a potential slight improvement, acid deposition from industrial sources of SO_2 and NOX emissions on mountain headwaters streams continues to be a concern. Mining occurs around headwater streams in southwest Virginia, which may cause elevated selenium levels in some fish species. High selenium levels can lead to spine, fin, and skeletal deformities during early life stages of fish.

Many valley headwater streams originate from groundwater sources such as springs and seeps. In contrast to montane streams, valley streams have high levels of carbonate from sedimentary limestone and dolomite geologies. Coldwater species can only occur for short distances in these streams before conditions transition to suit warmwater species. By not being confined to steep valley walls, these streams are able to meander laterally and can overflow into their adjoining floodplains. The result allows for a variety of habitats, including deep, wide pools; long riffles; and shallow runs. Gradient is usually lower (0.5% to 2%) and velocities slower than mountain headwater streams. Summertime water temperatures range from coldwater (10°C) at the spring mouth to warmer (25°C) downstream. The increased concentration of anions from carbonate rocks results in water chemistry consisting of high pH, high conductivity (i.e. hard water), and high buffering ability. These conditions lead to streams with high productivity and nutrient levels, which support abundant population of aquatic species. Compared to mountain streams, finer substrates of sand, gravel and cobble can be dominant in valley streams. Composition of these substrates are dependent upon the surrounding geologies and sources washed down from nearby streams. In areas with land-use disturbance, fines of silt and clay may cover courser substrate.

The geographic range known as the Piedmont is the largest physiographic province in Virginia and contains headwater streams and smaller tributaries that feed larger rivers. These streams are mainly moderate to low gradient, slow velocity with cobble, gravel, and sand-dominated substrate. Summertime temperatures in Piedmont streams usually range from 25°C to 35°C. Due to the geology, Piedmont headwater streams are typically neutral to slightly basic.

Valley and Piedmont streams face potential impacts from both point-source and nonpoint-source pollution including impervious-surface and agricultural runoff and industrial- or municipal-wastewater discharges. These sources of pollution drive changes in the chemistry, hydrology, sediment, and biota in the receiving stream. Additional habitat impacts include land-use practices such as removal of riparian

vegetation and canopy cover that can result in increased channel-bed sedimentation, increased turbidity, and warmer stream temperatures. All headwater streams are vulnerable to non-native floral and faunal invasive species, riparian habitat degradation, and loss of connectivity due to dams and road crossings.

Potential conservation actions to benefit headwater streams include protection of springs; establishment and enhancement of riparian buffers; implementation of BMPs for logging, agriculture, and other land-disturbance activities; mitigation of acid-mine drainage or acidification from atmospheric deposition through liming; and replacement of road-crossing barriers with structures that provide full aquatic organism passage.

Creeks & Rivers

The Valley and Piedmont creeks and smaller rivers serve as an important transitional zone connecting the forested headwaters of the Commonwealth to the larger rivers flowing towards the coast. These often-overlooked resources are far from inconsequential as they are the capillaries that carry the lifeblood for the larger rivers, coastal areas, and the Chesapeake Bay. These waterways are used for recreational and commercial angling, paddle sports and boating, and water withdrawal, and are home to a myriad of flora and fauna.

Virginia's warmwater creeks and small rivers meander their way throughout much of the Commonwealth, flowing through urban, suburban, rural, and wilderness areas. These gently sloped, lotic systems mainly consist of slow-moving, deep pool sections coupled with faster-flowing, shallow riffles and runs. Adjacent terrestrial habitats range from heavily forested, to tree-lined, to none. Substrate can include sand, silt, clay, gravel, cobble, boulder, and bedrock, and the amount of siltation over the substrate can be heavily influenced by surrounding land use. Creeks typically exhibit average levels of dissolved oxygen that rise and fall with habitat changes such as turbulence in shallow riffles or at varying water depths within pools. Turbidity can range from very clear to very turbid depending on land use and substrate type. Temperatures range from 20-30° C in the summer months. Submerged aquatic vegetation growth also increases within these resources in comparison to the headwater streams. Native species like water stargrass (*Heteranthera dubia),* wild celery (*Vallisneria americana*), and American water-willow (*Justicia americana*), among others, are common across the Commonwealth.

As water temperature increases, so too does the diversity of aquatic fauna. Unlike the headwater streams, which typically harbor only a small number of fish species, the creeks and smaller rivers harbor a variety of minnow, sucker, sunfish, and catfish species. Unfortunately, anthropogenic threats to these waterways increase within these reaches as well. Stream-channel and riparian-zone manipulations such as straightening, tile draining, and or livestock grazing/access often cause unnatural flow regimes, thermal stress, sedimentation, increased nutrient loading, and poor water quality. These changes can affect the habitat and the biota in a range of ways including shifts in aquatic-vegetation type and abundance, increased intensity of algal blooms, reduced spawning habitat due to embedded gravels,

altered macroinvertebrate-community composition, and increased levels of disease and/or mortality in fish communities.

Warmwater streams are heavily impacted by both point- and nonpoint-pollution sources. Point-source pollution include industrial- and municipal-wastewater discharge. Nonpoint-source pollution examples include runoff from urban development, certain agriculture, and mining practices. Common impacts on Virginia's warmwater streams from these pollutant sources and land use activities include sedimentation, changes in aquatic vegetation, algal blooms, increased nutrient loads and contaminant levels, as well as increased levels of disease in fish communities.

Within the more rural areas of the state, efforts to improve the health of Virginia's low-order streams should include constructing fences to exclude livestock from accessing streams and installing offsite water sources; riparian area restoration through maintaining buffer zones and planting native grasses, forbs, shrubs, and trees; utilizing streambank- and channel-restoration practices to return impacted streams to a more natural state; managing and treating stormwater runoff appropriately; minimizing fertilizer and pesticide use and application, utilizing erosion control barriers; removing aquatic organism barriers such as dams and culverts; and limiting and properly mitigating point-source discharges. Conserving established riparian areas from degradation is paramount for the future health of Virginia's small rivers and streams.

Similar efforts should be implemented for more developed, urban areas of the state; however, these areas have the additional stressor that results from an increase in impervious surfaces which adds to the intensity of runoff events. These events result in increases in sediment, chemicals from roadways and parking lots, pesticides and nutrients from lawns and gardens, heavy metals, and thermal pollution impacting the waterway. Localities should focus on curbing the use of pesticides and fertilizers used on yards, golf courses, and parks. Efforts should be made to increase water infiltration by reducing the amount of impervious surface within the watershed. Additional remediation efforts to be considered include converting to permeable-pavement options, creating stormwater-retention areas, utilizing green roofs and rain gardens, and reducing the use of road salt. Developers should focus on controlling construction site runoff from entering waterways through the use of silt barriers and retention ponds, and existing developments should seek out innovative ways to protect, improve and/or restore their local terrestrial and aquatic habitats.

Big Rivers

Virginia boasts numerous large, non-tidal riverine ecosystems supporting diverse mosaics of lotic habitats throughout several physiographic provinces, each resulting from a unique blend of watershed attributes, flow regimes, and physical habitat features influencing species assemblages. Chesapeake Bay drainage rivers (Shenandoah, Rappahannock, James, and Appomattox) share many attributes and function largely on a regional scale with respect to climactic conditions, flow, and fisheries recruitment mechanisms. Historically, many of these rivers were used extensively for navigation above the fall line, and various canal and lock systems were constructed to facilitate that use. Currently, recreational use is high for motorized and non-motorized watercraft alike, and some rivers have excellent options for river

trips or “floats” with a plethora of access sites; while others, such as the Rappahannock, have limited ingress. Recent, significant hydrograph changes, including increased prevalence of record-breaking high- and low-flow events, have resulted in highly variable recruitment of recreationally and commercially important fish species. Declines in certain Centrarchid populations (e.g., Rock Bass, Smallmouth Bass) may be linked to gradual warming temperature trends as well as this flow variability.

Efforts aimed at mitigating previous anthropogenic actions have resulted in the removal of a number of



James River - James River WMA

some the most dramatic habitat-altering features – impoundments – as efforts are made to restore riverine connectivity (e.g., Boshers Fishway, James River 1999; Embrey Dam removal, Rappahannock River 2004). However, flows of many reaches are still controlled by numerous power plant operations and their associated in-river structures. Much of the impetus for dam removals has centered on restoration of spawning habitat for anadromous fish, but most populations have failed to respond thus far. The benefits of dam removal extend beyond the passage of anadromous fish, though, and include the restoration of riverine hydrology, sediment transport, and hydraulics, all of which directly impact the aquatic habitat upon which resident fish and freshwater mussels rely.

Typical substrates west of the Piedmont include bedrock, large boulder, and cobble amidst Class II and III rapids, while many reaches within the Piedmont transition to wider, shallower, and sandy-bottomed channels. Aquatic vegetation, both native and non-native, is common and provides habitat for aquatic species as well as semi-aquatic and terrestrial organisms using rivers for various life-stage functions (e.g., waterfowl feeding). Nuisance aquatic vegetation blooms, including harmful algal blooms (HABs), many of which are fueled by cyanobacteria, have become more prevalent in recent years. These blooms can impact human and animal health and often lead to public health warnings to limit contact with water. Precursor nutrient enrichment fueling HABs and other deleterious aquatic effects have resulted in establishment of Total Maximum Daily Load (TMDL) designations by Virginia Department of Environmental Quality (DEQ) in an attempt to reduce negative impacts. Fish consumption advisories for

mercury and polychlorinated biphenyls (PCBs) are common. Emerging contaminants, such as perflourooctane sulfonic acid (PFOS) and perflourinated alkylated substances (PFAS) that are commonly used in non-stick and stain-resistant consumer products, food packaging, fire-fighting foam, and industrial processes, are causes for concern in large rivers, as bioaccumulation, toxicity, and environmental effects of these and other, similar substances are poorly understood.

Western mainstem rivers in the Appalachian Plateau and Valley and Ridge Provinces draining the Tennessee River tributaries of the Clinch, Powell and Holston rivers support many rare and listed endemic species. Current impacts and historical legacies of coal mining and natural gas extraction operations in these watersheds have often left the fauna in peril. In the North Fork Holston River, industrial pollution from the first half of the 20th century decimated the aquatic species and resulted in mercury contamination and fish consumption advisories. In some reaches of the Virginia's Tennessee drainage, water quality conditions have sufficiently improved to conduct restoration efforts, including species augmentation and reintroduction.

Most mainstem rivers in Virginia flow predominantly through farmland but also receive stormwater runoff and municipal and industrial effluents from towns and cities along the river valleys. Non-tertiary treated discharges pose a threat to the aquatic system primarily due to their nutrient content, but "emerging contaminants" such as endocrine disruptors, other pharmaceuticals, and PFOS/PFAS are also a significant concern and warrant further research. Threats from streamflow alteration due to water withdrawals or dam releases can also significantly impact water resources.

Though direct conservation actions (e.g., stream restoration, bank stabilization) on mainstem rivers can be difficult given the magnitude of the system, conservation actions taken throughout a river's entire watershed will likely benefit the mainstem. These actions include implementation of agricultural and urban BMPs intended to minimize nutrient loading and moderate hydrograph response to storm events. Similarly, riparian buffer establishment, protection, and enhancement throughout the watershed will filter nutrients and reduce sedimentation. Removal of dams should be pursued whenever feasible to address impacts that these structures present to aquatic-organism passage, hydrology, water temperature, and habitat. The Virginia Department of Environmental Quality (with support of DWR staff) aims to prevent alteration of the instantaneous flow in all rivers, regardless of size, by more than ten percent. These on-going efforts are critical to ensure that streamflow alterations result in minimal impacts to aquatic life.

Tidal Headwater Streams

Interposed on the west by Virginia's Piedmont and to the east by the Atlantic Ocean and the Chesapeake Bay, streams within the Coastal Plain of Virginia often have transitional areas known as the fall zone. It is within this fall zone that gravity-fed systems lose elevation and become undulating bodies of water that ebb and flow in conjunction with the tide cycles of the Atlantic Ocean. This natural feature commonly results in tidal headwater streams that contain distinctive sections, which can be generally classified as slow backwater swamps; low-gradient streams; and tidal estuarine waters. While these habitats are complex individually, and occasionally exist in homogeneity as a singular system, most tidal headwater

streams are comprised of a longitudinally dynamic network of each of these habitats, resulting in aquatic ecosystems that are the most ecologically diverse in Virginia

Swamps and wetland sections of Virginia's tidal headwater streams occur in areas with minimal slope and are often found in locations that have been dammed by beaver or impounded by anthropogenic activities. These locations are predominantly stagnant, can be characterized by varying levels of tree cover, and contain several species of submerged aquatic plants. Many of these habitats are found in locations with silicious geology, resulting in substrates comprised of silt, mud, and detritus with tannic waters that are often uniformly shallow in depth, high in acidity, low in conductivity, and very low in dissolved oxygen. While lethal to most species of fish, maintaining such parameters within tidal headwater streams is essential to protecting the endemic fishes that have adapted the feeding strategies, habitat needs, and reproductive processes to thrive in this environment.



Dragon Run Photo Credit: Connie Lapallo

Within the low-gradient, flowing sections of Virginia's tidal headwater streams, areas with higher discharge velocities have substrates comprised of cobble and gravel. As these systems meander and lose energy, finer suspended particles fall from the water column, and features such as runs and pools become dominated by sandy substrates. As the stream moves through these areas, it tumbles over rock formations, root structures, downed logs, and other important features that elevate dissolved oxygen levels. While stream temperatures and acidity are often comparable to swampy sections, the elevated oxygen levels and interstitial spaces in the substrates allows for an entirely different community of benthic macroinvertebrates to thrive. In response, the fish assemblage endemic to such environments possesses trophic, habitat, and reproductive niches that are dependent on the viability of these physical and chemical parameters.

Estuarine areas of Virginia's tidal headwater streams are under the constant natural pattern of receding and advancing tidal waters. Water chemistry at these locations varies immensely based on the strength of the tide, the size of the watershed, and recent precipitation trends occurring upstream. Substrates in estuarine areas are most often sand, silt, or mud. Because the habitats in this environment can alternate

from optimal to lethal for a given species multiple times per day, aquatic life within this environment is often nomadic. Fish assemblages within estuarine areas may have needs associated with saltwater, brackish, or freshwater requirements, and each may be present at different times of the year.

Virginia's tidal headwater streams provide an environment for an impressive diversity of ecological roles, allowing thousands of species of aquatic animals and plants to survive. Although important distinctions between microhabitats in this environment exist, many factors are collectively influenced by anthropogenic activities – both beneficial and detrimental. Major threats to tidal headwater streams include deforestation and anthropogenic development. Even if not occurring in close proximity to the stream, it is possible for such activities to alter the natural hydrologic function of an area, exacerbate sedimentation, increase thermal pollution, and increase point-source pollutants. An increasingly common threat to tidal headwater streams is the volume of water utilized in agricultural and municipal water intake systems, which alters flow patterns and has been documented as entrapping and entraining significant numbers of at-risk fish species. Not unique to tidal headwater streams, ubiquitous impacts from changing environmental conditions, invasive species, and land subsidence also exist. Promoted activities that may increase the resilience of habitats within tidal headwater streams include conserving contiguous tracts of undeveloped area, expanding riparian buffers, reducing existing development within floodplains, and preserving the natural heterogeneity of these dynamic habitats. Mitigation activities are largely unsuccessful in recreating the natural processes of this environment once they are disturbed, and therefore the conservation of what currently exists should be paramount to other alternatives.

Tidal Creeks & Rivers

Meandering throughout the low-elevation Coastal Plain of Virginia is a network of tidal creeks and rivers that serve as an intermediate link between smaller headwater environments and the expansive tidal ecosystems at their confluence. These dynamic estuarine systems act as a conduit for rhythmically fluctuating tidal flows which are characterized by an interplay of fresh and saltwater conditions. Aquatic habitats in tidal creeks and rivers can vary tremendously, as low-tide conditions often result in the active channel being at least partially dewatered, while incoming tides regularly produce water levels that spill out across expansive floodplains, creating diverse aquatic habitats throughout the inundated mosaic of grasslands, marshes, and forests that surround them. In these ever-changing conditions, aquatic biodiversity thrives, and the complexity of tidal creeks and rivers provide unique habitats for an array of plant and animal species which have adapted to persist along with the fluctuating water chemistry, substrates, and cover types of the environ.

The water chemistry of tidal creeks in Virginia is influenced by natural processes and anthropogenic sources. As with big tidal rivers, precipitation and tidal cycles are important drivers of water chemistry in tidal creeks and small rivers. Salinity levels fluctuate daily with tide cycle and over longer periods, with precipitation and freshwater inputs from upstream. Salinity also varies spatially, with creeks lower in the watershed undergoing higher magnitude fluctuations than those located further upstream.

Land use and habitat distribution within tidal creek sub-watersheds influence water chemistry on finer scales. Urban and agricultural runoff alter nutrient loads and may have bottom-up influences on creek

productivity. Groundwater seepage and inputs from tidal headwaters naturally influence nutrient loads and may alter pH, depending on regional differences in geology. Freshwater inputs from precipitation and runoff increase turbidity, by increasing suspended solids and sediment loads. These inputs are driven in turn by precipitation within the watershed and vary inter- and intra-annually. Spatial and temporal variability in water chemistry plays a significant role in shaping aquatic communities and the overall ecological functioning of tidal creeks.

Tidal creeks in Virginia face similar threats as tidal headwaters and large rivers, including development, pollution, and fish passage barriers. Urbanization is primarily a threat to larger creeks and those proximate to population centers. Runoff from non-porous surfaces and discharge from municipal wastewater treatment plants causes nutrient loading, sedimentation, and temperature increases, all of which can decrease habitat quality or suitability for aquatic species. Similarly, agricultural development increases inputs of fertilizers and pesticides, which directly impact nutrient cycles and productivity. Placement of riprap, seawalls, and bulkheads to protect industry and private property lead to loss of habitat, habitat fragmentation, and ultimately a decrease in resilience to disturbance. Water diversions for irrigation and industry alter natural hydrology, floodplain dynamics, and temperature regimes.

Barriers to fish passage, such as dams and culverts, are common in tidal creeks. These barriers restrict migration, limiting spawning habitat availability and thereby hindering recovery efforts for anadromous species, such as shad and herring. Collaborative efforts of federal and state partners have been successful in removing dams and replacing culverts, increasing habitat connectivity and opening miles of potential spawning habitat.

Saltwater intrusion from rising sea levels, increased water temperatures, and altered precipitation patterns caused by changing environmental conditions pose a significant, long-term threat to Virginia's tidal creeks. Salinity levels may increase in some creeks to the extent that they become unsuitable for freshwater or estuarine species, regardless of tidal cycle. Water temperature is an important reproductive cue for many species, including SGCN such as Atlantic sturgeon and American shad. Changing water temperatures have already altered migration timing for both of these species; further increases are likely to continue impacting migratory cues and river residence, to unknown effect. Similarly, changes in the frequency and magnitude of rain events will impact erosion, water quality, and water chemistry, impacting habitat suitability for aquatic species.

Threats to tidal systems will be compounded by the recent change in the definition of "waters of the United States" in the Clean Water Act. Wetlands had previously been subject to federal regulation under the Clean Water Act based on connectivity to navigable waters. The U.S. Supreme Court revised this definition in 2023, removing waterbodies lacking perennial flows. Tidal systems are dynamic by nature and include countless ephemeral and intermittent creeks and wetlands. Changes in precipitation patterns predicted by climate models may further impact flows and connectivity. Unregulated development of these areas will compound existing threats, alter hydrology, and greatly reduce resilience.

Recommended conservation actions for tidal creeks and rivers are similar to those of tidal headwater streams, though these habitats are typically less developed than tidal river mainstems. Conserving undeveloped tracts of land, expanding riparian buffers, and preserving wetlands are among the highest priorities to improve water quality and maintain resilience. New or replacement infrastructure should incorporate design elements that minimize in-stream footprints and bare hardscape. Riparian buffers and livestock exclusion on agricultural lands would limit nutrient and pesticide inputs, reduce the erosion that necessitates bank stabilization, and create higher quality shoreline habitat for aquatic fauna. Similarly, increasing riparian buffers on non-agricultural lands would reduce erosion and sedimentation and increase habitat quality. Efforts to remove dams and replace road-crossing barriers should be a priority. Water-intake and diversion permits should take long-term flow and climate trends into consideration.



Chickahominy River - Chickahominy WMA

Big Tidal Rivers

Virginia's tidal rivers are delineated by the Fall Line, the boundary between the Piedmont and Coastal Plain physiographic regions along much of the East Coast. The transition is characterized by a sharp increase in gradient, caused by differential erosion between the bedrock-dominated Piedmont and the softer sediments of the Coastal Plain. In Virginia, the Fall Line is marked by series of rapids in the James River at Richmond and in the Rappahannock River at Fredericksburg, where elevation drops 100 feet or more over several miles to reach sea level. The York River watershed is relatively small and the mainstem extends only 50 km inland before branching into the Pamunkey and Mattaponi Rivers. Small tributaries to the Mattaponi and Pamunkey Rivers cross the Fall Line further inland and generally lack the rapids and steep gradients characteristic of other systems.

Tidal rivers are dynamic systems characterized by wide channels, perennial flows, and a semidiurnal tidal cycle. Below the Fall Line, tidal rivers cut deeper channels through soft sediments along a low gradient before widening out. Habitat distribution along the tidal river gradient is defined by the interaction between freshwater inputs from precipitation and upstream sources and saltwater intrusion from the Chesapeake Bay. A salt front forms where freshwater and saltwater meet, and less dense freshwater flows on top of a layer of saltwater. Mixing occurs along the salt front and creates a gradient of salinity zones, transitioning from mesohaline to oligohaline and ultimately to tidal fresh water. The location of salinity zones differs among rivers, depending on position within the Bay watershed, bathymetry, and channel features. Within each river, salinity zones shift with tidal cycle, precipitation, flow rate, and wind.

The substrate consists of a complex mix of sediments, rocks, and organic matter. In the lower reaches where tidal influence is stronger, fine sediments such as silt and clay dominate in the river channel while sand is found along the shoreline. Coarser materials like sand and gravel are more prevalent in the tidal fresh reaches below the Fall Line. Natural and artificial structures provide essential cover for aquatic organisms. Downed trees and root wads from riparian forests and large, woody debris flushed downstream during high flow events create complex habitats along river margins. Underwater structures such as piers, sunken barges, docks, and channel markers provide structure in a range of depths and distance from shore. Both natural and artificial structure offers flow refugia, cover, and breeding areas for diverse aquatic communities.

Tidewater habitats are predominantly a mix of emergent and forested wetlands, where they have not been developed. In tidal fresh and oligohaline reaches, wetlands are common along inside river bends in shallow coves and sloughs. Arrow arum (*Peltandra virginica*), spatterdock (*Nuphar advena*), wild rice (*Zizania aquatica*), and pickerel weed (*Pontederia cordata*) dominate these areas and provide high quality nursery habitat to aquatic species. In mesohaline zones, wetlands are dominated by a few species of salt-tolerant grasses, including saltmarsh cordgrass (*Sporobolus alterniflorus*), black needle rush (*Juncus gerardii*), and saltmarsh bulrush (*Bolboschoenus maritimus*). Wide mudflats border the channel in downstream reaches providing foraging for benthivores and detritivores during high tides and birds during low tides.

Tidal river habitats in Virginia face a myriad of threats, including conversion or outright loss, invasive species, pollution, changing environmental conditions, and sea-level rise. The mainstem reaches of the James, York, and Rappahannock rivers are heavily impacted by industry and commerce, altering the historic floodplain and flow regimes. Regular dredging operations, river bend cutoffs, and water diversions to support mining operations and ports have permanently altered the floodplain. Bank stabilization protecting homes, factories, energy infrastructure, and parks further restrict natural hydrological processes. Industrial discharge, water intakes, agricultural runoff, urban stormwater runoff, and sewage effluents contribute to nutrient enrichment, sedimentation, and contaminant accumulation, compromising water quality and habitat suitability. Shoreline development, urbanization, and agricultural lands have reduced floodplain connectivity and encroached on wetland habitats, limiting resilience to storms and flood events. Invasive species, such as northern snakehead, blue catfish, and

flathead catfish, along with introduced sportfish, such as largemouth bass, have disrupted tidal systems by outcompeting and predating on native species.

Recommended conservation actions for large tidal rivers include land conservation, infrastructure upgrades, and riparian buffers. Land adjacent to the mainstem James, York, and Rappahannock rivers is heavily developed by industry and agriculture but undeveloped tracts have been conserved by tribal, federal, state, and local government entities. Supporting tribal landback efforts, direct land purchases, and conservation easements are supported mechanisms for limiting encroaching development. Wetland conservation and restoration are especially high priorities, given their role in increasing resilience. In urbanized areas, upgrades to sewer infrastructure to reduce effluent inputs is a high priority. Incorporating porous surfaces and living shorelines into hardscape features would offer habitat improvements where bank stabilization cannot be avoided. Riparian buffers and livestock exclusion on agricultural lands would limit nutrient and pesticide inputs, reduce the erosion that necessitates bank stabilization, and create higher quality shoreline habitat for aquatic fauna. Similarly, increasing riparian buffers on non-agricultural lands would reduce erosion and sedimentation and increase habitat quality. Water intake and diversion permits should take long-term flow and climate trends into consideration. Virginia is a hub for developing data centers, which require high energy inputs to maintain servers and water intakes for cooling purposes. Data centers are currently considered one of the top water-consuming industries, and development within tidal watersheds is slated to increase over the next several years. Invasive-species control efforts, including commercial fishery development and angler outreach, should continue with the goal of reducing impacts to native species.

Lakes

Clint Morgeson and Jeff Williams, Virginia Department of Wildlife Resources

Virginia has only two natural lakes, Lake Drummond in the cities of Suffolk and Chesapeake and Mountain Lake in Giles County, with the rest of the impoundments within the Commonwealth originating from anthropogenic activities. The two lakes share very few geophysical similarities and are located on opposing ends of the Commonwealth.

Located within the 113,000-acre Great Dismal Swamp National Wildlife Refuge, Lake Drummond is a large open body of water (3,142 acres) and is relatively shallow, at maximum six feet in depth. Roughly circular in shape, Lake Drummond is fed by surrounding marshes and swamps and is acidic; the leaching processes from organic matter give its waters a characteristic stained (blackwater) appearance. Historically, the forested wetland covered more than a million acres in southeastern Virginia and northeastern North Carolina. The area was drained and cleared after European colonization for agricultural land and timber production. Attempts to drain Lake Drummond and turn it into agricultural land by the George Washington-backed Dismal Swamp Company were abandoned in the early 1800s, but timbering operations continued into the 1950s. Drainage canals connect Lake Drummond to the Elizabeth River to the north and the Pasquotank River to the south. The Great Dismal Swamp National Wildlife Refuge was established in 1974 from purchased lands and a nearly 50,000-acre land donation from The Nature Conservancy.

Currently, the water level is controlled by the U.S. Army Corps of Engineers via a lock and system of water control structures in the draining canals/ditches. The lake and surrounding swamp are intensively and cooperatively managed by the U.S. Fish and Wildlife Service along with the Army Corps of Engineers. Much of the substrate is characterized by thick peat deposits, which are vulnerable to fire if not kept saturated. Since Lake Drummond supplies the water levels for the Dismal Swamp Canal, excessive dewatering of the lake must be prevented to maintain stable ecological conditions. No streams directly supply the lake as it is sustained by precipitation inputs from the surrounding swamp.

The ecology of Lake Drummond and the surrounding Great Dismal Swamp has been significantly altered due to the construction of drainage canals, the Great Dismal Swamp Canal connecting the Chesapeake Bay to the Albemarle Sound, and extensive deforestation of historic Bald Cypress and Atlantic White Cedar stands. Further, unmanaged fires have depleted the peat bank and hastened the conversion of surrounding forests to gum/maple-dominated canopies. This succession alters surface water patterns and creates more dry-land habitats within the ecosystem.



Lake Drummond, Great Dismal Swamp NWR

Future threats to Lake Drummond include increasing stochastic climatic events that impact water levels, invasive species infiltration, and watershed development. The lake is largely protected from watershed development, being surrounded by the Great Dismal Swamp National Wildlife Refuge, which also largely comprises the lake's limited watershed. However, water levels must be controlled to maintain lake levels and watershed sediment saturation to preserve the unique geophysical characteristics of the area.

Within the watershed, advanced rates of succession have been established due to the extensive logging of the Great Dismal Swamp. Future conservation actions to correct or mitigate these impacts might include water level manipulation, mechanical removal of late-stage species, and restoration of the historic timber stands, particularly with Atlantic White Cedar and Bald Cypress.

Located near the Town of Pembroke, Mountain Lake is the other of only two natural lakes found in Virginia and is the only natural lake located in the unglaciated southern Appalachian Highlands. The lake



Mountain Lake, Giles County, VA

rests near the summit of Salt Pond Mountain at an elevation of almost 1,800 meters. Estimated to be around 6,000 years old, Mountain Lake has a history of severe lake level fluctuations, and the origin of the lake has been the subject of much investigation. The earliest hypothesis of the lake's origin came in the 1930s and pointed to damming of the valley by a lateral landslide. This hypothesis was later modified in the mid-1970s to suggest that a vertical collapse of a canyon feature in one of the underlying geologic formations was more likely the cause. The presence of a crevice, likely a fault, located in the deepest part of the lake has also been pointed to as a potential area of seepage and water loss. Most recently, during a period when the lake was almost completely drained, four sinkhole-like depressions were observed. These areas had piping holes at their bottoms and sides and subsequent investigations suggested that the piping of lake sediment was the primary mechanism responsible for lake level fluctuations.

Mountain Lake was full for much of the twentieth century but had completely dried up by the fall of 2008. From 2008 to 2020, the lake was only partially filled with water. Since 2020, the lake has refilled to about one-third of its normal volume. The last such period of drastic fluctuations is believed to have occurred between 1751 and 1804, based on historical accounts of widely varying lake size. Researchers now believe that there is a natural cycle to the lake levels in Mountain Lake with extreme lows occurring about every 400 years.

When full, the small, narrow lake covers only about 50 acres and has a maximum depth of approximately 33 meters at the north end of the lake. This deepest point consists mainly of the aforementioned crevice. The remainder of the northern end of lake measures about 24 meters in depth. The Mountain Lake watershed is relatively small, measuring just 321 acres. The lake is fed by cold, underground springs causing the water temperature to typically stay below 21°C at the surface and 8° C at a depth of 15 meters.

The forest surrounding Mountain Lake consists primarily of a mix of upland hardwoods, such as oak and maple, and shows little evidence of harvest in the past seven decades. The only development that has

occurred within the Mountain Lake watershed is the privately-owned Mountain Lake Lodge. The hotel was initially built in 1856 to provide lodging for visitors to the lake. The original wooden structure was replaced in 1938 by the current stone structure, which utilized stone native to the area. Since 1989, the Mountain Lake Conservancy has worked to manage and protect the 2,600 acres of property around the lake.

Ponds

Susan Watson, Virginia Department of Wildlife Resources

Virginia's ponds and seasonally flooded depressional wetlands, the latter commonly referred to as *vernal pools*, are habitat to many obligate and facultative wetland SGCN. Ponds are dynamic habitats with fluctuations of water level depending upon weather conditions and changing climate. There may also be extreme fluctuations influenced by either natural events or human actions.

Vernal pools are isolated depressions on the landscape that fill with water during fall and winter months and dry or significantly decrease in water level during warmer months due to changes in the seasonal rates of precipitation, evaporation, and transpiration. They may be influenced by natural or human activities. In Virginia, vernal pools usually occur within or in the edge of a forested habitat, and they can range in size from just several inches across to a few acres. More detailed descriptions may be found Virginia Vernal Pools and in the Field Guide to the Animals of Vernal Pools.

The importance of vernal pools to many species that use them to breed, such as Ambystoma salamanders, is that the fluctuations in water annually and the usual lack of connection to flowing water systems prevent predatory fish from inhabiting these ephemeral habitats. Ambystoma salamanders (e.g., mole salamanders) are not adapted to coexist with predatory fish that would feed upon their eggs and larvae. Another important characteristic needed for Ambystoma salamanders is a surrounding upland forest habitat that adults use the rest of the year. Most of Virginia's vernal pools can be defined as isolated wetlands above minimal ecological value, according to the Virginia Department of Environmental Quality's regulation of definitions. Most of Virginia's pools are forested, which is one of the conditions in the definition, and some pools also meet some of the other conditions listed.

Vernal pools exist throughout the Commonwealth, with variations in landscape and associated species. Since most vernal pools are quite small (many less than 0.1 acres), they often do not show on wetland inventory maps, and information on historic presence is lacking. Virginia Commonwealth University studied a sample of vernal pools recorded in the greater Richmond area during the 1980s that showed approximately half of them were found to still exist during a rediscovery effort in 2010 to 2012. Among the other half of the pools recorded in the 1980s, about half of those were found to be lost to development or other land use, while the other half simply could not be determined by the past data provided.

Some variations of vernal pools that are used by SGCN species, such as Eastern tiger salamanders and Eastern chicken turtles, include sinkhole and interdunal pool/pond complexes. There are just a few

examples of these known in Virginia, in parts of the Valley and Ridge, the Blue Ridge Mountains, and the Coastal Plain. These are usually relatively deeper and larger than most vernal pools.

All vernal pools may be threatened with destruction/degradation due to development, land use (such as logging), depending on the methods and management of the activity, and changing environmental conditions. Best management practices that include certain buffers to the pool site and select cut timbering of the surrounding forest may help conserve this habitat and its associated species. A good summary about vernal pools, threats, and conservation has been developed by the Appalachian Trail Conservancy. Additionally, Partners in Amphibian and Reptile Conservation (PARC) has a working group to address vernal pool conservation.

Ponds created by damming flowing waterways, with dams constructed by beavers (*Castor canadensis*) or by humans, are another aquatic habitat type in Virginia. Fish species, such as black-banded sunfish, redfin pickerel, and swampfish, are adapted to very low flowing, dark-stained water found in eastern Virginia. These ponds may be forested or open but are often partially forested and partially open. The pond itself often provides a more open area in the long run, as those trees not adapted to surviving in standing water will die off. These wetland meadows that are comprised of emergent and submergent vegetation are beneficial to many SGCN species, including smooth greensnake, wood turtle, and spotted turtle. Beaver ponds occur throughout Virginia and support a variety of SGCN that either permanently or seasonally use these habitats. Human-created ponds, such as dams for mill ponds and farm ponds, can act as a surrogate for natural habitats. However, it is not uncommon for these waters to be stocked with predatory gamefish and only managed for angling, which can be incompatible for many SGCN.

Threats to beaver ponds and similar habitat types include removal of dams and of beavers inhabiting the area. There are also threats to the water quality and associated habitats due to development and incompatible land use practices. While many ponds are in rural areas, there are sites close to expanding roadways and related development. Unfortunately, roads and highways constructed adjacent to these habitats become death traps for wildlife transitioning or migrating between wetlands and upland areas. Introduction of grass carp is another threat to the emergent and submergent vegetation in these habitats, which are needed for the native fish species to thrive. Nonnative plants (i.e. hydrilla) can cause negative impacts by outcompeting native aquatic vegetation.

Maintaining beaver ponds is beneficial to many other species. Ponds decrease the amounts of nutrients and reduce sedimentation thereby helping to improve water quality for aquatic species inhabiting downstream reaches (Kroes & Bason, 2015) and (Bason *et al.*, 2017). Additionally, beaver dams have shown to increase groundwater levels (Feiner & Lowry 2015) and aid in the formation and persistence of wetlands during low and high flow periods (Westbrook et al. 2006).

Non-Tidal Wetlands

Ben Sagara, Virginia Department of Wildlife Resources

Historically, Virginia is estimated to have had just under 1.9 million acres of wetland habitats spread across the state. Following colonial settlement, approximately 42% of Virginia's wetland habitats were

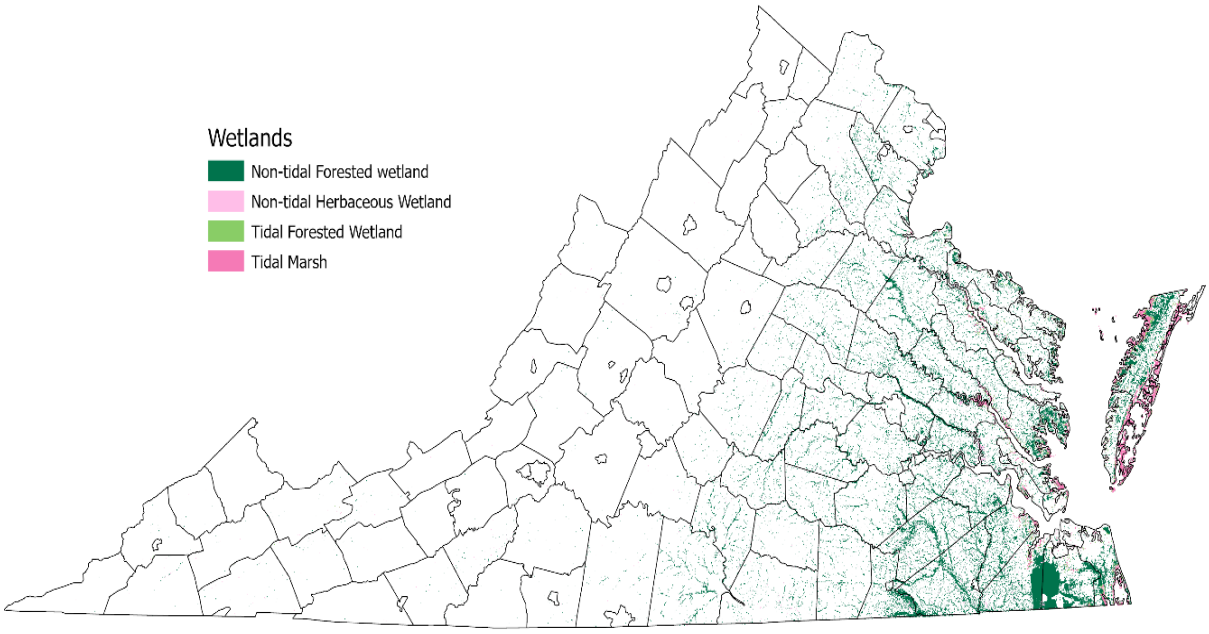


Figure 3.8. Wetland Habitats in Virginia

drained or filled in to support agriculture, silviculture, and development. This widespread landscape alteration led to severe flooding and poor water quality in many Virginia rivers and bays. Several federal and state policies were enacted beginning in the 1970s, including the Clean Water Act and the Virginia Tidal and Non-tidal Wetland Acts, which now protect most wetlands from detrimental impacts. Virginia is now estimated to support only 1.07 million acres of wetland habitats, with approximately 71% located in the Coastal Plain, 20% in the Piedmont, and 9% in the mountainous physiographic provinces. Nearly 75% of Virginia's wetlands are defined as non-tidal freshwater wetlands (Dahl 1990, Tiner and Finn 1986).



Tuckahoe Creek Swamp, Henrico, VA

Non-tidal wetlands cover a diverse array of habitat types including swamps, bottomland forests, wet meadows, marshes, bogs, fens, pocosin, seepages, springs, scrub-shrub thickets, impoundments, vernal pools, and much more. These wetlands are inundated or saturated with freshwater during the growing season long enough to influence soil characteristics and develop distinct vegetative communities. Wetland hydrology is received from either surface water (precipitation, snowmelt, riverine floodwaters) or groundwater (seeps, springs, high groundwater table) inputs, and wetlands can be inundated with water all year (e.g., portions of Coastal Plain Depression Swamps and Ponds) or may only have saturated soils for several weeks in the early growing season (e.g., some Non-Riverine Flatwoods and Swamps). Non-tidal wetlands provide vital fish and wildlife habitat for a great quantity of species, including 488 of Virginia's SGCN. These wetlands trap and store excess sediments and nutrients which is critical to the health of Virginia streams and waterways, including the Chesapeake Bay. Wetlands can also attenuate floodwaters, provide erosion control, stabilize local water tables, serve as an important storage component in the global carbon cycle, and provide endless educational and recreational opportunities.

Inland non-tidal freshwater wetlands, also referred to as palustrine wetlands, are distributed all across the landscape, and vary widely in structure, function, and vegetative composition with changes in hydrology, landscape position, geomorphology, soil composition, underlying geology, climate, and historic disturbance regime. Palustrine wetlands are often broadly defined by their canopy cover as either forested, scrub-shrub, or emergent. Although they are generally found along riverine bottoms and in other low-lying areas, some flat and concave landscape features at higher elevation can perch water and maintain wetland habitats like Appalachian Bogs and Piedmont Upland Depression Swamps. More information on Virginia's natural palustrine wetland communities can be found in the Virginia Department of Conservation and Recreation's Natural Communities of Virginia Classification of Ecological Groups and Community Types for Non-tidal Wetlands in Palustrine Ecosystems. Based on U. S. Forest Service LANDFIRE Vegetation Models, the historic fire regime for non-tidal wetlands has a very broad range depending on the larger vegetative community they are encompassed within. Historic fire regimes could occur as often as a nearly annual return interval in eastern woodland mosaic forests to an over 1000-year return interval for southern floodplain (rare fire) vegetative communities (LANDFIRE 2007).

Common threats to non-tidal wetlands include conversion to developed lands through drainage and/or fill, habitat fragmentation, changes in water level associated with a large increase in impervious services and stormwater infrastructure in rapidly developing watersheds, pollution impacts from stormwater and agricultural runoff, poor silvicultural practices, mowing, conversion to open water through damming, and colonization of aggressive invasive species. Some coastal inland wetlands are being converted to tidal wetlands due to rising sea levels, and increases in intense weather events, including severe storms and droughts, are also impacting wetland hydrology. There are several existing cost share programs, easement programs, and competitive grant programs offered by nonprofit, local, state, and federal organizations that support wetland conservation opportunities for both private and public landowners. Wetland conservation actions include enhanced legal protection through easement or acquisition; restoration on historically drained or otherwise impacted wetlands by plugging ditches, removing drain tiles, removing dams and berms, removing legacy sediments, reconnecting streams to floodplains, and/or regrading of the landscape where wetlands have been filled in or topographically altered;

enhancing existing wetlands through cattle exclusion, erosion protection, supplemental native plantings, maintaining effectively managed impoundments, and invasive species removal; and wetland creation where new wetlands are constructed from non-wetland areas such as impoundments created in uplands or island creation on subaqueous lands.

Nutria are an increasing threat to Virginia's tidal and non-tidal wetlands. This species is non-native and known to cause widespread damage to important coastal marsh systems through feeding and excavating activities. Nutria are endemic to South America but have been translocated throughout the world including the eastern United States. Nutria appear to be expanding their range further north and west, posing a potential threat to valuable wetland systems north of the James River and in river habitats west of the Great Dismal Swamp.

Tidal Wetlands

Ben Sagara, Virginia Department of Wildlife Resources

Historically, Virginia is estimated to have had just under 1.9 million acres of wetland habitats spread across the state. Following colonial settlement, approximately 42% of Virginia's wetland habitats were drained or filled in to support agriculture, silviculture, and development. This widespread landscape alteration led to severe flooding and poor water quality in many of Virginia's rivers and bays. Several federal and state policies were enacted beginning in the 1970s, including the Clean Water Act and the Virginia Tidal and Non-tidal Wetland Acts, which now protect most wetlands from detrimental impacts. Virginia is now estimated to support only 1.07 million acres of wetland habitats, with approximately 71% located in the Coastal Plain, 20% in the Piedmont, and 9% in the mountainous physiographic provinces. Nearly 25% of Virginia's wetlands are defined as tidal estuarine wetlands (Dahl 1990, Tiner and Finn 1986).

Virginia has vast estuarine ecosystems that support a complex network of tidal wetland habitats throughout the coastal plain physiographic province, including seaside bays, Back Bay, and the Chesapeake Bay and its major tributaries. This network of tidal wetlands serves as critical natural infrastructure, protecting adjacent uplands from storm surge, flash flooding, and erosion, trapping and storing excess sediment and nutrient, and serving as an important storage component in the global carbon cycle. Tidal wetlands also provide vital fish and wildlife habitat for 580 of Virginia's SGCN.

Tidal wetland habitats vary in structure, function, and vegetative composition with changes in landscape position, geomorphology, soil composition, underlying geology, salinity, tidal influence, climate, and historic disturbance regime. Tidal wetland communities can broadly be defined by regular (lunar tidal) or irregular (wind-tidal) flooding. These systems are further defined by salinity levels (polyhaline to freshwater). The terms "high marsh" and "low marsh" are used to define distinct habitat types restricted to high or low elevation areas within the intertidal zone (Figure 3.9). The historic fire regime for tidal marshes in the southeast is estimated to range from nearly annual, to up to a 300-year fire-return interval (Frost 1995). Although most tidal wetlands are represented as coastal marshes dominated by herbaceous vegetation with a scrub-shrub fringe along the high elevation edge, tidal wetland habitats can be represented by a range of forested, shrub, and herbaceous dominated communities. More

information on Virginia's natural tidal wetland communities can be found in the Virginia Department of Conservation and Recreation's Natural Communities of Virginia Classification of Ecological Groups and Community Types for Tidal Wetlands in Estuarine Ecosystems.

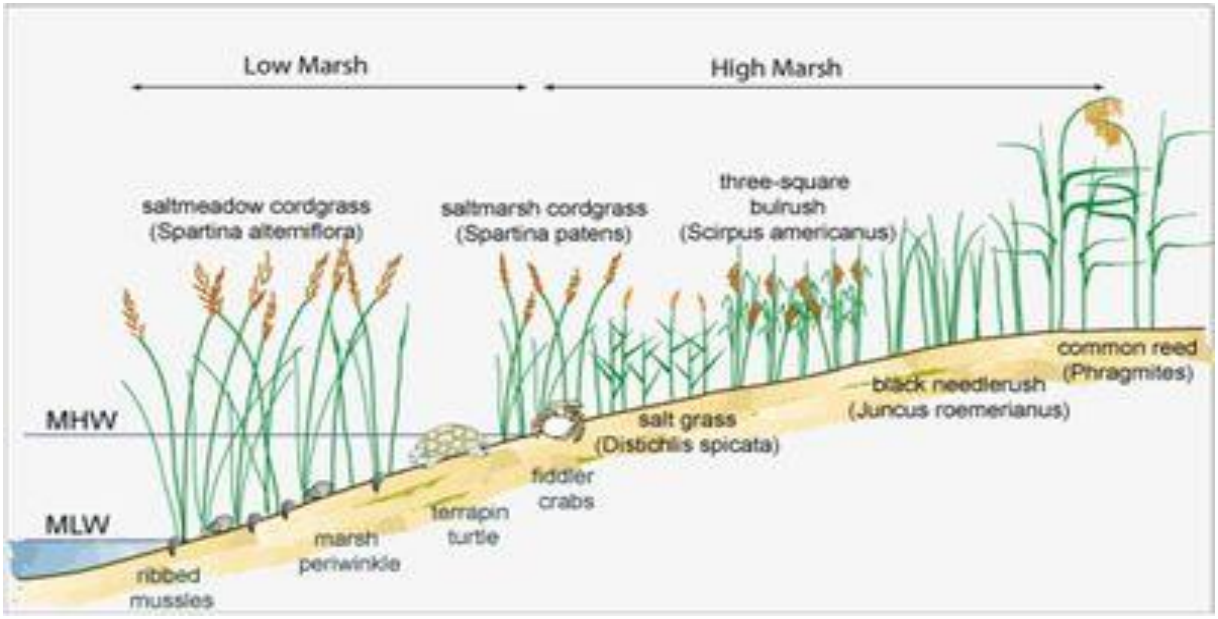


Figure 3.9. Tidal Marsh Structure (Saltmarsh Ecology, Cambridge University Press)

Common threats to tidal wetlands include development-related fill impacts, conversion of native habitat to invasive species (e.g., *Phragmites*), and pollutant impacts from stormwater and agricultural runoff. Many tidal marsh systems within Virginia are also experiencing significant change alongside rising sea levels and more frequent and intense storms. Furthermore, the southern portion of the Chesapeake Bay is experiencing substantial land subsidence, which has caused areas in Virginia to have the highest rates of observed relative sea level rise along the Atlantic Coast. There is a very thin range of elevations able to support tidal marsh vegetation establishment. Many existing low marshes are under substantial threat of drowning in the next few decades from rising sea levels, more frequent storm surges, and prolonged high tides. Natural marsh migration processes can ensure marsh habitats are not completely lost as the landscape changes. Marsh migration occurs when "low marshes" drown, higher elevation "high marsh" vegetative communities convert to "low marsh" vegetative communities, and adjacent even higher elevation uplands begin to regularly flood and transition to "high marsh" vegetative communities. However, much of Virginia's coastal areas are densely populated and developed, so natural processes like marsh migration will come into conflict with many existing human uses and activities (Figure 3.9). This puts Virginia's tidal wetland habitats at an increased risk of experiencing widespread flooding and loss. There is a need to protect existing low marsh to ensure existing quality habitat remains long enough for new quality marsh to establish. There is also a need to identify and protect areas with future marsh migration potential to ensure Virginia maintains vital marsh habitat through time.

Three SGCN, saltmarsh sparrow, eastern black rail, and American black duck, are also flagship species for the Atlantic Coast Joint Venture (ACJV). Where practical, tidal wetland conservation efforts should seek

to enhance habitat for these species, as they occupy a range of coastal marsh habitats that are highly threatened by sea-level rise and urbanization. Efforts aimed at enhancing habitat for these species would also benefit a host of other marsh-dependent fish and wildlife species. Tidal wetland restoration, enhancement, and protection techniques include living shorelines, dune restoration, berm removal, runnels, marsh terracing, thin/thick layer placement, back barrier marsh creation, island creation, and more. There are several existing cost share programs, easement programs, and competitive grant programs offered by nonprofit, local, state, and federal organizations that support tidal wetland conservation opportunities for both private and public landowners.

Estuaries

Margi Whitmore, Virginia Department of Wildlife Resources

Estuaries are dynamic environments, formed over geologic time scales, where saltwater from the ocean mixes with freshwater from rivers. This mixing creates a range of salinity zones that are further influenced by precipitation, wind, and tides. Aquatic and riparian habitats shift with these environmental factors along the continuum from the ocean to head of tide, supporting high biodiversity. Virginia's estuarine habitat is comprised of the northern waters of Currituck Sound and the southern portion of the Chesapeake Bay and its tributaries.

Currituck Sound is part of the Mid-Atlantic Embayed Region stretching from southeast Virginia to North Carolina's Neuse River. This Region consists of a complex of sounds and embayments, including Albemarle and Pamlico sounds, separated from the Atlantic Ocean by a narrow, nearly continuous strip of barrier islands. Formation began within the past 11,700 years with retreating glaciers raising sea level and flooding coastal valleys. Simultaneously, the interaction between high-energy ocean storms and the sediments of the low-sloping Coastal Plain began forming barrier islands. The ocean-facing sides of barrier islands absorb energy from waves, currents, tides, and storms, protecting inland habitats. As a result, the waters of the Embayed Region are uniformly shallow, supporting abundant wetlands and high biodiversity.

The waters of Currituck Sound cross the border from northeast North Carolina into southeast Virginia as two tributaries, the Northwest and North Landing rivers, and Back Bay. The Northwest River stretches northwest towards the Great Dismal Swamp, gradually turning to wetlands. The North Landing River stretches north, connecting to the Elizabeth River via the Intracoastal Waterway and Great Bridge Lock. Back Bay is a large embayment dominated by wetlands along its shoreline and numerous islands. All three waters were formerly influenced by diurnal lunar tides but are now upstream of tidal influence due to the closure of barrier island inlets over time. However, the shallow depths and low-velocity flows characteristic of these systems form unique wind-tidal marsh habitats. Strong winds from the south and southeast blow along the length of Currituck Sound, pushing water northward into Back Bay and the two rivers. Wind-driven currents cause water level variations of up to three feet and irregular salinity regimes that fluctuate from freshwater to brackish. As a result, Back Bay's marshes are a mixture of freshwater and brackish species, supporting diverse wildlife communities and providing critical habitat for migrating waterfowl, shorebirds and wading birds.



Westmoreland SP **Photo Credit: VDCR/VSP**

The Chesapeake Bay is the largest estuary in the United States and lies within the borders of Virginia and Maryland. The Bay first began to form 35 million years ago when a bolide collided with the continental shelf, near present day Cape Charles, creating a crater over 50 miles wide. Sea level was much higher during this period, pushing Virginia's coastline further inland to the west of Richmond and Washington D.C. While the bolide did not create the Chesapeake Bay, it determined where it would ultimately form as sea levels changed. Approximately 18,000 years ago, massive ice sheets covered the continent, reaching as far south as Pennsylvania. With so much water trapped in glaciers, sea level dropped 600 feet lower than it is today, exposing the continental shelf and what would become the Chesapeake Bay. As temperatures warmed, glacier melt formed streams and rivers that cut channels into the landscape, flowing towards the ocean. What is now the Chesapeake Bay began as the Susquehanna River Valley. The Susquehanna River is one of the oldest rivers in the world and the longest river on the East Coast, draining 27,500 square miles. Its headwaters in present-day Pennsylvania and New York created a network of streams and rivers funneling glacial meltwater through Maryland and towards the low-lying crater before draining into the ocean.

The impact crater filled in with soft sediments and compacted over time but the geological differences between the crater and surrounding rock still impact Virginia residents today. Subsidence is a term used by geologists to describe the gradual sinking of ground due to shifting underground materials. As the soft sediments filled in the crater and compacted, subsidence slowly caused the surrounding land to shift and move towards the crater. Today, this process has been tied to land instability and aquifer disruption and may be responsible for the high rates of sea level rise near the mouth of the Bay. A more visible effect of subsidence can be observed in the unique channels of the James and York rivers. Whereas the Potomac and Rappahannock Rivers flow steadily southeast into the Bay, the James and York Rivers have sharp turns to the northeast near their mouths, reaching towards the impact crater.

This, in turn, affects the hydrology and water chemistry of the estuarine portions of these rivers up to the Fall Line.

The Fall Line is a significant geological feature that marks the boundary between the Piedmont and Coastal Plain physiographic regions along much of the East Coast. In Virginia, the Fall Line runs roughly from Alexandria through Richmond to Petersburg and is characterized by a drop in elevation, leading to the formation of rapids. This transition zone delineates the upper limit of estuarine environments (head of tide) in Bay tributaries and marks a shift from the shallow, bedrock-dominated rivers of the Piedmont and the deep, soft-bottom streams of the Coastal Plain. The geology of the Fall Line influences the hydrology, water chemistry, and sediment distribution in the estuary below.

The Chesapeake Bay is characterized by a semidiurnal tidal cycle and fine sediment substrates. Habitat distribution throughout the Bay and its tributaries is driven by the interaction between freshwater inputs from rivers and saltwater intrusion from the Atlantic Ocean. A salt front forms where freshwater and saltwater meet, and less dense freshwater flows on top of saltwater. Mixing occurs along the salt front and creates a gradient of salinity zones, transitioning from polyhaline ocean water to mesohaline, oligohaline, and ultimately to tidal fresh water in Bay tributaries. The location of salinity zones differs among tributaries, depending on position within the Bay watershed, bathymetry, and channel features. Within the Bay and its tributaries, salinity zones can shift with tidal cycle, precipitation, flow rate, and wind.

Dynamic environmental conditions heavily influence habitat distribution, and the flora and fauna found there. In the lower estuary, beaches and coastal wetlands makeup most of the undeveloped shoreline. In shallow waters, submerged aquatic vegetation provides nursery habitat, refuge, and abundant food for fish, invertebrates, and birds. Eelgrass beds are important habitats for blue crabs, providing protection from predators and ample forage. Open water habitats historically supported vast oyster reefs. Habitat degradation and intense harvest decimated oyster populations but restoration efforts are working to reverse the trend. Oysters are a keystone species, and established reefs not only create habitat for fish and other invertebrates but also contribute to improved water quality through filter-feeding. Upper estuary habitats include emergent wetlands, forested wetlands, and mudflats that provide habitat and forage for abundant and diverse aquatic life.

Virginia's estuaries are complex and dynamic systems shaped by geological features, hydrological processes, and human development. Estuaries support high biodiversity and provide abundant ecosystem services. Understanding the interplay between anthropogenic impacts, environmental dynamics, and aquatic communities is crucial to the conservation and sustainable management of these vital ecosystems. Actions addressing point and nonpoint source pollution, sedimentation, time of year restrictions on dredging are just a few actions that would have positive impacts on Virginia estuaries.

Marine Nearshore

Brendan Runde and Kate Wilke, The Nature Conservancy

Nearshore marine habitats in Virginia represent an extensive and dynamic group of ecosystems. These waters include the surf zone along Virginia's ocean beaches, the coastal bays and inlets on the seaside of Virginia's Eastern Shore, and the lower Chesapeake Bay. In terms of extent, modern coverage of these habitats is not dissimilar to historical coverage. However, anthropogenic influence and human use of these systems is evident throughout.

Submerged aquatic vegetation, particularly eelgrass (*Zostera marina*), once dominated the substrate in Virginia's coastal bays. This species virtually disappeared from these bays in the 1930s, due to a combination of disease and the effects of a hurricane (Orth and McGlathery, 2012) but has since been restored to a total coverage of ~10,000 acres. This habitat serves as an invaluable nursery for myriad species of fish and shellfish (Lefcheck *et al.*, 2017), many of which are SGCN. The extent of eelgrass in the coastal bays continues to grow as a result of restoration efforts and – now – self-propagation from previously restored areas.



Mockhorn Island WMA

The eastern oyster (*Crassostrea virginica*) has long been one of the most important species in Chesapeake Bay and other Virginia waters. The ecosystem services provided by oysters are immense: their ability to filter water, plus the structured habitat they form for fish, crabs, and other marine life, make oysters a keystone species in these ecosystems. Records from the early decades of European contact suggest extensive oyster reefs in many nearshore waters of the Bay (McCormick-Ray, 2005), including the [perhaps embellished] 1608 account from Captain John Smith who wrote that "oysters lay as thick as stones." High levels of exploitation began in the 1800s and accelerated as technology allowed harvesting to become more efficient (Schulte, 2017). By 2011, one study estimated that the abundance of oysters in one section of Chesapeake Bay was 0.3% of its historical levels (Wilberg *et al.*, 2011).

Threats to the marine nearshore habitats in Virginia include those originating from changing environmental conditions. Increasing water temperature has the potential to disrupt spawning cycles

and thus survival of numerous organisms, including many SGCN, eelgrass, and oysters. Invasive species, such as blue catfish (*Ictalurus furcatus*) and northern snakehead (*Channa argus*), are more prevalent in the estuarine portions of the Bay but may threaten lower portions as well. These species are known to outcompete some native species, including striped bass. More informed management of the oyster fishery, paired with restoration efforts for the same species, have been somewhat successful; however, the diseases MSX and dermo have taken a further toll on this population over the last several decades (Ewart and Ford, 1993). Human uses of nearshore marine habitats in Virginia also threaten these ecosystems. These include dredging (e.g., for shipping channel maintenance and port construction), increased shipping activity, shoreline stabilization such as bulkheading, and agricultural and storm runoff which can greatly affect water quality.

There are many conservation actions for marine nearshore habitats in Virginia that could be considered priorities. Addressing nutrient-rich runoff, for instance by amending agricultural fertilizer application or modernizing sewage treatment and outflow, is likely to pay dividends for living habitats (such as eelgrass and oysters) as well as the marine life living in and around them. Continued restoration of eelgrass and oysters should also be prioritized. Finally, monitoring the impacts of human use such as shipping and dredging on SGCN using diverse empirical scientific methods is recommended.

Marine Offshore

Brendan Runde and Kate Wilke, The Nature Conservancy

The open ocean is one of the most extensive ecosystems on the planet. Off the coast of Virginia, pelagic and benthic zones provide habitat for dozens of SGCN. Continental shelf habitat off Virginia consists of approximately 20,000 km^2 of seafloor. Although much of this area is unconsolidated sediment, natural hardbottom habitat and artificial structures provide refuge and forage for many SGCN. Approximately 0.05 km^2 (i.e. 50,000 m^2) of Virginia's seafloor is occupied by state-managed artificial reefs (Paxton *et al.*, 2024), and likely far more is covered by natural reefs (Steward *et al.*, 2022). The extent of artificial reefs is increasing, while changes in the extent of natural reefs off Virginia is not known. In addition to purpose-built artificial reefs, man-made structures, such as wind turbine foundations, offer habitat for diverse marine life. Virginia's number of wind turbine foundations has increased from a historical absence to two in 2020 and over 150 additional foundations planned as of this writing. Each of these seafloor habitats are important for marine life, including many or all SGCN that live in the ocean.

At and beyond the continental shelf break off Virginia, deepwater canyons offer high-relief habitat for marine life. Indeed, deepwater corals are present in these canyons (Brooke *et al.*, 2017) that are not found elsewhere on the sedimented shelf and slope of the Mid-Atlantic Bight. Due to the importance of these habitats, the canyons of the Mid-Atlantic are protected from fishing and other extractive use.
The oceanic habitat may be far from shore, but it is still subject to anthropogenic threats. Pollution, in the form of macro-plastics (Jambeck *et al.*, 2015), microplastics (Everaert et al., 2020), heavy metals (Mart et al., 1982), and other contaminants threaten the quality of seawater and the biological processes that take place therein. Warming ocean waters are causing increases in sea surface temperature in the global ocean, including off Virginia (Lapointe *et al.*, 2020). While the Gulf Stream has historically driven processes off states south of Virginia, changing environmental conditions are driving

major changes in this current that will impact Virginia as well (Gonçalves Neto *et al.*, 2021). Indeed, the effects of these changing conditions on marine life are manifesting as (for example) poleward shifts in distributions (Morley *et al.*, 2018; Nye *et al.*, 2009). These climate-driven distribution shifts may complement range expansions that are facilitated by the emplacement of artificial structures in the ocean (Paxton *et al.*, 2019).



Humpback Whale off of Virginia Beach

Invasive species in Virginia's ocean waters include lionfish (*Pterois spp.*) and green crab (C*arcinus maenas*). While it is not currently believed that lionfish can overwinter north of North Carolina, increasing seawater temperatures and the increase in rocky habitat (i.e. due to offshore wind foundations) may allow them to do so. Green crabs are generally estuarine or shore-associated; however, they may colonize offshore structured habitats as well. As waters continue to warm and the availability of novel structured habitats increases, these and other invasives should be priorities for monitoring as they may outcompete native species (including some SGCN).

Priority conservation actions in Virginia's marine offshore ecosystem should include continued protection of deepwater coral ecosystems, monitoring for the spread of invasive species, and research on the impacts of new built habitats such as offshore wind on SGCN. Furthermore, empirical research techniques such as acoustic telemetry would further elucidate habitat use by SGCN.

Urban Lands

Steve Living, Virginia Department of Wildlife Resources

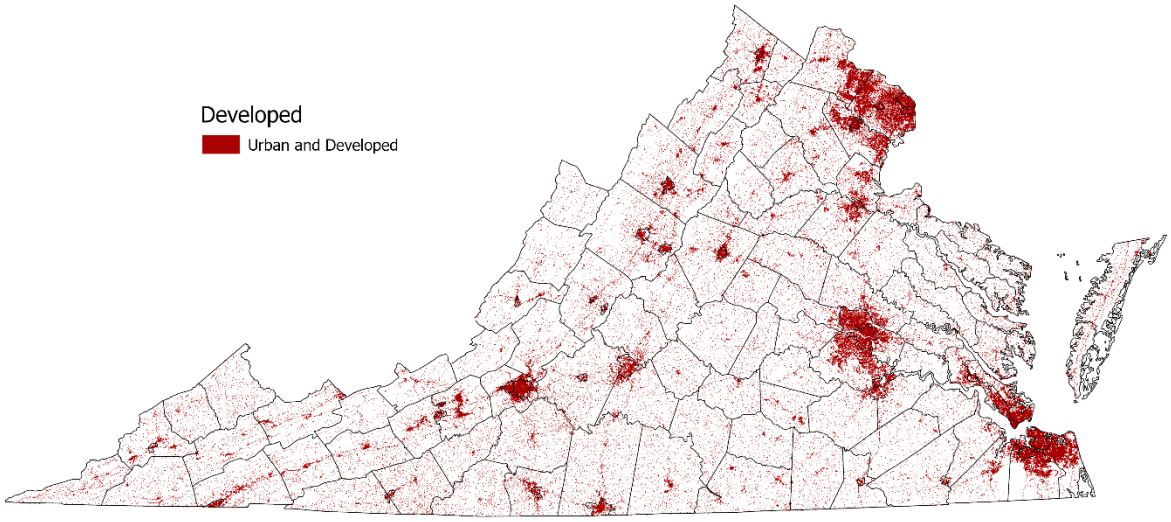


Figure 3.10. Urban/Developed Land across Virginia

Urbanization poses a variety of challenges to wildlife. Development of natural habitat can directly displace species and fundamentally alter habitat characteristics. The fragmentation can isolate populations and increase the impacts of predation and degradation of habitat. Sensitive species and specialists may be more susceptible to these effects. Urbanization can introduce chemical pollutants, litter and debris, as well as light and noise pollution that can significantly impact the life processes of a variety of species. The risk of collision with structures and vehicles poses another risk. Invasive species are often more prevalent in urban areas and can reduce the value of what natural cover may remain. Urban areas are comprised of a complex mixture of structures, undeveloped spaces and aquatic habitats. The relative ratio of each component varies widely across the urban landscape. A variety of



Goochland/Henrico County Line, 2024

wildlife make their home within this urban framework. This includes generalists like racoons, resident Canada geese, and even deer and black bear. A variety of non-native species thrive in the urban context including rock pigeons, house sparrows and black rats.

Virginia's largest urban areas are all associated with significant waterbodies. These provide valuable habitat and act as corridors providing connection to other less developed lands and habitats. These aquatic (or marine) habitats also face pressures from urbanization including channelization, thermal impacts from loss of streamside vegetation, erosion, and pollution in the form of chemicals, nutrients, trash and sedimentation. There is a discussion of the importance of wildlife corridors on page 97.

Despite these challenges, urban areas can still provide valuable habitat for a variety of SGCN. Green spaces with urban settings may be relatively small but can still support wildlife such as pollinators and can provide stopover habitat for neo-tropical migratory birds. For example, Monroe Park in Richmond, Virginia, is 7.65 acres in a highly urbanized setting and has eBird records for 55 bird species including five SGCN.

Several SGCN can thrive in urban habitats. The peregrine falcon (*Falco peregrinus*) is an excellent example of this adaptability. Peregrines were deemed extirpated in Virginia by the 1960s. In conjunction with national efforts, releases took place in coastal Virginia beginning in 1978 and continued through 1985. Although the intent had been for these birds to wander and eventually reestablish historic breeding sites in the mountains of Virginia, the birds instead established breeding sites on bridges and in urban areas of Virginia. A well-known territory in Richmond, Virginia, is the subject a widely viewed live webcam and generates significant public interest in conservation. In downtown Richmond, the peregrines find ample avian prey and the high-rise buildings provide a constructed analog to the cliffside aeries that the birds nested in historically. This includes urban birds such as rock pigeons but perhaps surprisingly, a number of prey items typically associated with forested habitats like yellow-billed cuckoo or even wetland dependent species like bitterns and rails. This would seem to highlight the importance of riparian buffers and forests both as habitat in and of themselves and as corridors for connectively and



Richmond City, James River Photo Credit: VA Tourism Corp.

dispersal. Understanding that urban areas are potential habitat is important in understanding how wildlife use these areas and how best to manage those species.

Programs to enhance habitat within existing public and private greenspace can bolster the habitat value of these habitats in the urban environment. Encouraging the use of native plants and the maintenance of native tree canopy can have direct benefits for wildlife while addressing environmental equity issues such as heat islands and access to quality outdoor nature based recreational opportunities. The monitoring for and removal of invasive species can further enhance habitat value.

The monitoring for and provision/protection of resources for wildlife that take advantage of urban spaces can provide additional benefits. Chimney swifts will utilize large industrial chimney stacks in urban areas as communal roosts during migration and as such these can provide a key habitat resource.

Working with partners to promote Lights Out campaigns and other mitigation strategies to address window strikes where appropriate can help to mitigate a significant threat to bird populations.
Urban habitats present complex challenges for many wildlife species, especially habitat specialists and those sensitive to human disturbance. A select suite of wildlife, including SGCN, are able to successfully make use of urban habitats. Identifying these species, understanding their needs and the opportunities for management within the urban context will be important to maximizing the value of this habitat type. The proximity to significant human populations creates opportunities to make positive connections with wildlife, enhancing the overall understanding of DWR's mission to conserve, connect, and protect wildlife and habitat conservation.

Transportation Networks
Steve Living, Virginia Department of Wildlife Resources

Virginia's transportation network is a landscape feature that is distributed throughout the Commonwealth, intersecting other habitat types and occurring in both rural and urban areas. Within the urban framework, this network is concentrated as road and rail infrastructure corridors intersect in hubs and can be seen as part of the larger matrix of the built environment. In rural environments this network is more dispersed, but its impact on habitat perhaps more immediately noticeable as road and rail infrastructure corridors dissect habitat that may otherwise be relatively contiguous.

Virginia's road network is comprised of 70,239 miles of roads

- Interstate: 1,119 miles of four- to ten-lane highways that connect states and major cities
- Primary: 8,037 miles of two- to six-lane roads that connect cities and towns with each other and with interstates
- Secondary: 50,088 miles of local connector or county roads (1,817 miles locality maintained).
- Frontage: 312 miles of frontage roads
- Urban streets: 10,624 miles (maintained by locality)
- Toll Roads: 59 miles (maintained by private or public/private enterprises)

The majority of these roads are comprised of impervious surface and are accompanied by rights-of-way of varying widths that are maintained with a combination of mowing, trimming and herbicides to maintain drainage and line-of-sight as necessary.

Road networks pose a variety of challenges to wildlife and their habitats. Roads create barriers to dispersal and a direct hazard due to the risk of vehicle collisions. The noise and artificial light associated with roadways create additional impacts for wildlife.



Springfield Interchange Photo Credit: VDOT

Virginia's Rail network is comprised of 11 freight lines, eight Amtrak intercity passenger routes, and two Virginia Railway Express (VRE) commuter routes. The passenger rail services operate primarily on rail lines owned by the freight companies under negotiated agreements. Rail lines pose hazards similar to road networks, creating barriers to dispersal and the risk of strikes. The managed rights-of-way adjacent to these networks create potential attractants and habitats for wildlife. The Virginia Department of Transportation participates in the Monarch Butterfly Candidate Conservation Agreement with Assurances program administered by the University of Illinois-Chicago. Under the auspices of this program VDOT has contributed over 8,000 acres of pollinator habitat, including planting 82 acres in 2023 with 135 acres slated to be planted in 2024.

These rights-of-way also create pathways for the spread of a variety of invasive plant species. These can become well-established within these areas and provide sources for continued invasion. Inclusion of invasive species monitoring and control as part of right-of-way vegetation management protocols can help mitigate this issue.

Attractive habitat adjacent to these road and rail infrastructure corridors is not without potential risk to wildlife. Wildlife species may be attracted to browse on vegetation or to hunt. Scavengers may be attracted to roadsides by the carcasses of previously struck wildlife. Carrying out these activities adjacent to roads and railways creates potential risk.

Some transportation infrastructure can offer analogues for key habitat features. Bridges and culverts can act as substitutes for caves, rock and tree crevices and hollow trees and are utilized as roosts and hibernacula by up to half the North American bat species. Notable Virginia bat SGCN that are known to utilize these features include Rafinesque's big-eared bat (*Corynorhinus rafinesquii macrotis)*, Virginia big-eared bat (*Corynorhinus townsendii virginianus)*, Indiana myotis (*Myotis sodalis)* and northern long-eared bat (*Myotis septentrionalis)*. Opportunities exist to retrofit existing bridges or to incorporate bat-friendly features into new designs.

The continued study and implementation of wildlife passage related to transportation infrastructure corridors has the potential to mitigate habitat isolation and the risk of strikes. Identifying effective designs and locations for such passage efforts will be increasingly important as development pressures continue to fragment wildlife habitats.

Wildlife Habitat Corridors and Connectivity

Virginia is one of the first states in the eastern U.S. to create a Wildlife Corridor Action Plan (Plan) (VDWR et al. 2023) with a clear emphasis on protecting vital wildlife habitat corridors and reducing wildlife-vehicle conflicts, such as collisions, to promote driver safety. Wildlife corridors connect fragmented habitats separated by human activities or infrastructure; this habitat connectivity is vital to the long-term sustainability of wildlife biodiversity. When road infrastructure fragments wildlife habitats, some species of wildlife may need to move across roads to reach suitable habitats for fulfilling their food, water, shelter, and mating requirements. Wildlife-vehicle conflicts can occur, resulting in driver safety risks due to direct collisions with the animals or crashes from avoidance maneuvers, as well as wildlife population impacts such as significant mortality and barriers to dispersal. More than 60,000 (Donaldson and Elliott 2021) known deer-vehicle collisions have occurred annually in Virginia since 2015, costing the Commonwealth and its citizens approximately $533 million each year. One example of creating these corridors are the areas along the Nottoway and Blackwater Rivers in Southeastern Virginia related to the conservation of longleaf pine ecosystems (see page 41.)

One of the key outcomes of the Wildlife Corridor Action Plan is the identification of Wildlife Biodiversity Resilience Corridors (Figure 3.11). These coarse-scale statewide wildlife corridors were identified by leveraging the Commonwealth's ConserveVirginia and Virginia Natural Landscape Assessment conservation planning tools (Virginia Department of Conservation and Recreation), as well as other geospatial data sources. Conservation of these existing large-scale wildlife corridors, and their connectivity, are important for the long-term sustainability of Virginia's native biodiversity and habitats in the face of threats such as land development and climate change. In 2027, the Wildlife Corridor Action Plan will also integrate species-specific habitat corridors for 11 Species of Greatest Conservation Need thought to be vulnerable to road risks (e.g., via direct mortality and/or dispersal disruption through habitat fragmentation). The VDWR is partnering with VDOT-Virginia Transportation Research Council, VDCR, Smithsonian Conservation Biology Institute, and George Mason University to pilot how to identify priority species habitat corridors for SGCN using expert input, available biological data and research outcomes, and geospatial and remote sensing data within a Google Earth Engine modeling workflow. This pilot is focused on the following 11 SGCN: bog turtle (*Clemmys muhlenbergii*), spotted

turtle (*C. guttata*), wood turtle (*Glyptemys insculpta*), box turtle (*Terrapene carolina carolina*), Mabee's salamander (*Ambystoma mabeei*), northern diamondback terrapin (*Malaclemys terrapin terrapin*), timber rattlesnake (Crotalus horridus), eastern mud snake (*Farancia abacura abacura*), common rainbow snake (*F. erytrogramma erytrogramma*), eastern spotted skunk (*Spilogale putorius putorius*), and Allegheny woodrat (*Neotoma magister*). Understanding the location of important habitat corridors for SGCN will inform future conservation actions, such as priority locations for installing wildlife crossing infrastructure on roads, land conservation, and habitat restoration. In addition, the modeling methodology developed for these 11 SGCN will serve as a protocol that can be duplicated for additional SGCN which are also detrimentally impacted by road infrastructure or other land uses causing habitat fragmentation.

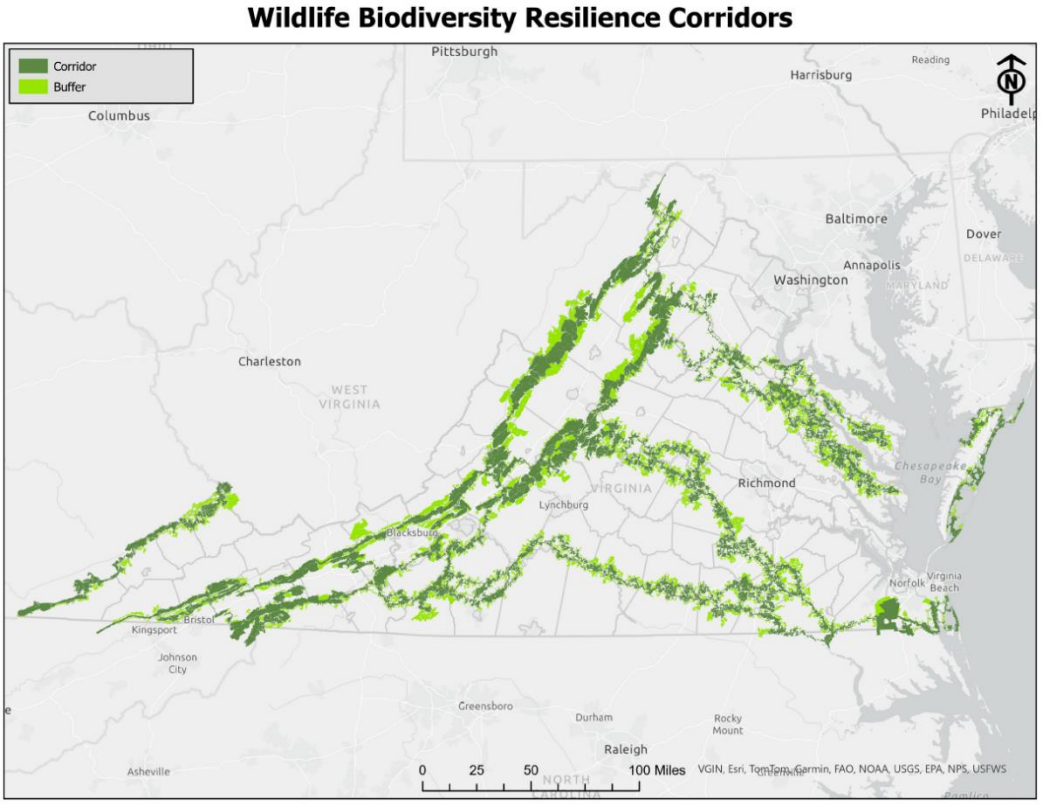


Figure 3.11. Wildlife Biodiversity Resilience Corridors, VA Wildlife Corridor Action Plan, VDWR et al. (2023)

Working Lands

Clay Ferguson, VA Department of Wildlife Resources

Lands and waters from which food or fiber are provisioned to support the needs of people are known as working lands and waters (hereafter referred to collectively as working lands). Working lands exist in actively managed areas, are typically privately owned – but can be publicly owned, and include a broad spectrum of agricultural, aquacultural, and silvicultural practices (Placerrcd.org). In Virginia, working lands occupy undeveloped spaces and include timbered forests and tree plantations, pastures, hayfields, crop fields, shellfish farm leases, orchards, nurseries, gardens, and vineyards. Besides furnishing many of

the resources that society needs to function, working the land is vital to many landowners' financial solvency. Today, well beyond half of Earth's habitable land is utilized as working land (Ritchie and Roser, 2024), hence the considerable potential for working lands to impact wildlife and their habitats.

Not all modern versions of food and fiber production qualify as working lands. A first requisite of working lands is a direct physical connection between the food production system and local environment. For instance, although confined animal feeding operations (CAFOs) produce lots of food, the human-built, impervious and artificial environment disqualifies them as a type of working land. However, the crop and hay fields that grow inputs for CAFOs are subject to the climate, soil, and biota of a site and qualify as working lands. Another key requisite that distinguishes working lands from other related land uses is the harvest of renewable resources. Industries such as mining or drilling, though capable of producing goods comparable to those derived from working lands (such as synthetic fibers and building materials), are not considered working lands because the operation is non-renewable and merely extractive. Lastly, working lands preserve some level of ecosystem services that were present in the previously natural, unworked landscape. For example, timbering regenerates forests and provides crucial early successional habitats for many SGCN. Although activities commercial fishing, mining, and CAFOs produce important resources for humanity, they cannot provide valuable habitat to Virginia's wildlife like working landscapes.

Nonetheless, working lands can have serious impacts on Virginia's biota. Working lands tip the delicate scale from ecological asset to liability when their operations sever key cycles of nature (White Oaks, 2021). The carbon, nitrogen, mineral, microbial, fungal, light, wind, and water cycle are among a few such key cycles whose disruption can upend the stability of a habitat or greater ecosystem. At the same time, because of their direct connection to the environment, working lands have the potential to align harmoniously with nature's cycles. When harmony is struck between natural habitats and resource provisioning, ecosystem services both critical to our and other species' wellbeing are preserved – services like clean air, abundant water, and healthy soils.

Working farms, ranches, and forest lands are some of Virginia's best examples of intact ecosystems, functioning natural cycles and processes, and resilient wildlife communities. Many of these lands and waters are managed by the Commonwealth's most dedicated stewards and strongest champions for conservation. As such, maintaining the economic viability of working lands is a top priority of Virginia's conservation strategy, as is finding more cost-effective ways to financially reward managers who cannot afford to adopt or sustain wildlife-friendly BMPs, despite a desire to do so. At more than 20% of the state's gross domestic production, working lands are recognized as the foundation of Virginia's economy and receive broad public support for conservation programs that assist farmland sustainability (Rephann, 2022). Collaborating more fully with the working land industry must continue growing as a central tenet to Virginia's wildlife conservation strategy.

Working Lands Pre-Commonwealth

The recorded history of working lands in Virginia began around 4,000 BCE, when native peoples first developed stone axes large enough to clear small patches of forests (VDOE, 2024). Clearing forests

provided not only bulk timber for building more substantial tools and structures but also encouraged plants of more direct benefit to people, such as berry bushes, fruit and nut trees (VDOE, 2024). As harsh conditions of the late Pleistocene gave way to the milder Holocene, longer growing seasons and expanding working lands spurred human population growth across what would later become Virginia's Commonwealth.

Once bands of people came to inhabit all regions of Virginia, they began establishing small, more sedentary settlements and developing unique tribal cultures (VDOE, 2024). The gradual abandonment of nomadic ways necessitated more substantial cultivation of food. Native plants like sunflowers, gourds, tuckahoe and amaranth were cultivated through selective breeding. Fields of beans, corn, and squash, all of which were traded into Virginia from the southwest US or Mexico, eventually provided foodstuffs throughout the seasons. Fire, a tool long used to corral animals for ease in hunting, found greater use in clearing land for more productive grass and shrubland habitats, where wild provisions are more accessible.

As tribal populations surpassed the tens of thousands, larger parts of the natural landscape underwent significant change. Marshes adjacent to settlements were commonly converted to monocrops of wild rice (Nomad Seed Project, 2017). Similarly, floodplain bottom lands were deforested and cultivated for crop production. For many species of wildlife, these anthropogenic conversions from natural to working landscapes would have resulted in a net loss of habitat, or at least a decline in habitat functionality within the acreage impacted. But given the small scale and low intensity of these early food and fiber production systems, the loss was negligible.

From Inconsequential to Highly Consequential Land Use

The geospatial scale and production intensity of Virginia's working lands was radically increased when European colonization imposed a new global economy on the landscape commons. The subsequent privatization of land and establishment of commodity-driven economies all but antiquated the notion of sufficiency in working the land – that was, working the land to feed family and immediate community. Land became a commodity from which individual owners could obtain transferrable wealth (money) via resource extraction. Those who maximized resource extraction could purchase more land or make other investments to advance their social ranking. Prospects for wealth accumulation were high, given the virgin richness of many Virginia soils and relatively stable climate.

Periods of indentured servitude, chattel slavery, and technological advancements of the industrial revolution enabled vast expansion of working lands across the Commonwealth. Eventually, working lands expanded across Virginia so widely that practically every forest was timbered – most have been logged numerous times. Similarly, nearly all tillable land has been plowed and cropped for decades, centuries in some places. Moreover, much of the land has, with few exceptions, been grazed by livestock over similar timeframes. Conversion of natural habitats to working lands accelerated so rapidly during the 19th century that species across all taxonomic groups experienced population declines. The near or complete extirpation of Virginia's big game species (elk, deer, turkey, and bear) provides a reminder not only of the destructive potential of technological advancement within working lands, but

also as an indication of the likely losses of more sensitive, endemic species were unknown (Cowie, et. Al, 2022).

This is not to say that before European contact, land was never overworked. However, prior to the development of a global economy, the direct consequences of overworking the land, as is evidenced by erosion of soil fertility and "souring" of previously arable lands, were not readily escapable. Depletion of localized resources would have almost certainly required settlement relocation – a strong disincentive against unsustainable resource extraction and strong incentive for preserving considerable natural habitat for ecosystem resilience. In contrast, the globalized economy has enabled commodity production to steadily intensify in the face of localized overexploitation. Soils depleted of organic matter and key nutrients are renourished by importing nutrients (fertilizers) from off the farm – sometimes from around the world (World Population Review 2024). Likewise, loss in a soil's water-holding capacity is overcome by irrigating crops with nearby ground or surface waters. On the demand side of the equation, once local food or fiber supplies saturate regional markets, export markets are pursued to maintain revenue potential. Increases in food and fiber production have historically resulted in human population growth, which in turn has necessitated additional conversion of natural habitats to working lands to support growing demands.

Moving Past a Conservation Philosophy Crossroads

Anthropogenic manipulation of a natural ecosystem for the benefit of humanity is implicit to working lands. Working the land necessarily displaces some degree of natural ecosystem functionality that co-evolved for millennia prior to human inhabitance. However, some of Virginia's most successful



Timber Management Cut

conservation initiatives of the 21st century have centered on keeping working lands working for the landowner and wildlife. Notable among these initiatives are USDA's Working Lands for Wildlife program – supported by many state and NGO personnel in the Commonwealth (NRCS, 2024), Virginia land trusts' holdings of conservation easements on working lands that now exceed more than a million acres (Shepherd, 2023), a concerted reorientation of Chesapeake Bay pollution reduction efforts towards working lands (Blankenship, 2023), and unprecedented levels of grant funding awarded to cooperative extension efforts that assist producers and harvesters in adopting best management practices (Taylor, 2023).



Working Farm

This approach tethers working lands and wildlife conservation under the shared mission of economic and ecological resilience. It recognizes that biodiversity and the modern economy are inextricably interlocked – that the longevity of one requires strength and support from the other. It embraces the nuanced concept that working lands of Virginia "cover the full gradient from intensively managed to semi-natural, constitute a vast reservoir of land area, [and] are both part of the problem and also, part of the solution (Coffin, et. al, 2021)."

No Two Working Lands are Exactly Alike

Categorizing Virginia's working lands by their relative compatibility with native wildlife results in a wide spectrum of groupings. On the "highly compatibility" side of the spectrum are versions of farming and forestry that closely emulate the natural ecosystem processes that define the resilient habitats with which native biota coevolved. Highly compatible farming and forestry practices, often referred to as holistic, regenerative, or nature-based systems, preserve most or many of nature's key processes, such as the water, carbon, mineral, fungal, and microbial cycle. These high-functioning systems tend to be managed at low-to-moderate production intensities by managers who value ecosystem services, biodiversity preservation, and thus longevity of their farms, in addition to immediate economic needs.

Some other farm and forestry practices result in novel, anthropogenic ecosystems. Although select species thrive in these human-dominated settings, rarely do SGCN since the novel conditions are mostly unrecognizable from natural habitats. Examples include most commercial crop fields, orchards, vineyards, gardens, and plant nurseries. Unlike highly compatible working lands, these systems necessarily sever many key cycles of nature. For example, cost-effective row crop farming requires the suppression of all but one plant variety (monocrop). Following mechanical harvest, the field lies barren with no physical structure, forage, or live perennial roots to provide wildlife habitat, until a cover crop can be sown and established. These novel working lands are typically managed intensively, often for the sole purpose of provisioning food and fiber. Although best management practices can minimize their ecological impact, improve economic performance, and increase ecosystem services, they do not serve as effective surrogates for Virginia's natural habitats. Working lands that result in novel, anthropogenic-dominated ecosystems are low priorities for wildlife conservation.

The following habitat classes are those which have associated working lands with the greatest potential to support Virginia's SGCN. Discussion of these highly compatible working lands detail the status quo of operation, potential for supporting SGCN, and barriers precluding realization of support potential.

Working Lands and Waters Summaries

Working Forests & Woodlands

Working forests and woodlands include stands of trees that have been timbered and are being considered for a future harvest by the current landowner. They exist on most private and many public lands and include nearly all forest species compositions, barring the less accessible forests at high elevations or in lowland swamps. Much of the diversity in the Commonwealth's forest age-classes results from logging – the timber-harvesting practice that makes a forest a working forest. Though certainly not free of ecological impact, logging benefits many SGCN, particularly birds and mammals, by regenerating young forests as early successional shrubland habitat. Ruffed grouse, golden-winged warblers, bobwhite , woodcock, spotted skunk, and snowshoe hare are just a few SGCN that rely on shrublands for food, cover, nesting, and other key life stages.

Without active logging, young forests would cease to exist across much of the state, along with their co-dependent SGCN. Although early successional forests existed prior to human inhabitance, virtually all the disturbance mechanisms that naturally regenerated forests – old-growth deadfalls, disease, fire, beavers, bison, elk, have been markedly reduced or entirely removed and now, in many cases, would be difficult to restore for scalable reestablishment. Fire, for example, would have naturally opened forest canopies in mosaic-like patchworks when and where flames burned intense enough to girdle or torch trees, creating early successional habitats. Today, the ubiquity of people across the Commonwealth and their financial dependence on private property resources (timber) potentially serve as barriers to returning healthy fire at a meaningful scale. Because logging does not deal with the same degree of risk and liability to people and their property, it is a more viable disturbance regime.

Clear cuts – A logging method where all trees are removed from a contiguous block of forest at once, this approach is perhaps the most common harvest method employed in the Commonwealth. The popularity of clear-cut practices is economically driven – they are more cost-effective for loggers (more revenue per time invested) and more immediately lucrative for the landowner (VDOF, 2014). However, some landowners prefer *select cuts* for various economic and environmental reasons, and loggers are typically willing to accommodate if the tract is large enough with a mature stand to select from. Light-to-moderate select cuts, where some mature and many maturing trees are left to grow, are generally considered more supportive to Virginia's wildlife as they create multi-aged canopies with a diverse assemblage of plant species. Moreover, by preserving some canopy coverage, light select cuts continue to shield sometimes highly erodible soil from the elements (wind, precipitation, UV radiation), helping keep watersheds healthy and soils productive. Still, clear cuts can mimic the type of broad forest regeneration that would have historically followed an intense wildfire and are compatible with many SGCN, especially when conducted at flatter topography. If prescribed fire is integrated into the timber rotation, natural habitat conditions are even more achievable.

How a working forest is allowed to regenerate following a timber harvest is also of consequence to SGCN. Ideally, for native wildlife, the native seedbed and stump sprouts are allowed to regenerate naturally. Natural forest regeneration enables a diverse array of species associated with multiple stages of forest succession to express themselves and support co-dependent species. Rarely thinned between harvests, natural regeneration limits the frequency at which heavy machinery compacts the soil and reduces hydrologic functionality, which is a threat to aquatic SGCN. When markets are up, timber harvests can produce considerable economic windfalls for the landowner, especially stands of mature hardwood. At the very least, timber harvests help cover the cost of landownership from years prior and years to come, disincentivizing deforestation (the conversion of forests to another land use). With harvest frequencies ranging typically somewhere between a half and full century, naturally regenerated forests require patience. Working with a professional forester to develop a forest management plan helps landowners fully consider all economic and ecological factors.

Landowners who desire more frequent infusions of revenue from their working forests often convert a clear-cut stand to a commercial tree plantation. In Virginia, these are typically pine plantations, mostly replantings of fast-growing loblolly, but increasingly native short- and long-leaf pine. Commercial pine plantations are characterized by relatively high density, even-aged, single-species stands planted in rows at regular intervals (FWC, 2019). Site prep and subsequent thinning can be harsh on the environment since intensive use of herbicides and mechanical tillage/compaction is requisite. Except for the first and last few years of a stand's lifespan, most commercial pine habitats consist of monocrop, closed canopy, needle-covered forest floors with little value to SGCN. However, tree plantations that are thinned, burned, and allowed to mature beyond initial market readiness often reestablish an early successional understory with considerable value to the SGCN that can migrate to it (mostly birds).

Regardless of harvest method, when a forestry management plan is developed and BMPs adopted, impacts to SGCN can be minimized and habitats can recover more quickly to a condition that supports wildlife. Importantly, BMPs help keep fertile soils in place throughout the timbering rotation, ensuring a future forest's ecological and economic productivity. Landowners who need not maximize profits from their working forest, who would like to ensure the forests productivity for future generations, and who would like to increase their forest's compatibility with SGCN might consider letting their forests naturally regenerate after harvest, opt for light select cuts (especially on steeper topography), incorporate prescribed fires, and leave behind some mature trees to support wildlife that rely on old-growth habitat.

Prescribed Fire – The importance of prescribed fire is well-documented for many species. The regular rotation of fire to conserve fire-dependent plants and animals is an important part of conservation efforts in Virginia. Without regular logging, application of herbicides or prescribed fire, lands in Virginia naturally progress from grasslands or timbered lands to shrublands to early successional forests to old growth forests. In addition, many species, such as northern bobwhite, red-cockaded woodpecker, frosted elfin, and long-leaf pine require either fire directly to germinate or fire-maintained habitats to thrive. Increasing residential development, urban growth and stricter air quality standards are making prescribed fire harder to plan and carry out. It is crucial for the conservation of fire dependent communities that prescribed fire continue to be an available tool for wildlife and ecological conservation

professionals. There are 339 SGCN in the 2025 Wildlife Action Plan that benefit from the occurrence of fire in their habitats.

Working Grasslands, Savannas, & Early Successional Shrublands

Like forests and woodlands, most of Virginia's grassland, savanna, and early successional shrubland habitats are active working lands. Working lands associated with these habitats include agricultural pastures and hayfields, both of which are directly or indirectly managed to produce livestock. Although more prominent on private land, open-land habitats on public lands are occasionally maintained as pastures and hayfields. Unlike slow-growing forests, livestock grazing and hay production afford farmers a more consistent commodity capable of generating substantial annual income off average-sized farms (186 acres in Virginia; Ellison, 2022). Generally, grazing confers better income potential than haymaking because of the high value of livestock and relatively low expenses needed to grow them. This is especially true for ruminant grazers, which require little to no supplemental feeding when pasture forage is diverse and strategically stockpiled for grazing outside the growing season. As the costs of fertilizer, feed, fuel, equipment, and other farming expenses outpace rises in commodity values (Myers, 2022), grazing pastures has become a financial stronghold for rural communities, helping maintain grasslands, savannas, and shrublands.

Pastures have more potential than hayfields to support diverse flora and fauna because grazing-animal impact (hoof tramping, manure, urine, etc.) is a natural disturbance mechanism and the only disturbance necessary for most livestock production. When managed with care, livestock impart a disturbance pattern that closely simulates the herbivory cycles once fulfilled by native elk, bison, and even larger herbivores that are now extirpated or extinct. Biomimicry is the term used to reference working land systems that intentionally simulate natural systems and processes. To achieve biomimicry, livestock farmers adopt a suite of best management practices (BMPs) such as stocking their pastures at a site-appropriate rate (below carrying capacity) and allowing pastures ample rest by rotating the herd. Cattle are well suited for biomimicry in Virginia because their size and herd-like tendencies are close surrogates to bison and elk. Cattle is the predominant livestock animal pastured in the Commonwealth, but sheep, goats, pigs, and poultry are also pastured and have compatible potential with native biota. Most of Virginia's pastures are classified as treeless grasslands. However, savanna-like silvopastures are also common and can establish one of two ways: when heavy thinning of a woodland allows light penetration to the forest floor, advantaging herbaceous grasses and forbs, or when intentional tree plantings or natural tree regeneration occurs within a grassland pasture. Pastures also account for a good percentage of Virginia's bramble-dominated early-successional shrublands, which form when grazing pressure is light and managers choose not to control all woody encroachment in their pastures. Shrubland pastures are therefore considered habitats transitioning from a grassland to a savanna or woodland and require heavy browsing to persist.

In the absence of grazing or fire, most of Virginia's grasslands would cease to exist. This is because Virginia's climate and soil profiles, with few exceptions, support the succession of grasslands into shrublands, woodlands, and eventually forests, the "terminal" terrestrial habitat type. While forests provide critical wildlife habitat and ecosystem services, they do not support SGCN that are dependent upon open-canopy habitats. Grasslands and similar herbaceous-dominated open lands are Virginia's

most imperiled habitat (Borowy, 2013). As such, area ecologists often emphasize the need for prescribed grazing and fire across Virginia's landscape to create and maintain a patchwork mosaic of forested and open habitats. Indeed, habitats managed both by grazing animals and fire represent some of Virginia's most intact ecosystems. Without these regenerative disturbances, SGCN like the loggerhead shrike, bobolink, and bog turtle could well vanish from the Commonwealth.

Poor management practices, such as stocking animals on pastures far above the farm's carrying capacity, continuously overgrazing pasture paddocks, and allowing livestock routine access to streams are among the top threats prompting the inclusion of many SGCN. Invariably, grazing operations become harmful when farmers manage for maximum commodity production. Such operations are never sustainable since soil fertility and hydrologic functionality are eventually lost, imperiling both the farmer and wildlife.

Virginia's hay fields are complementary to grazed pastures in that they serve as the forage base for livestock outside of the growing season. Some hayfields represent Virginia's purest stands of native warm season grasslands, but most are dominated by non-native, naturalized cool-season grasses. Hayfields consist primarily of perennial grasses and are distinguished from monocrop annuals that produce haylage and result in a truly novel, human-altered ecosystem. Active hayfields are harvested every year – up to four times a year, depending on climate conditions, grass composition, and nutrient application.

As Virginia's temperature regime warms and growing seasons expand, Virginia grazers are focusing less on hay production and more on stockpiling cool season grasses for winter grazing. Some grazers have joined Virginia's Graze 300 campaign to limit hay feeding to 65 days or less – impressively, some have been able to stop feeding hay entirely (except during times of severe winter weather or growing season droughts; VCE, 2024). Rising costs in hay production is motivating more farmers to convert hayfields to pastures. Depending on the intensity of a grazer's operation, getting by without hay usually requires a reduction in herd size, even with converting hayfields to pastures. But despite reduced income from selling fewer head of livestock, reductions in haying expenses have reportedly made this alternative business model more profitable, less risky, and enjoyable for many grazers (USDA, 2000;Teutsch, 2008;Williams, 2019).

Because pastures have greater habitat potential than hayfields, converting hayfields to pastures is a boon to grassland SGCN. Unlike hayfields, pastures do not require a replenishment of soil nutrients over time. The resulting reductions in chemical fertilizer application on the watershed improves soil, stream, and bay health and helps make farms more profitable long-term. Moreover, regeneratively grazed pastures – those grazed under appropriate stocking densities and resting rotations - build soil fertility through animal impact (root sloughing, trampling, manure, urine). By sequestering carbon into stable soil reservoirs, regenerative grazing is both a key adaption and mitigation to changing environmental conditions (Wiltshire & Beckage, 2022). Hayfields also tend to be less diverse than pastures in species composition and structure. This is because hay mowing necessarily clips fields immediately prior to seasonal extremes, such as peak summer heat and first fall frosts. These highly stressful events select for a few hardy grasses and forbs that can endure. Over time, most hayfields become quasi-monocrops,

dominated by one or two varieties of grass (typically non-native) and have extremely limited habitat value for SGCN, despite being undeveloped green space.

Low-intensity haying is key to achieving compatibility with Virginia's SGCN. The fewer the hay harvests, the less fertilizer is applied to the watershed, the less equipment compacts the soil, the less equipment physically kills wildlife, the more plant diversity can express itself, and the more plant structure and living roots can provide wildlife habitat.

Working Estuaries and Marine Nearshore
John Lewis, VA Institute of Marine Science

In addition to working terrestrial landscapes, Virginia has a deep history of working the marine and estuarine waters in the Chesapeake Bay and outer coast of the state. This key sector of Virginia's economy involves harvesting renewable marine resources via numerous methods of take. A multitude of species are harvested commercially in Virginia waters, with some of the more notable including Atlantic menhaden, striped bass, blue crabs, hard clams, and eastern oysters. According to a report



Tangier Island, Virginia

prepared by the Virginia Seafood Agricultural Research and Extension Center, marine resource harvests contributed $1.1 billion to the Commonwealth's economy in 2019, incorporating multiple facets of the supply chain to include harvests made by watermen, value added through processors, and services provided by distributors (Goncalves *et al.*, 2022). Annually, Virginia ranks among the top seafood producers in the United States, boasting the titles of largest hard clam producer in the nation, the bulk of which are aquacultured products, and largest eastern oyster producer on the East Coast.

Working waterfronts are also a source of pride and cultural significance to the people who take part in or live adjacent to such operations. Symbols of working the water are woven into daily life in these areas, with numerous social events revolving around products harvested from local waters (i.e. oyster roasts, crab feasts). Restaurants, hotels, housing developments, and other social constructs share

monikers with terms or symbols directly related to working the water. While such things may seem trivial in the broad view of wildlife conservation, these cultural influences can lead to positive changes in the minds of the average person regarding marine conservation, cultivating a respect for the resources related to said symbols and, in a best-case-scenario, leading to lifestyle changes that will benefit the local environment. Through this process, generational conservation ethics are developed frequently in the form of 'wise use' of the environment or utilizing natural resources for human benefit while maintaining good stewardship.

While Virginia employs a diversity of techniques for harvesting marine resources, many of these methods of take are solely extractive. While this can be sustainable with adequate management, it does not typically involve a reinvestment to the resource, relying instead on natural productivity. However, an expanding segment of the seafood industry is taking a more intensive approach via shellfish mariculture, commonly referred to as shellfish aquaculture. Shellfish aquaculture is a large, growing part of Virginia's seafood economy and major contributor of ecosystem services to marine ecosystems. Of the $1.1 billion contribution of the seafood industry reported in 2019, $117.2 million was attributed to the shellfish aquaculture sector (Goncalves *et al.*, 2022). Of this sector, the overwhelming majority of landing values are credited to hard clams and oysters, with hard clams being the largest contributor (Hudson, 2019). In 2021, hard clam aquaculture produced the number one seafood item by value for the entire Commonwealth of Virginia (Snyder, 2021).

Containerized culture is a common system for shellfish aquaculture used by growers throughout the state. By placing animals in a container or planting them within a specific area leased from the state (with specific permit requirements), shellfish farmers can return to their nearshore site to work their crop for regular maintenance or harvest. Not only do these containment systems confine the shellfish to prevent product loss, but they are also designed to reduce predation. While these containers are intended to protect the shellfish within, they are also used by a plethora of sea life as artificial reefs. Shellfish leases tend to be in areas that are relatively shallow and protected from wind and waves, similar to nursery grounds for many species found in and around seaside coastal lagoons, the Chesapeake Bay, and its tributaries. Juveniles of many species seek refuge from predation in these nursery areas, where food resources are also abundant. The infrastructure provided by aquaculture gear has the potential to offer excellent protection in such environments while also accumulating biofouling, a term used for unwanted biotic growth on otherwise clean farming gear (i.e. barnacles, hydroids, sea squirts), which may serve as a food source for juvenile fishes and invertebrates.

Bivalve shellfish, especially oysters and clams, are proficient filter feeders, known for their excellent ability to filter large volumes of water to sustain growth of their outer shell and somatic tissue. Aquacultured shellfish are no exception to this rule, providing an ecosystem service similar to those in the wild. This filtration potential is considered one of the greatest benefits of aquaculture to the environment, where shellfish remove particles from the water, selectively consuming microalgae while rejecting inedible particles which results in clearer water for seagrass growth and benthic algae colonization, ultimately lessening the effect of nutrient loading. Nutrients such as nitrogen are then stored within the animal which is directly removed from the system upon harvest. The waste produced through filtration also benefits the surrounding environment by providing nutrients to the benthos,

potentially spurring the growth of submerged vegetation such as eelgrass (Peterson and Heck, 1999) and offering additional food sources for bottom-dwelling organisms. This biodeposition can also lessen nitrogen loads in the water column through burial and nitrification-denitrification, or the coupled process by which microbes convert reactive ammonium into nitrate, which is subsequently converted to nitrogen gas and removed from the system (Ayvazian *et al.*, 2021). In addition to filtration, some farming systems (e.g., floating oyster gear) possess the added potential to decrease wave action which may lessen the impact of shoreline erosion adjacent to the farm site. Shellfish aquaculture operations can even be set up in areas that aren't necessarily suitable for wild shellfish colonization, in turn providing robust ecological benefits in areas that otherwise may not receive them.

The shellfish aquaculture industry can produce negative externalities, however. For example, derelict gear, or equipment dislodged or otherwise lost from an aquaculture operation, can be potentially harmful to marine life. While no shellfish farmer intends to lose gear, some degree of loss is inevitable due to bouts of severe weather and aging equipment. This can lead to debris washing up on marshes, beachfronts, or other habitats adjacent to aquaculture operations, though it is best practice (and most economical) to anticipate impending scenarios that may lead to gear loss and take appropriate measures to reduce such loss. Most aquaculture operations and trade organizations like the Virginia Shellfish Growers Association will readily respond to calls and aid in the retrieval of derelict gear in their area. While aquaculture operations can positively impact submerged vegetation, they also have the capability of harming seagrass beds through shading and bottom disturbance which can lead to significant loss of vegetation directly under aquaculture gear (Howarth *et al.*, 2022). This impact, however, is limited to the given farm site and is often mitigated entirely during the application process for aquaculture leases, where new proposed leases sited near seagrass beds are heavily scrutinized and those that are applied for within seagrass bed boundaries are typically denied. Additional information on potential issues and best management practices regarding bivalve shellfish farming can be found at the East Coast Shellfish Growers Association.

Even with potential negative impacts in mind, shellfish aquaculture in Virginia is one of the most environmentally conscious and net-positive food systems the Commonwealth has to offer. Shellfish farmers tend to be staunch stewards of the environment they work in, as their livelihoods are directly impacted by the health of the waterways from which they draw their sustenance and personal satisfaction. A healthy aquaculture product is just one part of a broader coastal ecosystem, and aquaculture operations throughout Virginia are striving to create a healthier environment to the benefit of all flora and fauna found within.

CLIMATE OF VIRGINIA

Clay Ferguson, VA Dept. of Wildlife Resources

Virginia's tremendous biodiversity is enabled by a diverse range of climates. Spatial variability in temperature and precipitation patterns result in six distinct climate regions within the Commonwealth, labelled east-to-west in **Figure 3.12** as: 1) Tidewater, 2) Eastern Piedmont, 3) Western Piedmont, 4) Northern, 5) Central Mountain, 6) Southwestern Mountain. Some of this climatic diversity is explained by Virginia's 3-degree span in latitude, measured from the North Carolina border to the northernmost

piked corners that help shape parts of Maryland and West Virginia. But political boundary lines alone cannot explain the Commonwealth's regionally exceptional climatic differences. For instance, summer middays that rival Florida's heat and humidity across the Eastern Piedmont can simultaneously feel like a pleasantly moderate New England summer day in the high terrain of the Southwestern Mountains. Likewise, winter nights in the Central Mountain region can rival the bitter, blustery cold of a Chicago blizzard, while, at the same time, register calm, well-above-freezing conditions in the Tidewater region. The land and waterscape features that engender substantial regional variation in Virginia's climate include Virginia's diverse topography, mainland orientation, and ocean proximity, among other influential physiographic features.

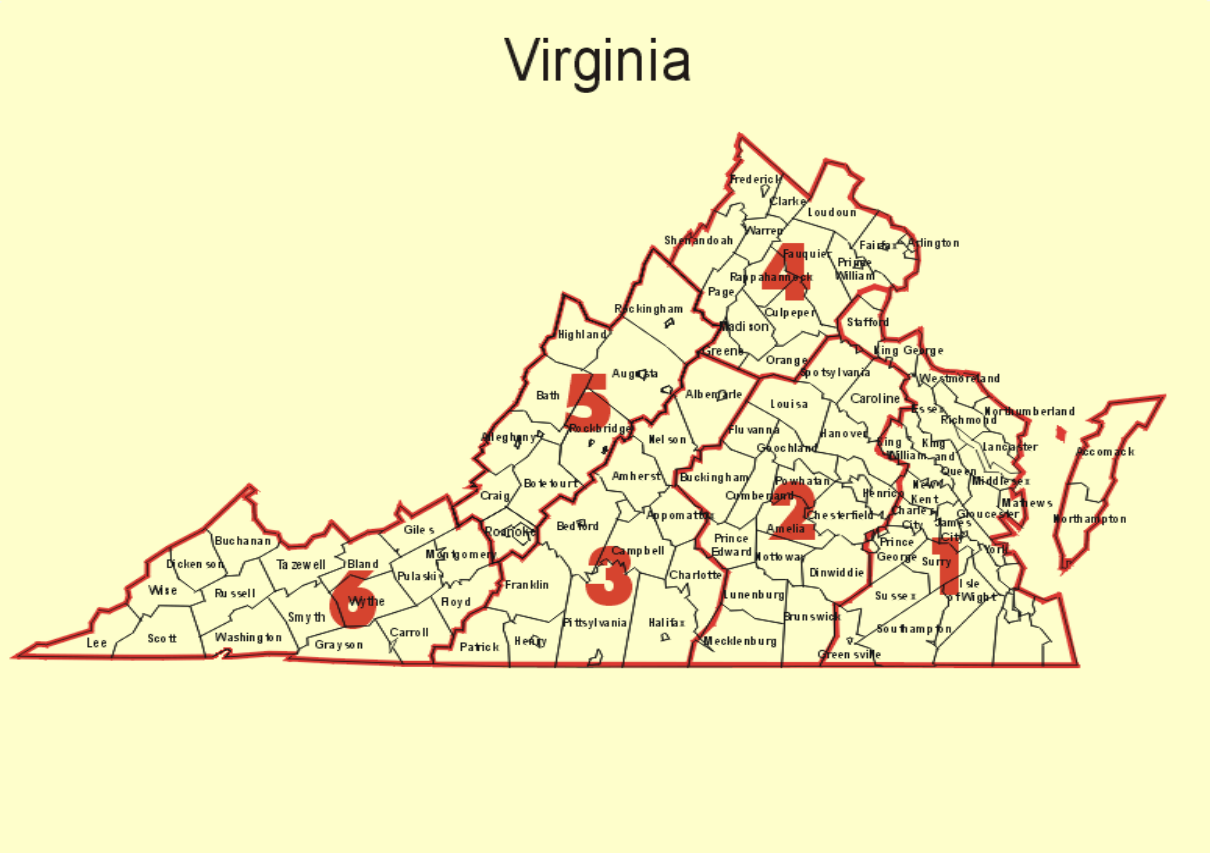


Figure 3.12 – The six distinct climate regions of Virginia, according to the National Weather Service: 1) Tidewater 2) Eastern Piedmont 3) Western Piedmont 4) Northern 5) Central Mountain 6) Southwestern Mountain.

The climate variables described in this chapter pertain to the latest "normal" climatological conditions, as determined through data collected across the state from 1991-2020 and published by the National Oceanic and Atmospheric Administration's National Center for Environmental Information. Although the shifts and trends that are evident across this mere 30-year period are useful for predicting climate conditions into the future, a later chapter will explore in greater depth how and at what rate environmental change has and is expected to continue shifting Virginia's climatic patterns and subsequent selective pressures on Virginia's flora and fauna. Over the decadal tenure of this second Wildlife Action Plan revision, the climate conditions described below will be considered normal for the state.

Precipitation and Storm Patterns

Precipitation does not hydrate Virginia evenly. Several high-elevation summits and mountain sides average more than 70 inches of liquid-equivalent precipitation each year, at par with much of Africa's tropical Congo Region. On the other hand, some central and western regions of the state, including valleys directly adjacent to the wettest summits, receive only half that volume of precipitation in the average year. In those drier regions of the Commonwealth, moisture profiles more closely match the annual precipitation patterns for the semi-arid state of Nebraska. When averaged statewide, Virginia receives over 45 inches of precipitation every year with no distinct dry season, although monthly precipitation totals are about an inch greater than the annual mean from late spring through early fall (Figure 3.13).

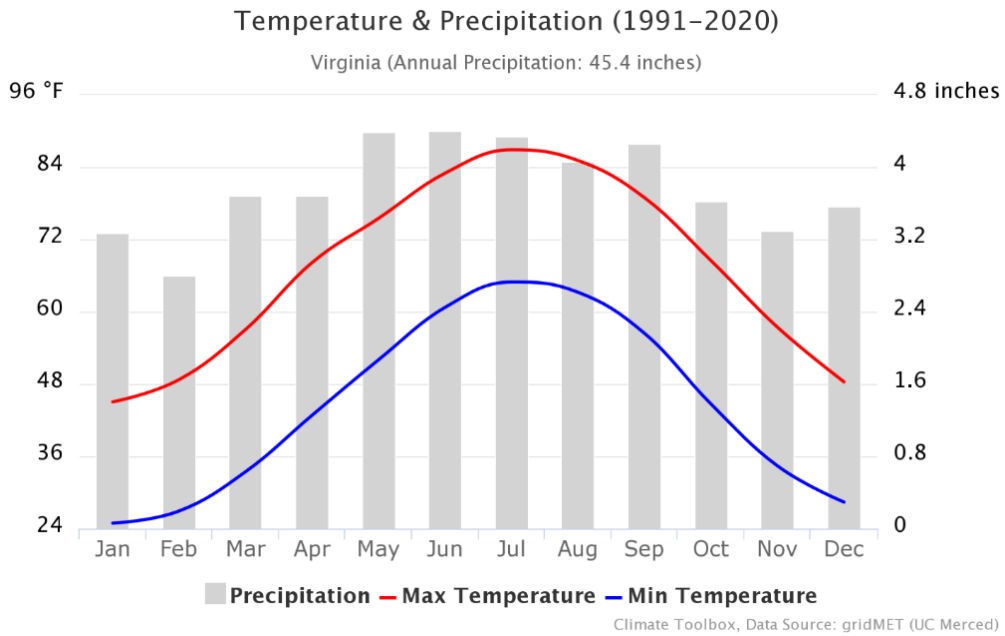


Figure 3.13 – National Oceanic and Atmospheric Administrations calculated normalized, 30-year period climate data for the state of Virginia. Temperature curves, like precipitation bars, reflect monthly averages in maximum and minimum daily temperatures.

As **Figure 3.14** illustrates, some years deviate significantly from the 45-inch average as a result of widespread flooding or droughts. Year-to-year vagaries in precipitation maintain dynamic pressures on Virginia's ecosystems, advantaging species that can tolerate a wide spectrum of moisture conditions.

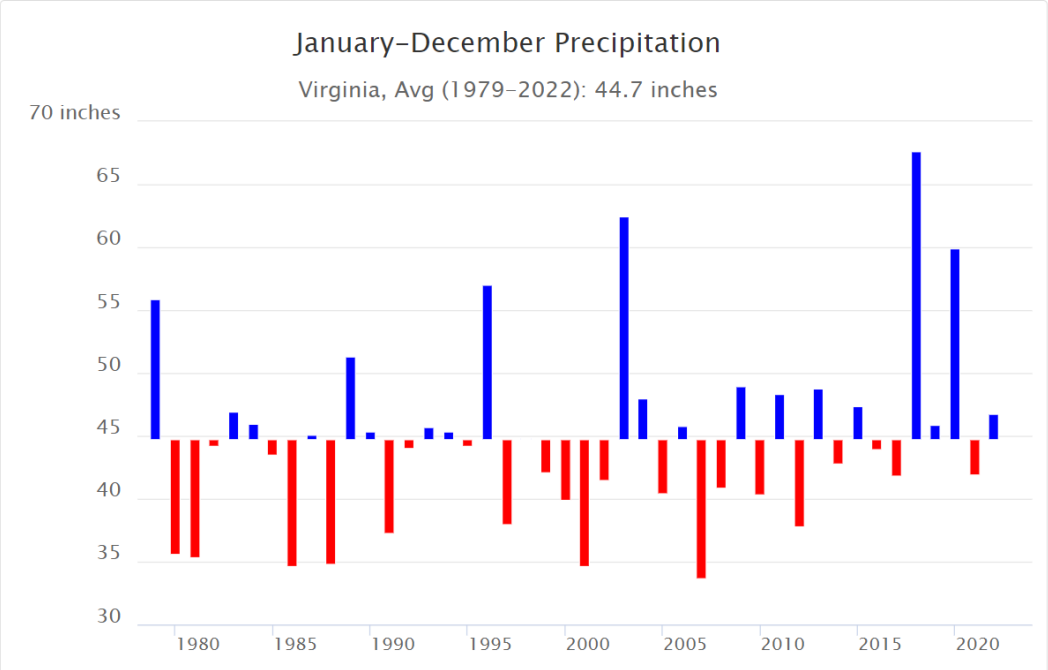


Figure 3.14 – Statewide precipitation averages over the past 43 years. Climate toolbox – University of California.

Regional disparities in precipitation can be attributed largely to the size, location, and orientation of Virginia's mountain ranges, river systems, and coastlines. The Appalachian Mountain range is often first to influence precipitation patterns across the state, since the plurality of storms entering Virginia in the average year move west to east, guided by the Coriolis-driven jet stream. These continental storms grow with the merging of warm, evapotranspiration-filled air from the Gulf of Mexico and Mississippi River Valley, and as they approach the Commonwealth, moist air is deflected upward by the Appalachian's western flank (**Figure 3.15**). Water vapor subsequently cools in the upper atmosphere and condensates in mass, inducing heavy precipitation. This topography-driven phenomenon is referred to as orographic precipitation and explains why far-southwest Virginia is consistently one of the wetter regions of the state. Over the past 30 years, parts of Lee and Wise County have averaged more than 55 inches of precipitation annually, with years of 60 plus inches occurring roughly 25 percent of the time (NOAA NCEI Normals Mapper).

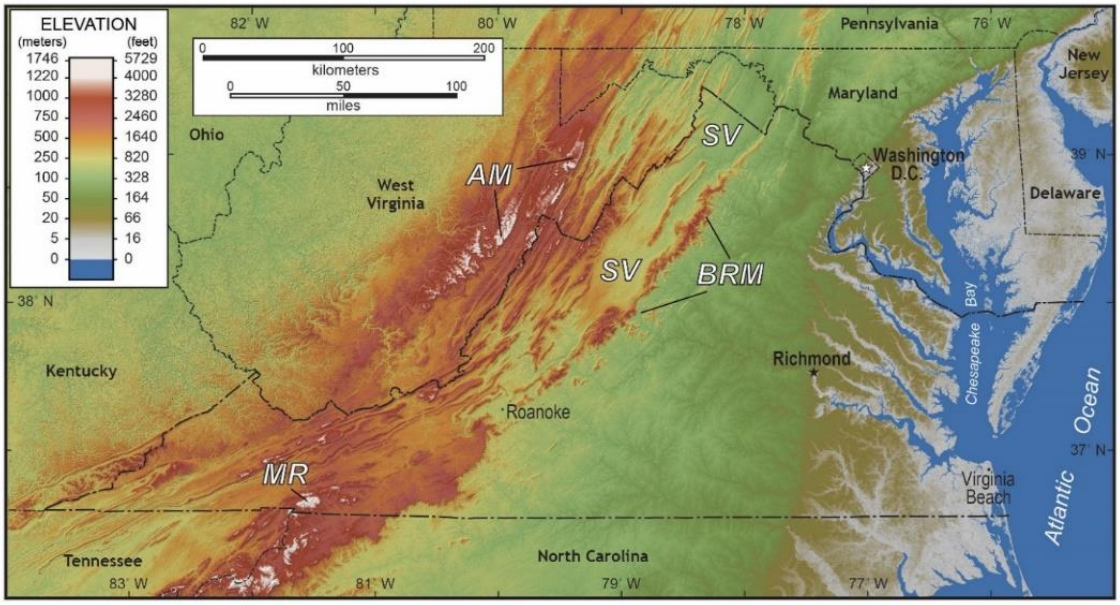


Figure 3.15 – Elevation map of Central Appalachia, with key landmark features centered in Virginia. BRM = Blue Ridge Mountains, SV = Shenandoah Valley, MR = Mount Rogers (Virginia's tallest peak), and AM = Alleghany Mountains of Western and West Virginia. Sourced from Bailey 2016.

Continental storms that make it up and over central Appalachia descend into Virginia's ridge and valley and western Piedmont terrain where they mix with warmer surface air that stifles condensation and resultant precipitation. With these eastern-advancing weather systems, eastern-facing mountain slopes are said to be in the mountain's rain shadow, or on the dry leeward side, and usually receive just a fraction of what fell on the western, windward mountain sides. The typically weakened and fragmented fronts continue their eastward journey across the Piedmont where they slowly regain precipitation potential by warming and rising higher in the troposphere, again where cooler air excites condensation. Fed steadily by an infusion of evapotranspiration coming off Virginia's river and riparian systems, storms tend to follow major rivers like the James and Rappahannock as they meander east towards the Chesapeake Bay and Atlantic Ocean. If this pattern sets in during the summer, when evapotranspiration rates peak, areas of the Piedmont most distant from major river systems can fall into periods of intense drought. These droughts can extend into the Coastal Plain but fronts typically reassemble by then with moisture supplements from the exceptionally humid coast.

Nevertheless, the eastern flank of the Appalachian Mountains, specifically the eastern-facing Blue Ridge mountains, consistently register the greatest annual precipitation totals (**Figure 3.16**). This is because the occasional storms, fronts, and systems tracking north from over the Gulf of Mexico or Atlantic Ocean are responsible for over half the state's precipitation. When precipitation moves into Virginia from the coastal southeast and abuts the eastern Blue Ridge escarpment, heavy orographic precipitation commences. Most of Virginia's highest-record flooding events have occurred when a strong oceanic storm stalled out against the eastern Blue Ridge. Such incidents have resulted in the dramatic reshaping of river channels within their floodplains or the sloughing off of entire hillsides via mud slides. Historic events like these can be particularly perilous for SGCN with confined distributions or heightened vulnerabilities and is why much focus is given here to increasingly extreme precipitation events.

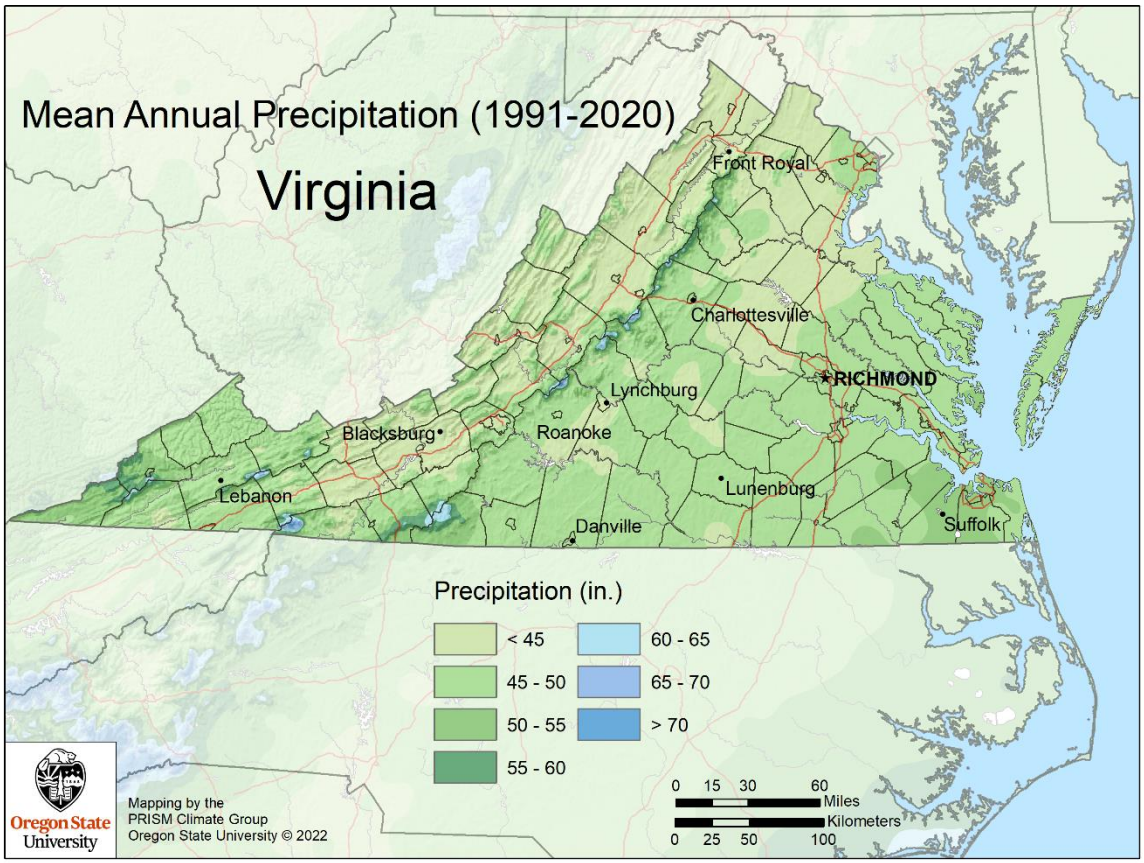


Figure 3.16 – Normalized, statewide precipitation totals map. PRISM climate group.

In the average year, ocean-sourced precipitation more than makes up for the precipitation that the Appalachian Mountains deprive Virginia's eastern terrain, except for the valleys that are bordered by mountains both to their west and east. As was noted by Hayden and Michaels in a previous Virginia climate summary (2011), "[w]hen the [air]flow is from the west, the New River and Shenandoah River valleys are in the rain shadow of the Appalachian Mountains; when the airflow is from the east, they are in the shadow of the Blue Ridge Mountains. As a result, both the New River and the Shenandoah River valleys are the driest portions of the state," averaging under 40 inches in a normal year. Furthermore, because the respective rivers flow north through both valleys, when occasional storms line up with the river's direction and drops into the bowl of the valley, leeward air currents force clouds down where condensation is less conducive. While some degree of drought is expected in these valleys each year, it is also normal for at least some other region of the state to endure a similar drought each year. And while droughts can strike anywhere, historic regional land-use practices, particularly industrial timbering and farming, alter evapotranspiration cycles and have been increasingly linked to drought proneness in-place and downwind (Marengo et al. 2018). Increased adoption of land-stewardship practices aimed at improving the water-holding capacity of soils are helping, but progress is difficult to discern amidst simultaneous growth in industrial land development. Like industrial farming, rapid expansion of

impervious surfaces via urbanization has demonstrated intensification of local drought and flood events (Roy et al. 2022).

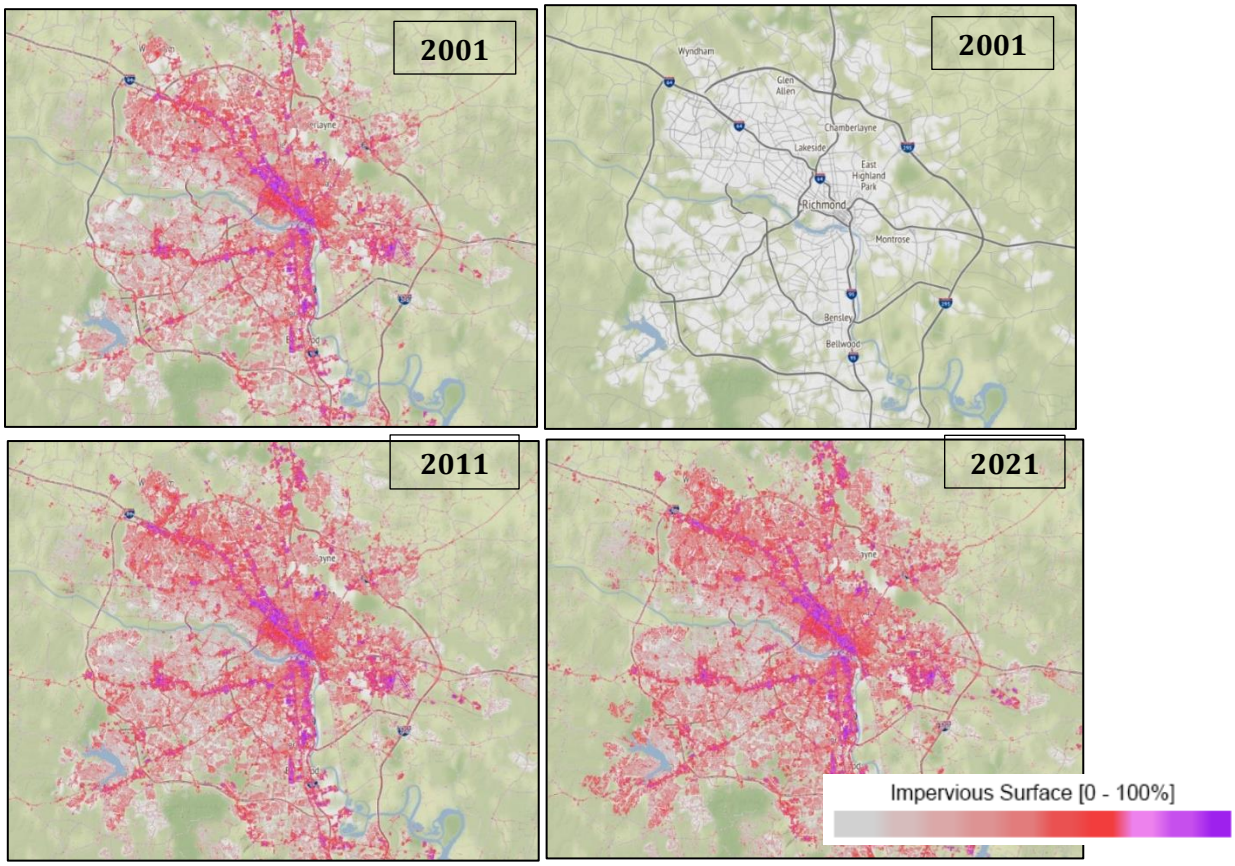


Figure 3.17 - Impervious surface-area coverage of Virginia's greater Richmond area. Images were derived from USGS Multi-Resolution Land Characteristics National Land Coverage Interactive Viewer web application

Storms sourced from the Atlantic and Caribbean oceans, and Gulf of Mexico can manifest in diverse temporal, spatial, and intensity scales of precipitation. Some systems deliver gentle soaking rains over extended periods of time, while others deliver extreme downpours in relatively short spurts. Of the various types of oceanic storms impacting Virginia, hurricanes often garner the most attention because of their acute, high-energy impacts capable of transforming built and natural infrastructure with the violent battering of wind, rain, and waves. The Bermuda High, a dynamic high-pressure system over the Northern Atlantic, is a major determinant of where hurricanes make landfall and subsequently traverse the continent (**Figure 3.18**). A narrow and contracted Bermuda High sends hurricanes north up the Atlantic seaboard, whereas a range extended Bermuda High funnels hurricanes west into the Gulf of Mexico. The former can result in a direct hit to Virginia's Coastal Plain, where damages are most severe Virginia's marine and estuarine ecosystems. However, hurricanes that end up impacting Virginia more commonly make landfall along Gulf shores and recurve northeast towards the Atlantic Ocean.

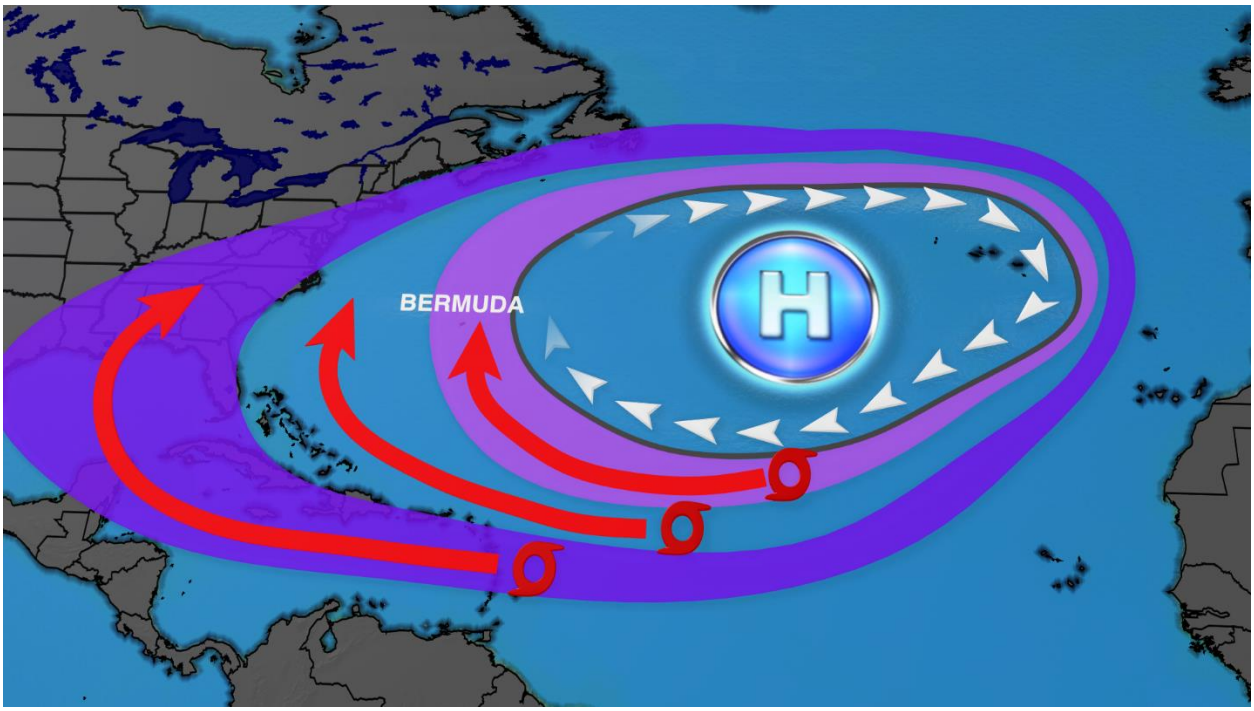


Figure 3.18 – The Bermuda High pressure extension scenarios and resulting pathway influence of tropic storms. Thomas (2021) Action News 5, Memphis Tennessee.

During peak hurricane season, typically September, tropical storms and hurricanes can contribute up to 40 percent of the state's monthly rainfall, rarely less than 10 percent (Hayden and Michaels 2011). Hurricane season for the Atlantic's northern hemisphere typically starts in June and goes through November.

Nor'easters are the other major ocean-originating storm system that impact Virginia. They are aptly named after the strong and persistent winds that blow in from the Northeast Atlantic, often days ahead of the storm. If the foreshadowing winds sustain for days, wind-driven storm surge can dramatically inundate coastal lands. Waves have reached, but are not limited to, 30 feet in height (ACS UVA, 2010). Like hurricanes, severe Nor'easters often result in transformed coastal habitats, saltwater-inundated coastlines, and extreme inland precipitation. However, Nor'easters are massive, slow-moving systems that can span 1,000 miles and unload their disturbance over relatively long durations of time. While hurricanes rarely hit Virginia directly, the Commonwealth lies at the center of the typical latitudinal band where Nor'easters make landfall along the eastern seaboard. Moreover, because Nor'easters tend to develop during the winter and early spring in a more northern reach of the Atlantic, they are "cold-core" systems that are as likely to precipitate snow and ice as they are cold rain. As they move inland, precipitation can intensify, particularly if polar air from the continental jet stream is nearby to force the ascent of warm-moist oceanic air. An oft-cited example of a Nor'easter that intensified upon landfall was the blizzard of December 1989, which resulted in the first-ever recorded white Christmas for the entire Atlantic Coastline. **Figure 3.19** reveals the expansiveness of the most recently memorable Nor'easter to hit New England and the Mid-Atlantic. Coastal forces of these magnitudes exert great pressures on species inhabiting Virginia, and when severe enough, can serve as singular events that restrict which species persist in the state. For species whose northernmost range is expanding into

Virginia as a result of warming temperatures, a single Nor-easter can knock back decades of range expansion. Conversely, the same Nor'easter might offer a high-latitude, cold-loving species a few more years of competitive advantage before their predicted extirpation due to increasing temperatures.

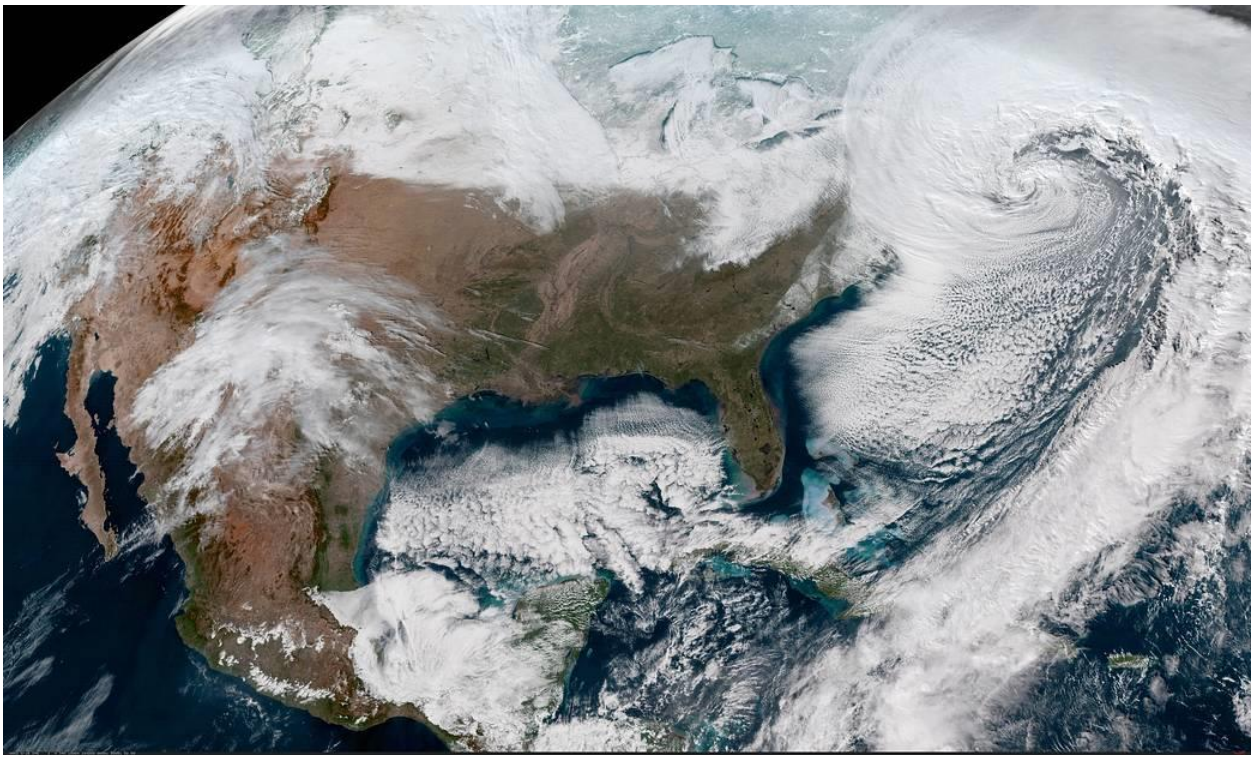


Figure 3.19 – Satellite view of the powerful January 2018 Nor'easter that engulfed much of the Northern U.S. in a harsh blizzard.

Virginia's wintertime temperatures are more likely than moisture availability to be the determining factors as to how much precipitation falls as snow and ice in a given year. It is rare for measurable snow or ice to fall outside of winter, except for select areas of Virginia's highlands. Naturally, mountainous regions of the state receive far greater winter weather than the Piedmont or Coastal Plain. The western sliver of Highland County, Virginia's snowiest area, receives 20 annual snowfall events of one inch or more and well over 40 inches in the average year, all despite being in the snow shadow of West Virginia's Alleghany Mountains, just a few miles away from where some of the highest annual snowfall accumulations in the Eastern U.S. are recorded, at more than 100 inches (Hayden and Michaels 2011). Conversely, because surface waters of the Chesapeake Bay and Atlantic Ocean retain the solar heat of summer well into the first part of winter, snowstorm development along the eastern part of the state is unlikely, though not impossible. But again, and not coincidentally, the eastern flank of the Blue Ridge accounts for the state's heaviest single and multi-day snowfall events. The top five three-day snowfall records in Virginia belong to the northern Blue Ridge range; of which the blizzard of 1996 is the most significant at 49 inches in Madison County (NOAA 2023). As increasing temperatures makes for milder Virginia winters, sleet and freezing rain become more likely outcomes of high-moisture cold fronts. This is an important trend for SGCN and their habitats because freezing rain can damage large enough swaths of vegetation to induce population-level impacts.

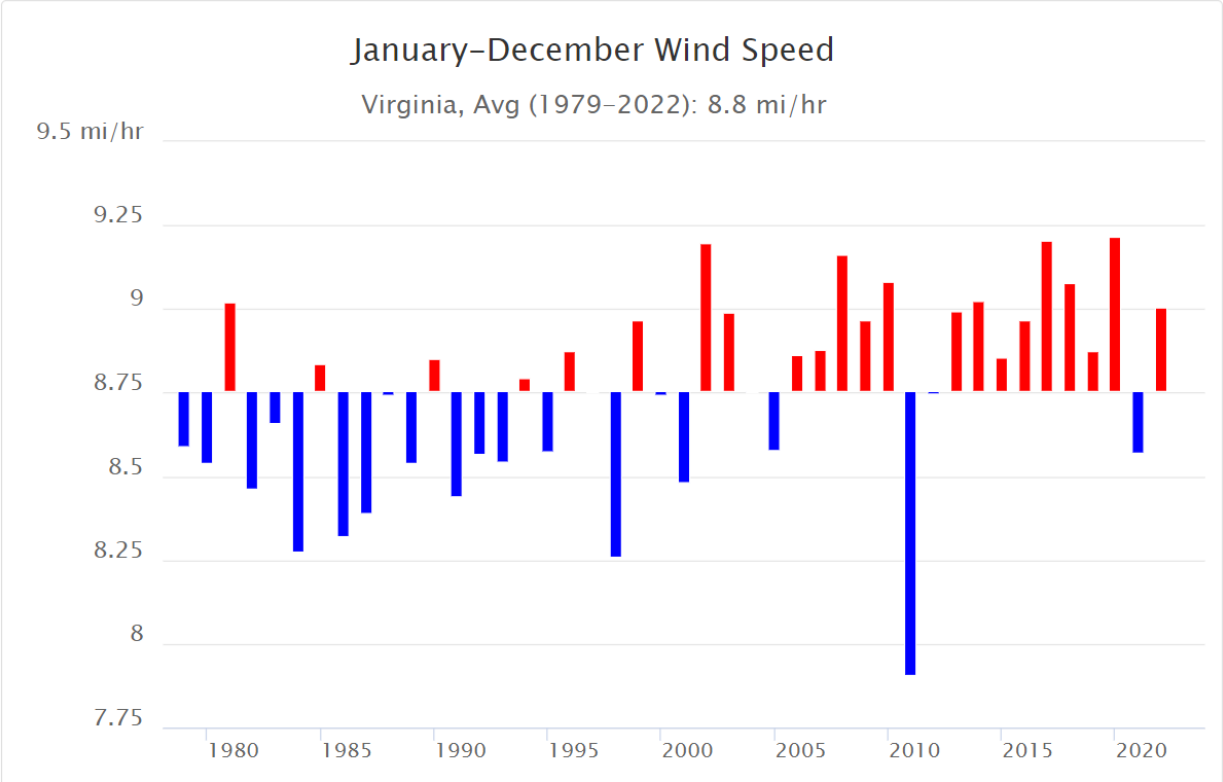


Figure 3.20 - Statewide windspeed averages over the past 43 years. Climate toolbox – University of California.

Tornadoes are not particularly common in Virginia, relative to many other states. Over the past 25 years, Virginia has averaged 20 per year, comprising about 1 percent of the nation's total annual tornadoes (NOAA 2023). April, May, and September account for over half of Virginia's tornadoes, which coincide with the typically windy spring and peak hurricane season – hurricanes routinely spin off tornados as they unload energy inland. With a nine-mile-per-hour average wind speed (**Figure 3.20**), Virginia is not a relatively windy state – likely a result of Virginia's heavily forested landscape and state-spanning mountain ranges. Naturally, wind speeds are greatest where air-fetch is minimally impeded, along the coastline and atop bald Appalachian summits.

Temperature

The average annual temperature in Virginia registers at 55.6°F but can range considerably from year to year. Over the most recent "normalized" 30-year period (1991-2020), average annual temperatures have diverged from the mean low of 53.6 °F (1996) to a mean high of 58.2 °F (2012) (**Figure 3.21**).

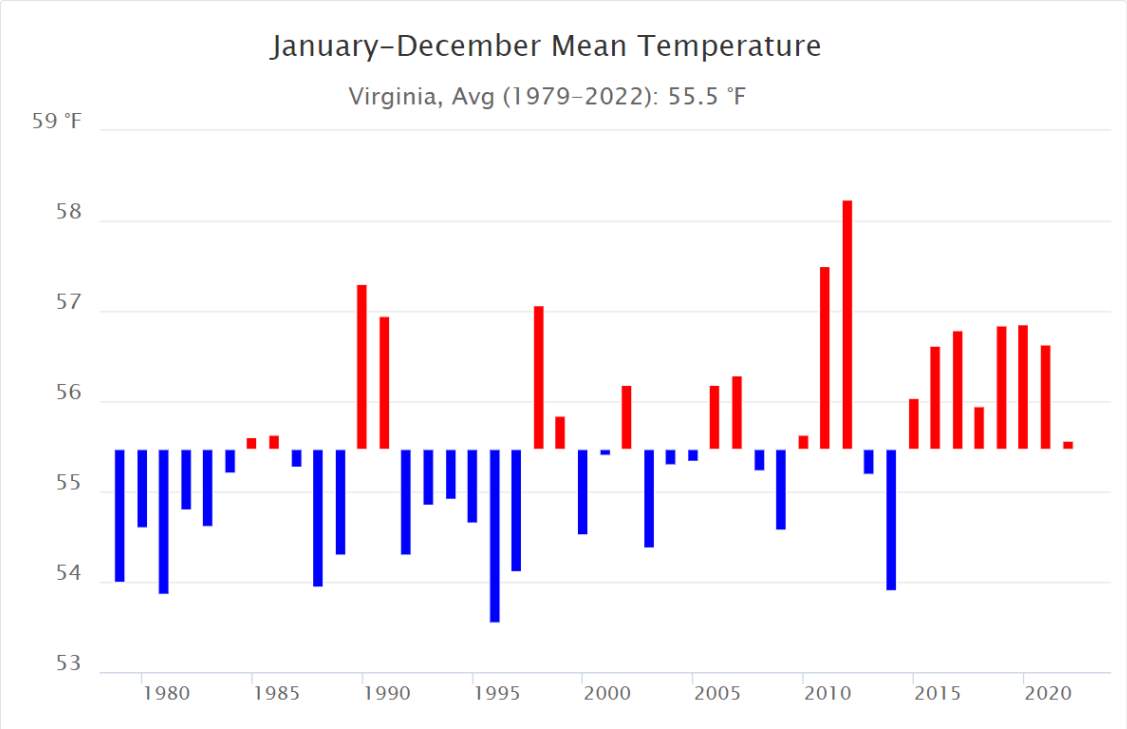


Figure 3.21 - Statewide temperature averages over the past 43 years. Climate toolbox – University of California.

Like precipitation, variance in temperature patterns across the Commonwealth is primarily a function of topography and coastal proximity. Virginia has five mountain peaks that extend beyond 5,000 feet in elevation, the tallest of which is Mount Rogers at 5,729 feet above sea level (**Figure 3.22**). Mount Rogers

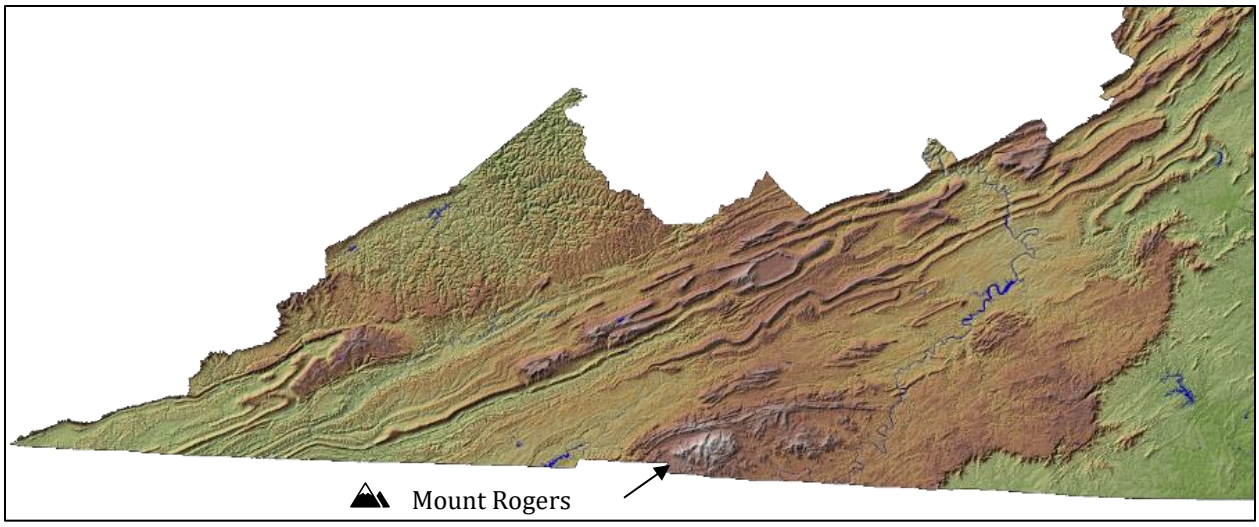


Figure 3.22 – US Geological Survey (USGS) NED Shaded Relief topographical layer of Southwest Virginia, featuring Mount Rogers, VA's tallest peak at 5,729 feet above sea level. Virginia's other four summits above 5,000 feet in elevation are within 7 miles of Mount Rogers.

substantiates the general rule that average temperatures fall 3.5°F for every 1,000 feet ascent in elevation, as it averages approximately 20° F cooler than the Tidewater, year-round. However, because Mount Rogers is near Virginia's southern border, several summits at lower elevations but more northerly reaches of the Commonwealth are comparable in coolness to the state's true pinnacle

(VP.org). Thus, the topography of Virginia "usually masks the 3° latitudinal difference between the state's southern boundary and its northernmost point," noted Terwilliger (1991).

Virginia's generally humid, subtropical climate is the product of a near-middle latitude (upper 30°s Lat) and warm coastal influence. The moist, warm air entering Virginia from the Gulf Stream offshore is effectively illustrated by the orange-to-red colored cells in **Figure 3.23.** Most of that land area is below 2,000-foot elevation and categorically falls under Köppen climate classification code *Cfa*: temperate with no dry season and a hot summer (≥ one month above 71.6°F). While parts of the Western Piedmont, Northern, and Southwestern Mountain regions marginally qualify for this climate class, Tidewater cities

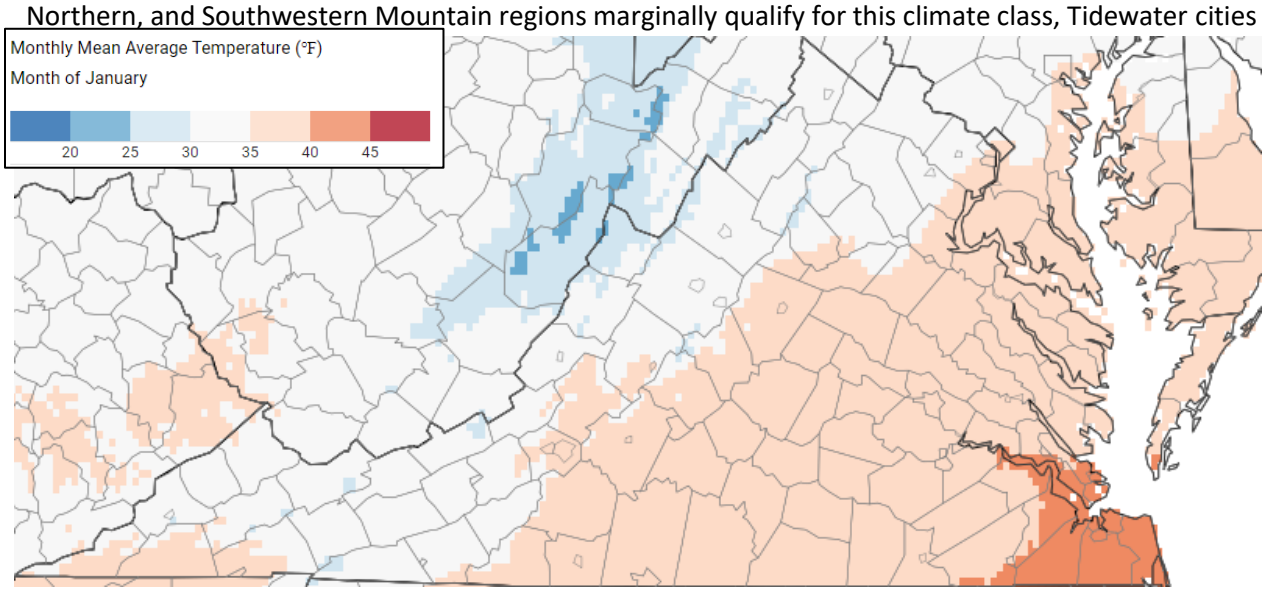
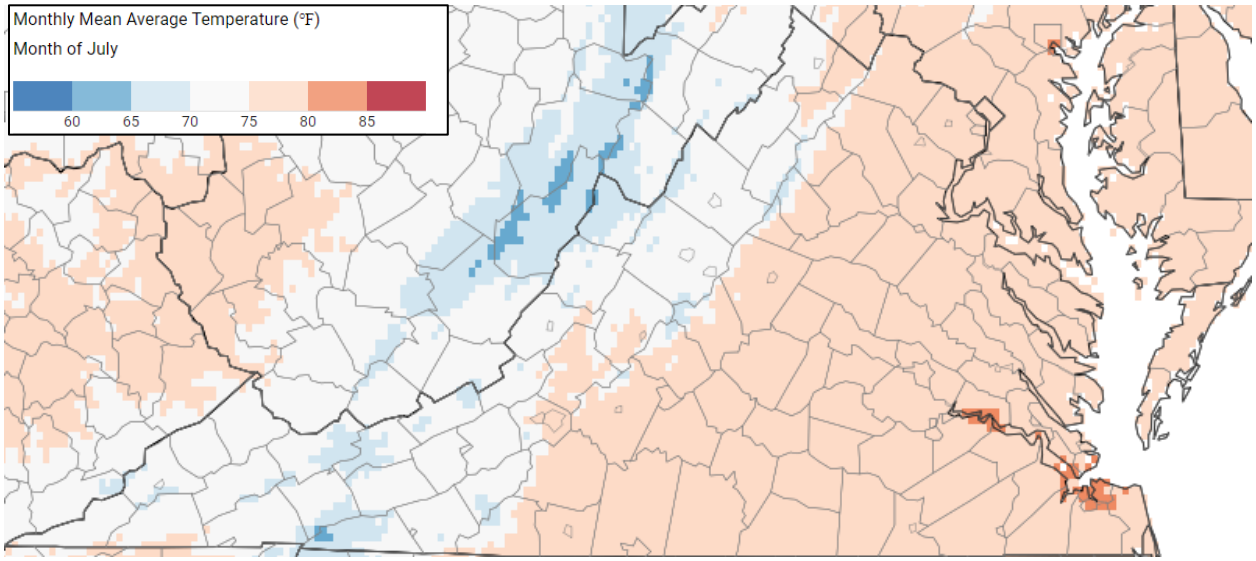


Figure 3.23 – Above, 1991-2020 normal-mean temperature for the month of January (range from 22.86 to 41.75°F). In contrast below is the 1991-2020 normal-mean temperature for the month of July (range from 61.19 to 80.19 °F).



like Chesapeake and Portsmouth fall firmly within the *Cfa* bounds, consistently recording the state's warmest temperatures throughout the year. The mountainous regions qualify Virginia for two other Koppen climate zones, *Dfa* and *Dfb*, the former being associated with white cells and the latter with the select blue cells in **Figure 3.23**. Both zones are associated with milder summer and colder winter

temperatures. These cooler zones, particularly *Dfb*, serve as key thermal refuges for heat-intolerant species. As changing environmental conditions continues to shrink *Dfb* and *Dfa* climate zones to isolated mountain ridges and peaks, so too will the population ranges of remnant cold-obligate species.

Mountainous topography and ocean influence also regulate plant and wildlife phenology. The peak flush of springtime blooms and buds moves northwest across the state, mirroring the heat maps shown in **Figure 3.23**. Virginia's frost-free growing season averaged nearly 194 days from 1991-2020, more than half the year (**Figure 3.24**). But like other climatic variables, the growing season varies considerably across regions of the state. In the average year, southeast Virginia, including the Eastern Shore, experiences three additional months of growing season over the more mountainous parts of western Virginia (STEM), such as Virginia's highest valley, Burkes Garden. Such dramatic differences translate to unique floral and faunal compositions across the state and its four distinct seasons.

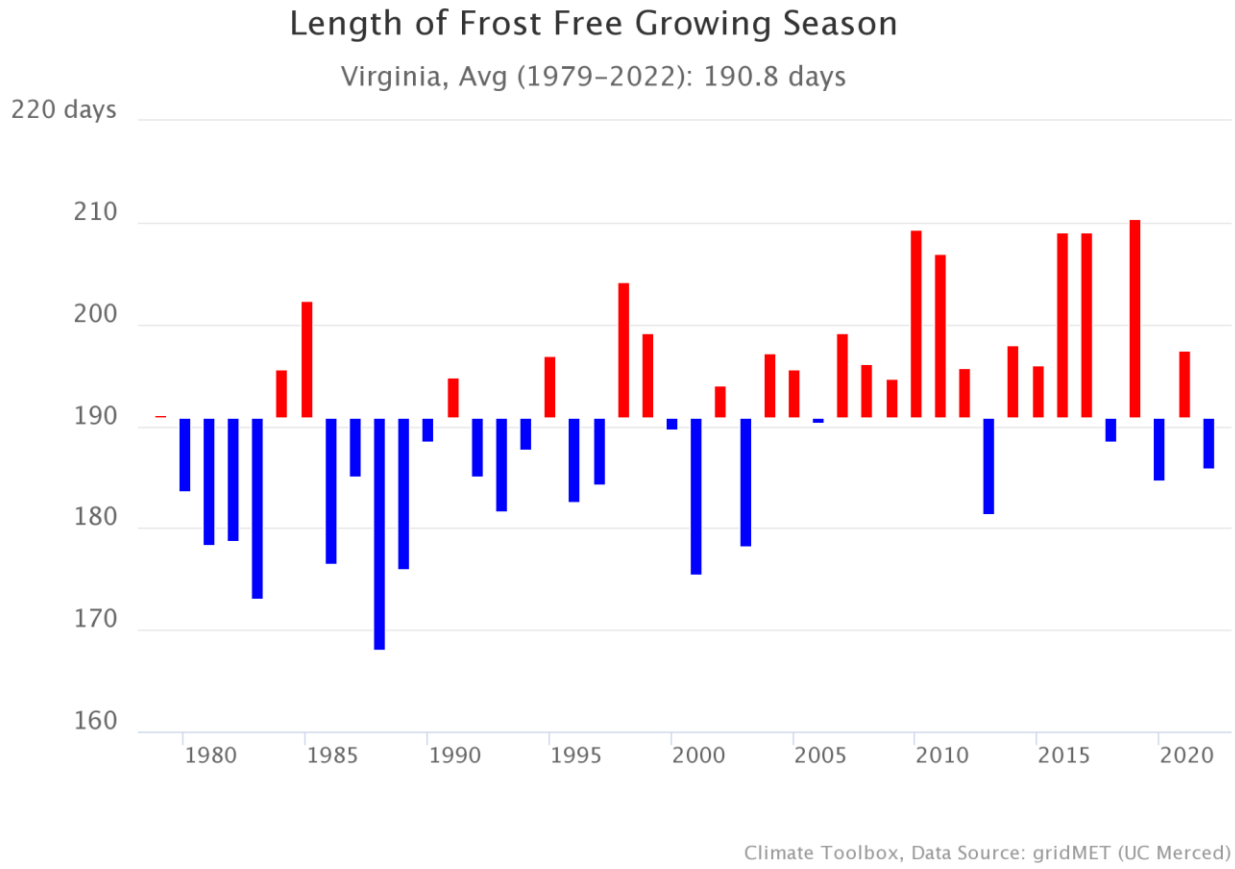


Figure 3.24 – Average length of frost-free growing season in Virginia. When clipped to the normalized data range of 1991-2020, the average climbs to 193.8 days. Climate toolbox – University of California.

Given the emphasis placed here on discerning the state's regional climates, it is worth noting that the lines dividing the six regions (**Figure 3.12**) are fluid and subject to considerable movement year to year. It is, for example, not exactly uncommon for the Central Mountains to experience temperatures and precipitation more normal to the Western Piedmont, and vice versa. The expansion or shrinking of regional climates further complicate climate dynamics experienced by Virginia's biota.

4. THREATS

Overview

Threats and conservation actions are described at the species level, with the DWR's taxonomic teams pairing each SGCN with three high-priority threats and three associated conservation actions. To develop these sections, the authors tasked the TACs with first identifying three threats drawn from the Conservation Management Partnership's (CMP) Direct Threat Classification Lexicon. This approach allows for population impacts to be classified using a standardized definition and coding system. This tactic was recommended by the Northeast Association of Fish and Wildlife Agencies so as to allow for comparable species impact narratives and regional aggregate statistics to support multi-state and regional conservation initiatives. The TACs were then asked to write a short description on the conservation action recommended to address the associated threat; unlike the threats, these action descriptions do not follow standardized definitions, and TACs were encouraged to include whatever narrative information would be most useful to managers in Virginia. By standardizing the threats but not their corresponding actions, the authors intend to build a Plan that is both useable to a wide variety of potential partners and aligned with regional assessments and conservation efforts. It should be noted that some issues were considered as part of larger considerations. Issues like solar farms, data centers or loss of beach habitat may have been lumped underneath larger issues such as habitat loss or sea-level rise instead of being called out specifically in each instance.

The 2015 update of the Wildlife Action Plan attributed threats at the habitat level and subsequently paired them with the SGCN which lived in those habitats. For the 2025 Update, the authors have departed from this strategy for two reasons. First, some SGCN are most directly impacted by threats which are not habitat related. Examples of such threats include high-impact pathogens, a major threat to several terrestrial mammal SGCN, and poaching/illegal pet trade, a major threat to several marine and reptile SGCN. Additionally, threats which may be habitat-centered are often best addressed with conservation actions which are unique to a particular SGCN and therefore not uniform across a particular habitat type. The habitat type summaries found on page 28 also include expert assessments on the biggest threats affecting each of these areas and the conservation actions which support broader landscape recovery.

The SGCN threats and associated conservation actions included in this section are not ranked by importance, conservation opportunity, or any other metric. All three threats are considered equally as the most paramount concerns for each SGCN. Whenever possible, the authors attempted to capture threats and actions which are manageable at a local or near-local scale. However, many SGCN required threat narratives centered around systemic challenges such as changing environmental conditions or environmental regulatory structures. As with Element 1 and Element 2 of this Plan, all data were first provided by the DWR's taxonomic efforts, then reviewed by the Stakeholder Advisory Committee, then re-verified by the taxonomic experts before final review from the Plan authors.

The NE Regional Conservation Synthesis summarizes the issues and problems identified in the 14 Northeast Wildlife Action Plans that may adversely affect regional SGCN or their habitats. It also describes the priority research and survey efforts needed to support restoration and improved

conservation of these species and habitats. Following the development of the 2015 Plans, the Northeast State Wildlife Action Plan Synthesis: Regional Conservation Priorities report synthesized the threats to both species and habitats identified in the 14 individual state Plans (TCI and NEFWDTC 2017). The Conservation Measures Partnership (CMP) and the International Union for Conservation of Nature (IUCN) have developed several threat classification systems, which were advanced by Lamarre *et al.* (2021) for use in Quebec. This classification system is consistent with the older classification systems and was modified to include relevant threats for the Northeast. The only change the Virginia staff made to the threat codes was to specifically add Data Centers to the Residential & Commercial Development codes under 1.2.1 Commercial & Industrial Areas. This was done in response to a request from the Rappahannock Tribe to specifically call out data centers for their impacts to land and water and their energy requirements.

1. **Residential & Commercial Development** – This threat refers to all human settlements (cities, towns, etc.) or non-agricultural land uses with a substantial ecological footprint. It includes habitat conversion that is associated with early phases of development (deforestation, filling/excavation, drainage, etc.), as well as infrastructure use, maintenance and subsequent impacts that are related to the presence of infrastructure (e.g., birds flying into window) It excludes transportation- and pollution-related issues.

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

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

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

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

        1.2.1. Commercial & Industrial Areas – e.g., industrial parks, manufacturing plants, offices, shopping centers, all military base facilities, power plants, seaports, shipyards, airports, and data centers (includes impacts resulting from development, water withdrawal impacts and energy supply requirements.)

        1.2.2. Open Dump Sites – open-air facilities that are used to dispose of materials or to store them prior to recycling. E.g., automobile junkyards, metal recycling centers

1.2.3. Landfills

1.2.4. Nuclear Waste Disposal Facilities

1.3. Tourism & Recreation Areas – Tourist sites or recreational facilities with a significant ecological footprint. Excludes residential infrastructures.

1.3.1. Parks and Sports Fields – areas that are intensively managed (e.g., grass-cutting, thinning of woodlands) and are primarily designed for recreational activities, such as walking in urban parks and sports. Also includes outdoor sites that are managed for prayer or mourning (cemeteries)

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

1.3.3. Ski Resorts – rights-of-way of ski trails (managed areas of the hills) and service facilities (ski lifts, visitor centers, etc.)

1.3.4. Recreational Trails – creation of trails in parks (see Parks and sports fields, Threat 1.3.1) or areas outside the urban environment for walking and recreation. Includes the creation and maintenance of trials in recreational parks as well as private properties. Excludes activities that are related to the use of the trail (e.g., hiking, Threat 6.1.2).

1.3.5. Docks & Marinas – high-impact infrastructures that are associated with recreational boating. To be distinguished from the activity of recreational boating itself (Threats 6.1.4) and includes local dredging. E.g., docks, marinas, boat launches.

2. **Agriculture & Aquaculture** – Threats from agricultural activities, such as the expansion and intensification of agriculture and livestock farming, including silviculture, mariculture, and aquaculture and related infrastructures. This includes the initial conversion of habitat (deforestation, filling/excavation, draining of wetlands, etc.) that is associated with cultivation or infrastructure development, as well as uses and practices (intensification of agricultural practices, use of machinery, etc.), but not the transport of the resources that are produced, crop irrigation, of the resources that are produced.

2.1. Annual & Perennial Non-Timber Crops – Non-timber crops that are planted for food, fodder, fuel or other uses; farms, crop fields, vineyards, mixed agroforestry system, etc. For rotational crops, it is necessary to refer to the most intensive practice that is used. Considered the diversity of agricultural practices and related impacts, some specialty cultures will be pooled into a generic threat category.

2.1.1. Annual Cropping Systems (field crops) – wide-row crops that require the most intensive agricultural practices and which has the most significant impacts. E.g., maize (corn), soybean, barley, vegetable crops, oat, wheat, canola, hemp.

2.1.2. Perennial Cropping Systems – crops that are associated with less intensive agricultural practices that have less of an ecological impact than do annual crops. E.g., pastures, forage crops, hay, alfalfa, clover.

2.1.3. Other Types of Agriculture – specialty crops for which the ecological impacts may vary depending on the practices that are used. E.g., cranberry bogs, vineyards, verry fields, sod production, greenhouse farming.

2.2. Plantations – Wood plantations that produce timber, fiber or other non-timber products that are made from trees and which maintain a certain amount of forest cover year-round. This type of plantation is generally located outside of natural forests and often consists of non-native tree species.

2.2.1. Plantation of Pulpwood – cultivation of hybrid poplars and other species that are used for pulp production.

2.2.2. Ornamental Tree Plantations – e.g., cultivation of ornamental cedars, Christmas tree farms.

2.2.3. Non-Timber Products from Plantation – cultivation of trees outside of natural forests for the production of fruits, nuts, barks or sap. E.g., orchards, walnut production, rubber production

2.3. Livestock and Poultry Farming – Farming of various domestic (cow, pigs, chickens, sheep, goats, turkeys, ducks, etc.) or semi-domesticated animals (llamas, alpacas, etc.); livestock rearing in outdoor pens (farms) or extensive rearing in natural habitat (pastures, ranching). Productivity is measured in terms of animal units.

2.3.1. Outdoor Extensive Livestock Operation (On Pasture)
2.3.2. Outdoor Intensive Livestock Operation (High-Density)
2.3.3. Indoor Livestock Operation

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

2.4.1. Marine Finfish Aquaculture
2.4.2. Finfish Aquaculture in Outdoor Tanks
2.4.3. Finfish Aquaculture in Indoor Tanks
2.4.4. Algae Cultivation
2.4.5. Marine Shellfish Cultivation – e.g., oyster farming and cultivation of other shellfish (scallops, mussels, softshell clams, etc.)

3. **Energy Production & Mining** – Threats from the production/development of non-biological resources, including the conversion of the original habitat, development of necessary infrastructure, as well as uses and practices (use of machinery, exploration, excavation, drilling and storage of ore or drill cuttings, tailing ponds, settling ponds, site reclamation after development, etc.). Excludes the transport of resources (threat 4) and contaminants (threat 9). Also includes the impacts of wildlife collisions with the related infrastructure.

    3.1. Oil & Drilling – Exploring for (prospecting), developing and producing petroleum or other hydrocarbons.

        3.1.1. Onshore Oil Development
        3.1.2. Offshore Oil Development
        3.1.3. Oil Development in Freshwater
        3.1.4. Onshore Natural Gas Development
        3.1.5. Offshore Natural Gas Development
        3.1.6. Natural Has Development in Freshwater

    3.2. Mining & Quarrying – Exploring for, developing and producing minerals, rocks and various other substrates (sand, gravel, etc.). Includes trialing treatment (settling and tailings ponds), site expansion and site reclamation after development. This threat does not include the transportation of resources (threat 4) and acid mine drainage (treat 9.2). Although not a mineral resource, peat harvesting induces impacts on the ecosystem that are similar to quarries and sandpits due to the use of similar excavation machinery. E.g., coal mines, mining of various sources of metals (gold, copper, nickel, magnesium, etc.), quarries, sand pits.
        3.2.1. Underground Mines
        3.2.2. Open-Pit Mines
        3.2.3. Quarries & Sand Pits
        3.2.4. Peat Harvesting

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

        3.3.1. Hydroelectric Dams
        3.3.2. Wind Farms
        3.3.3. Hydrokinetic Turbines
        3.3.4. Solar Farms

4. **Transportation & Service Infrastructure Corridors** – Threats from developing, using and maintaining transportation infrastructure corridors (road, pipelines, power lines, etc.) and their rights-of-way. These types of facilities may create obstacles or hinder the natural movement of species in addition to causing disturbances during maintenance (e.g., disturbance of falcon nests during bridge maintenance; widespread avoidance of roads by caribou, etc.). This threat also includes vegetation control during rights-of-way maintenance and collisions with wildlife.

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

4.1.1. Roads
4.1.2. Railroads
4.1.3. Bridges – includes road and rail network bridges.
4.1.4. Logging Roads

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

4.2.1. Power and Service Lines – networks of buildings, towers, pylons and poles that are associated with electricity distribution and telecommunications, excluding hydroelectric dams of power plants (Threat 3.3.1). The scope of rights-of-way may vary according to their size.

4.2.2. Oil & Gas Pipelines – infrastructure network for transporting oil and natural has products aboveground or underground, including seismic lines, but excluding extraction sites (Threat 3.1)

4.3. Shipping Lanes – Threats associated with transportation people and goods on water (oceans, estuaries, rivers, etc.), as well as waterway development. This category does not include activities that are related to creational boating (Threat 6.1)

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

4.3.2. Dredging of Shipping Lanes – dredging in order to facilitate the transit of boats. Excludes dredging within marinas and docks (Threats 1.3.5) and dredging for looks and canals (Threat 4.3.3)

4.3.3. Locks & Canals – creation, maintenance, and use of locks and canals. Includes the associated dredging.

4.4. Flight Paths – Using air space to transport people and goods, excluding recreational activities such as hang-gliding and drones (Threat 6.1)

4.4.1. Flight Paths – flying airplanes, paragliders, helicopters or ultralight aircraft at low altitudes, which could lead to collisions with birds or disturbance of other wildlife. E.g., disturbance of caribou herds by low-altitude training flights.

5. **Biological Resource Use** – Threats that are due to the use/consumption of wildlife biological resources, including the impacts of legal, illegal and unintentional harvesting. The disturbance and control of certain species falls under this threat category, which includes habitat conversion and degradation, the development of related infrastructure as well as the uses and practices that are associated with the latter (e.g., use of machinery, wood storage, soil management). Excludes the transport of resources (e.g., logging roads (Threat 4.1) and peat harvesting (Threat 6.3))

5.1. Hunting & Collecting Terrestrial Animals – Hunting animal species or collecting animal products for commercial, recreational, subsistence, cultural, research study or control purposes. Including hunting terrestrial species and trapping semi-aquatic species. This category also covers incidental captures, control and persecution, but excludes harvesting for research purpose (Threat 6.3)

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

5.1.2. Trapping – harvesting of wild terrestrial or semi-aquatic animal species (e.g., beavers_ by trapping that is governed by management measures. Includes incidental killing, but animal control by trapping should be classified under "Management/control for terrestrial animals" (Threat 5.1.5). E.g., trapping of wild terrestrial or semi-aquatic animals for fur, meat, taxidermy, trophies, non-target birds or prey caught in traps.

5.1.3. Non-Lethal Harvesting of Terrestrial Animal Products – harvesting of terrestrial animal products that does not require the killing of individuals and that is governed by management practices. E.g., down collection, guano collection.

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

5.1.5. Management/Control of Terrestrial Animals – deliberately killing individuals of a terrestrial species for human gain that is governed by management measures. E.g., cormorant culling.

5.2. Gathering Terrestrial Plants or Fungi – Harvesting and gathering wild plants, mushrooms or other non-animal/non-timber species for commercial, recreational, subsistence, cultural, research or control purposes, but excludes research (Threat 6.3)

5.2.1. Recreational or Subsistence Harvesting – harvesting or plant or fungi species that has a lethal effect on the individual and is governed by managed measures. Illegal harvesting should be classified as "Poaching/eradication of terrestrial plants or fungi" (Threat 5.2.4) E.g., recreational or subsistence harvesting of wild leeks.

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

5.2.3. Non-Lethal Harvesting of Terrestrial Plant Products – sub-lethal harvesting of plants or fungi related products, which is governed by management measures. E.g., collecting of cedar bark, tree tapping for sugar maple production.

5.2.4. Poaching/Eradication of Terrestrial Plants or Fungi – deliberate and illegal harvesting of plants or fungi for personal or commercial purposes oreradication due to prejudices against the species. e.g., illegal gathering of American ginseng, eradication of cow parsnip because of its similar appearance of giant hogweed, which is an invasive alien species.

5.2.5. Management/Control of Terrestrial Plants or Fungi – deliberately destroying a plant species or fungi for human gain. Includes indirect or unintended impacts on other species, but excludes cutting or vegetation management due to maintenance activities or early phases of development. E.g., eradication of dandelions from lawns.

5.3. Logging & Wood Harvesting – Harvesting trees/other forest species in natural environments for timber or fiber outside of plantations (Threat 2.2). Includes cutting and the use of machinery, as well as wood storage and debris management, excluding their transport (Threat 4.1) and associated erosion (Threat 9.3)

5.3.1. Complete Removal of the Forest Cover – cutting removing the majority of the forest cover. E.g., clear-cutting and related cuts (CT, CRS, CPRS, CPHRS, CPPTM).

5.3.2. Partial Removal of the Forest Cover – partial cutting of the forest leaving a certain amount of cover. E.g., shelterwood cutting, selection cutting.

5.3.3. Improvement Cutting in Natural Forests – silviculture treatments that alter the composition of the forest to increase the growth of certain plant species. These interventions alter wildlife habitat by affecting the availability of food and shelter. E.g., pre-commercial thinning, tending felling.

5.3.4. Artificial Regeneration of Forest Stands – planting of trees in natural forests (opposed to planting taking place outside of natural forests, threat 2.2.) to promote the regeneration of stands that are composed of species of commercial interest where natural regeneration is absent or insufficient.

5.3.5. Management of Cutting Areas – management of the area and debris during a cutting or afterwards. E.g., scarification, formation of windrows from woody debris.

5.4. Fishing & Harvesting Aquatic Resources – Harvesting aquatic species (wild plants and animals) for commercial, recreational, subsistence, cultural, research or control/scaring purposes. This category also covers incidental capture (bycatch), but excludes research activities (Threat 6.3)

5.4.1. Recreational of Subsistence Fishing – harvesting of aquatic species for recreation or subsistence that is governed by management measures. Illegal harvesting by fishing should be classified under "Poaching/persecution of aquatic species" (Threat 5.4.4). Includes bycatch and damage to released individuals, but excludes contamination of habitats due to solid lead from fishing gear (Threat 9.4.2). e.g., recreational fishing of sturgeon, accidental catching of mudpuppies during ice fishing, sea turtles ingesting hooks, personal collection for aquariums with authorized species.

5.4.2. Commercial Fishing – harvesting of aquatic species for commercial purposes that is governed by management measures for which the environmental impact is primarily on the species (as opposed to habitat damage from sea bottom trawling, Threat 7.3.6). Includes bycatch but excludes ghost fishing gear entangling wildlife (Threat 9.4.4). E.g., commercial fisheries, use of nets and fishing gear for eels, factory ships, marine mammals caught in industrial fishing nets.

5.4.3. Poaching/Persecution of Aquatic Species – deliberate and illegal harvesting of aquatic animals for personal or commercial purposes or persecution, harassment, abuse or to cause deliberate harm due to prejudices against the species. E.g., poaching of glass eels.

5.4.4. Management/Control of Aquatic Species – deliberately killing individuals of an aquatic species for human gain that is governed by management measures. E.g., control of lampreys using lampricides, control of mosquitos in their aquatic larval stage , water weed cutting.

6. **Human Intrusions & Disturbance** – Threats from activities (unrelated to the use of biological resources) that disturb, alter, or destroy habitats and their species.

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

6.1.1. Motor Vehicles – using recreational motor vehicles. E.g., ATVs, motocross motorcycles, snowmobiles.

6.1.2. Hiking – walking, cycling or horseback riding on or off trails in natural environments. Includes opportunistic observation of nature but excludes disturbance by intensive observation/photography that is oriented towards one

of several target species (Threat 6.1.8). e.g., walking, running, dirt biking, geocaching, orienteering, disturbance from users or their domestic animals.

6.1.3. Recreational Use of Cliffs and Rock Faces – e.g., rock climbing, hang-gliding

6.1.4. Recreational Boating – use of recreational boats and watercraft that disturb wildlife, incur collisions with animals, and induce wake damage. Excludes the spread of invasive species (Threat 8.1). E.g., yacht, zodiac boats, watercraft

6.1.5. Wilderness Camping Without Amenities – temporary camping without amenities, away from dedicated networks. Distinguished from Threat 1.3.2 (campgrounds) by the lack of amenities.

6.1.6. Drones

6.1.7. Caving

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

6.1.9. Special Events in Natural Environments – outdoor performances in natural settings, gatherings that cause trampling and disturbance of habitat. Does not include noises pollution (Threat 9.6.3). E.g., outdoor concerts, gatherings on beaches that incur some trampling, outdoor sports competitions in natural habitats.

6.2. War, Civil Unrest & Military Exercises – Military and paramilitary activities that do not have a permanent ecological footprint. To be distinguished from the construction and use of permanent military bases (Threat 1.2)

6.2.1. War – e.g., military intervention in conflicts, transportation using military vehicles, minefields.

6.2.2. Riots

6.2.3. Military Exercises – off-base military training activities with a local footprint. E.g., unexploded ordinance, trampling from military training activities, firing ranges, military equipment testing.

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

6.3.1. Research Activities – research activities that are governed by management measures that can affect species by causing disturbance, by

collecting individual, or by degrading the environment. E.g., research fisheries requiring mortality, trampling by research teams.

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

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

7. **Natural Systems Modifications** – Threats from activities that are generally carried out to improve human welfare but may result in habitat degradation or destruction. This threat category includes the development or redevelopment (management) of natural and semi-natural habitats, as well as certain natural processes that can act as threats. Stopping a conservation action or a practice that is conducive to conservation is not interpreted as a threat, but as a return to the source threat (e.g., vegetation succession affecting pioneer species). Excludes meteorological or threats related to changing environmental conditions that may modify natural systems.

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

7.1.1. Increase in the Fire Regime – increase in fire frequency/scope/severity due to human activities. E.g., out of control agricultural burning, campfires.

7.1.2. Suppression in the Fire Regime – intervention aimed at preventing and putting out forest fire (fire management). E.g., putting out forest fires, controlled burning, creating firebreaks and trenches, and other measures.

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

7.2.1. Water Level Management Using Dams – construction, operation and water management using non-power dams. Includes the dismantling of man-made dams and excludes dams used for power generation (Threat 3.3.1) and excludes lock system (Threat 4.3.3.)

7.2.2. Beaver Dam Management – structures (dams) built by beavers create habitats for a number of species; however, these dams may be dismantled by humans. Dismantling of dams result in habitat loss by drying out the beaver-created basin and flooding lands downstream. It could also potentially cause loss of accumulated sediments due to increased flow in streams farther downstream.

7.2.3. Water Management using Culverts – the design, installation and management of culverts that are used to permit water flow under roads or railroads can cause discontinuities in streams and promote erosion.

7.2.4. Drainage in Agricultural Environments – construction and maintenance of channels that drain surface waters in agricultural environments. Excludes the use/management of culverts (Threat 7.2.3). Excludes erosion/sedimentation that are associated with the drainage system (Threat 9.3.2).

7.2.5. Drainage in Forest Environments – construction and maintenance of channels that drain surface waters in forest environments. Excludes erosion/sedimentation that is associated with this drainage system (Threat 9.3.2).

7.2.6. Withdrawal of Surface Water – withdrawal of fresh surface water for human consumption, crop production or other purposes. E.g., withdrawal by municipalities, spring water bottling companies and farmers; reservoirs for firefighting, creation of man-made lakes.

7.2.7. Withdrawal of Groundwater – withdrawal of groundwater for human consumption, crop production or other purposes. E.g., pumping water from the water table.

7.3. Other Ecosystem Modifications – Other activities that contribute to habitat alteration or loss by redeveloping natural systems to improve human welfare. To be distinguished from the development and maintenance of urban parks (Threats 1.3).

7.3.1. Shoreline Alteration – e.g., shoreline hardening, riprap along shorelines, breakwaters, concrete walls, shoreline filling

7.3.2. Vegetation Succession – natural vegetation succession causing habitat loss for species of early successional habitats.

7.3.3. Natural Erosion and Sedimentation – removal, transport and deposition of sediments that is caused by natural erosional processes. To be distinguished from the transport of sediments that is associated with tides (Threat 4.3.1), or by drainage systems in agriculture (Threat 7.2.5) and forestry (Threat 7.2.6).

7.3.4. Beach Development – creation of beaches, their nourishment (substrate replenishment) and maintenance.

7.3.5. Removal of Snags in Watercourses – removal of snags and other structures that are used by wildlife within watercourses to promote water flow, embellish the landscape, or facilitate boating. Excludes the maintenance of road ditches (Threat 4.1.1) and agricultural ditches (7.2.4), as well as shoreline clean-ups that are performed as conservation action. E.g., removal or snags that are used by river turtles for basking.

7.3.6. Sea Bottom Trawling – trawling of the sea bottom that alters marine habitats. Excludes the impact of harvesting on target species (Threat 5.4.2).

8. **Invasive & Other Problematic Species, Genes & Diseases** – Threats posed by non-native and native species (plants, animals, pathogens or genetic materials) that have or are expected to have harmful effects on biodiversity following their introduction, spread or increase in population (abundance).

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

8.1.1. Terrestrial Animals
8.1.2. Terrestrial Plants
8.1.3. Aquatic Animals
8.1.4. Aquatic Plants

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

8.3. Habitat Alteration by Beavers – flooding/drainage of habitats caused by beavers

8.3.1. Increased Grazing by Vertebrates – e.g., increased grazing by white-tailed deer and snow geese.

8.3.2. Localized Increase in Invertebrate Grazing – e.g., increased grazing of American ginseng by native slugs.

8.3.3. Insect Pest Epidemics – increased in insect pest density, resulting in large-scale impacts on the ecosystem. To distinguished from localized increases in invertebrate grazing (Threat 8.2.3).

8.3.4. Increased Predation by Mesopredators – e.g., racoons, striped skunks, foxes, coyotes.

8.4. Introduced Genetic Materials – Human modified or altered organisms/genes that pose a threat to biodiversity in natural environments by competing with wild populations or hybridizing with them and altering their gene pool.

8.4.1. Genetic Material from Agriculture – e.g., pesticide-resistant cereals/forages, use of genetically modified insects for biocontrol.

8.4.2. Genetic Material from Silviculture – e.g., genetically modified trees.

8.4.3. Genetical Material from Aquaculture – e.g., genetically modified salmon.

8.5. Pathogens – Diseases caused by various taxa of pathogenic micro-organisms living within hosts.

8.5.1. Bacterial Pathogens

8.5.2. Viral Pathogens – e.g., ranavirus in amphibians, rabies in raccoons.

8.5.3. Fungal Pathogens – e.g., white-nosed syndrome in bats (WNS), snake fungal disease (SFD), salamander chytrid disease (BSal), fungal pathogens affecting the roots of American ginseng.

8.5.4. Worm-Induced Disease – any diseases directly induced by a worm (helminthiases). E.g., flatworms, nematodes, nemertean worms.

8.5.5. Protozoan-Induced Diseases

8.5.6. Prion Disease – e.g., chronic wasting disease of cervids (CWD).

9. **Pollution** – Threats that are associated with the introduction of foreign or excess material/energy from point and non-point sources. Threats that are posed by pollution are typically correlated with other human activities listed in the other sections (e.g., air pollution from cars, water pollution from sewage, agricultural effluents). Although there is a direct correlation between pollution and these other threats, their impact (scope and severity) is often evaluated separately from the source activity.

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

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

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

9.2. Industrial & Military Effluents – wastewater (pollutants) from industrial and military sectors, including mines, energy production sectors and other resource extraction industries. These effluents may result from deliberate or accidental spills that are legal

or illegal and (may) contain various nutrients, sediments, toxic substances and chemicals. Among others. Considering the difficulty in identifying contaminants or contaminant "cocktails" that are responsible for environmental damage, other unknown contaminants from industries will be listed with Threat 9.2. This section excludes natural sources of contaminants that are found in the environment (e.g., mercury found in soils or in river substrates). Intoxication due to natural sources of these contaminants are likely to result from an indirect threat increasing exposure and to which conservation actions can be matched.

9.2.1. Oil Spills – spills from vehicle fuel tanks or from facilities that are associated with hydrocarbon extraction and transportation. E.g., oil spills from grounded vessels, military vehicles, pipeline failures.
9.2.2. Acid Mine Drainage (AMD)
9.2.3. Flame Retardant
9.2.4. PCB
9.2.5. Mercury
9.2.6. Industrial Lead – lead released into the environment by industrial effluents. Excludes lead contaminants due to hunting ammunition or fishing gear (9.4.2).
9.2.7. Other Industrial Discharges – unidentified or mixed toxic liquid chemicals that are released from industrial plants.

9.3. Agricultural & Forestry Effluents – Wastewater (pollutants) that is generated by agricultural, silvicultural and aquacultural activities. These discharges are transported primarily in drainage systems, runoff and eroded; they (may) contain various nutrients, toxic substances, chemicals, etc. Excludes erosion and sedimentation that is associated with drainage systems in agriculture and forestry (7.2) or oil spills from machinery (9.2)

9.3.1. Nutrient Loads – e.g., manure, compost, chemical fertilizers.

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

9.3.3. Herbicides & Pesticides – includes the use of inputs for controlling crop pests. E.g., herbicides, insecticides, fungicides.

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

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

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

9.4.3. Asbestos

9.4.4. Drifting Plastic and Entanglement Rubbish – plastic garbage adrift or ashore of oceans or large water bodies that intoxicate or entangle wildlife. E.g., floating rubbish, nets, robes, buoys, ghost or derelict fishing gear, plastic bags.

9.5. Airborne Pollutants – Air contaminant emissions from a point or non-point source.

9.5.1. Acid Rain

9.5.2. Smog – smog caused by air pollutant emissions from cars (vehicles in general)

9.5.3. Ozone – atmospheric nitrogen deposition.

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

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

9.6.1. Light Pollution – e.g., lamps (light) that attract insects or birds, lights on beaches that disorient turtles.

9.6.2. Thermal Pollution – e.g., heated water discharges from power plants (coal, gas, nuclear, etc.), atmospheric radiation resulting from ozone layer thinning.

9.6.3. Noise Pollution – e.g., noise from highways, air traffic (airplanes), submarine sonar that disturbs whales and other marine mammals, loud music from outdoor events and engine noise from marine traffic.

10. **Geological Events** – Threats from catastrophic geological events.

10.1. Volcanoes – volcanic activities, eruptions, emissions of volcanic gases
- 10.1.1. Eruptions
- 10.1.2. Emissions of Volcanic Gases

10.2. Earthquakes/tsunamis – earthquakes and associated events (tsunamis, etc.).
- 10.2.1. Earthquakes
- 10.2.2. Tsunamis

10.3. Avalanches/Landslides

10.3.1. Avalanches
10.3.2. Landslides and Mudslides

11. **Changing Environmental Conditions & Severe Weather** – Threats from major changes in ecosystems and severe climate/weather events outside of the natural range of variation that could harm species or habitats. May or may not be related to changing climate.

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

        11.1.1. Changes in Vegetation Communities – major changes in an ecosystem resulting in changes to vegetation communities distinguished from natural vegetation succession, which may threaten open-country species (Threat 7.3.2). E.g., migration of deciduous trees towards the boreal forest, rising sea levels, desertification, thawing permafrost (in tundra), coral bleaching.

        11.1.2. Phenological Mismatch – behaviors that have evolved to adapt to seasonal changes become unsynchronized due to irregularities or delays in the cycle of the seasons.

    11.2. Changes in Geochemical Regime – large-scale changes in an ecosystem's physio-chemical makeups

        11.2.1. Changes in pH of habitats – e.g., ocean acidification
        11.2.2. Changes in salinity

    11.3. Changes in Temperature Regimes – periods in which temperatures of the air, water or soil either exceed or fall below the normal range of variation. Events that may or may not be related to changing environmental conditions.

        11.3.1. Heat Waves

        11.3.2. Extreme Cold Spells

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

        11.3.4. Increase in Temperature Fluctuations – increase in temperature fluctuations, which disturb the phenological responses of wildlife. E.g., raise in the frequency of freeze-thaw events, rain-on-snow events, etc.

    11.4. Changes in Precipitation & Hydrological Regimes – Periods in which the amount and frequency of precipitation either exceeds or falls below the normal range of variation. Events that may or may not be related to changing climate conditions, and exclude periods that are associated with storms and heavy weather (Threat 11.5)

        11.4.1. Overabundant Rains

11.4.2. Droughts
11.4.3. Gradual Change in the Precipitation Regime
11.4.4. Increase in Fluctuations in the Precipitation Regime – increase in the fluctuations that are related to the precipitation regime, which have impacts on the hydrology of natural habitats.

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

11.5.1. Storms & Severe Weather – e.g., thunderstorms, tropical storms, hurricanes, cyclones, tornadoes, hailstorms, ice storms, blizzards, dust storms.

11.5.2. Storm Surges – e.g., erosion of shorelines/beaches during storms.

Statewide Threats to Multiple Habitats

Invasive Species

In addition to the previously noted impacts that invasive species have on wetland habitats, the Virginia Invasive Species Management Plan (VISAC 2018) 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 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).*

Changing Environmental Conditions In Virginia

Changing environmental conditions – precipitation, temperature, sea levels – are expected to have significant effects on Virginia's fish, wildlife, and natural communities. At least six SGCN salamanders, found nowhere else in the world, live in high-elevation habitats in western Virginia that are expected to die out over the next 100 years as the result of increased temperatures and changed precipitation regimes impacting the cool-climate vegetation. Without significant intervention to expand their footprints and extend their presence in Virginia, remnant spruce-fir forests are also expected to disappear for the same reason. In coastal Virginia, species such as eastern black rail and saltmarsh sparrow, both dependent on high saltmarsh habitats, are expected to be extirpated within the next 30 to 50 years as coastal high marshes succumb to a combination of rising sea levels and land subsidence (Ezer, T. and L. Atkinson, 2016). These changing conditions are undermining the ability of lands and waters to support Virginia's native fish and wildlife and the cultural and economic benefits they provide. Taking proactive measures to prepare for the impacts on the state's native species and habitats will make these challenges more manageable.

In 2021, the Commonwealth published the state's first Coastal Resilience Master Plan (Phase 1) that outlined the imminent threats to communities, businesses, national defense, infrastructure and natural habitats in coastal Virginia. Of particular note relevant to the Wildlife Action Plan was the finding that an estimated 170,000 acres (89 percent) of existing tidal wetlands and 3,800 acres (38%) of existing dunes and beaches may be permanently inundated by 2080, effectively lost to open water. Of the nearly 1,000 adaptation and resilience projects captured presently in the Virginia Coastal Resilience Project Tracker, a super-majority of them relate specifically to the protection of people and property. The Commonwealth anticipates completing the first Virginia Flood Protection Master Plan in 2025, which will be an actionable plan to use in crafting policies and programs to mitigate the impacts of flooding on people, the economy, and the environment. Both of these initiatives have provided significant attention to certain aspects of environmental conditions, but neither is comprehensive with respect to all anticipated changes, and both have an emphasis on people, property and infrastructure.

Warming temperatures are already affecting fish, wildlife and habitats in Virginia. Within the past 30 years, armadillos have naturally expanded their range from southern states northward, observed in southwest Virginia beginning in the mid-2010s. Spotted lanternfly, emerald ash borer, and spongy moth – all insect pests significantly impacting native vegetation – have become more pervasive across Virginia's landscape due in part to more moderate winter conditions. Other impacts, such as the earlier arrival of spring-like conditions and changes in the timing of biological events (such as migration, reproduction and flowering) which potentially lead to mismatches in the life cycles of interdependent species, are also being observed as of this writing.

Across the DWR, and indeed the conservation community more broadly, actions are underway that support the adaptation and resilience of species and habitats to these on-going environmental changes. Specific examples include treatment (or removal) of invasive common reed (Phragmites australis) from wetlands to prevent crowding of native species or alteration of water regimes, the application of prescribed fire to increase the resilience of habitat to wildfires and improve ecosystem health, and improvement of riparian habitats – most often through vegetative plantings – to moderate water and air temperature changes.

In their assessments of species for possible inclusion as SGCN, the TACs evaluated, where possible, climate change vulnerability assessments (CCVAs) to determine potential impacts of changing environmental conditions to species and habitats and the likely responses of these resources. These CCVAs evaluate exposure (the degree of change likely to be experienced), sensitivity (the degree of susceptibility or responsiveness to the climatic changes), and adaptive capacity (the ability of the resource to cope with or adjust to the changes). Adaptive capacity has three main components: demographic or life-history traits, including dispersal and colonization abilities that support range shifts; genetic diversity and potential for evolutionary adaptation by natural selection; and phenotypic plasticity, including physiological and behavioral acclimation. Conducting the CCVAs helped identify uncertainties in need of further study, many of which are outlined in identified conservation actions or future research needs explained in Chapters 5 and 6.

Ultimately, the outcome of changing climatic and environmental conditions is that a species persists in place, shifts in space, or becomes extirpated. However, the rapid rate of change and the fragmentation of habitat will make it more difficult for many species to move in a timely manner or without assistance to preclude local extirpation or extinction. The implementation of conservation migration (or human-assisted migration for conservation purposes) is in its infancy in the U.S., with few policies or protocols at national or state levels to guide this work. Issues regarding genetic integrity, wildlife disease, and invasion; more importantly, though, no frameworks currently exist to support states in their efforts to authorize translocations of most species for conservation purposes and regulatory mechanisms to support that work are lacking. The DWR is taking a small step in this arena in its proposed translocation of eastern tiger salamanders to a DWR-owned property in southeastern Virginia, outside of the known range of the species in the Commonwealth. This effort will increase the resilience, redundancy and representation of the species in Virginia, as the three populations currently known in eastern Virginia are at great risk of extirpation.

To ensure that the DWR addresses and responds appropriately to these changing conditions, the agency launched the development of its own adaptation and resilience plan in 2025. This effort will help ensure that, across the organization, employees understand the risks and opportunities associated with changing climatic conditions and incorporate appropriate actions into the Department's programs to maximize the conservation, use and enjoyment of fish, wildlife and habitats now and into the future. Keys to success will include maintaining and restoring key ecosystem processes, supporting a statewide network of lands and waters to support fish and wildlife adaptation (i.e. movement), evaluating proposed management actions in the context of changing conditions, and coordinating with

governmental and non-governmental partners, stakeholders, businesses, and communities. The project team began by interviewing employees across the organization to develop a baseline of adaptation and resilience actions already being implemented in agency programs. From there, a suite of goals and actions will be developed to augment existing work and begin the integration of relevant actions into other DWR programs and in discussions with partners and stakeholders. This work will also complement new efforts begun in 2025 in the Virginia Secretariat of Natural and Historic Resources with the establishment of the Office of Commonwealth Resilience and a supporting Interagency Resilience Management Team, recruitment of a Chief Resilience Officer and program staff, and development of a report on the status of resilience in the Commonwealth.

Other Specific Threats

As previously mentioned, several threats are not necessarily habitat-related or specific to one habitat. Illegal poaching, conservation actions on out-of-country avian wintering grounds, need for specific actions and increased regulations impacting these actions (e.g., prescribed fire) and other anthropomorphic impacts (e.g., lights on buildings) are unique and are addressed specifically in this section.

Threats to Avian SGCN - Lighting can attract large numbers of night-migrating birds from as far as 5 kilometers away. Birds can become entrapped in these areas of bright lights, circling endlessly, depleting energy stores needed for migration, and even colliding with buildings and infrastructure. This phenomenon is particularly prevalent on nights with low-cloud ceilings or foggy weather, when birds tend to migrate at lower altitudes where light reflecting on clouds can be disorienting. Multiple mass-mortality events, each involving hundreds of birds, have been documented on foggy nights during migration.

Throughout the year, nighttime lighting can affect birds by illuminating their habitats. This can cause birds to avoid habitats essential for their survival and can alter the relationships between predators and prey, all because these areas have too much light. Birds that migrate or forage offshore are also affected by and disoriented by nighttime lighting from coastal areas and offshore vessels and structures.

In addition to migration issues, every year anywhere from 365 million to one billion birds collide with glass in the U.S. alone. While most fatal collisions happen at homes and buildings shorter than four stories tall, smaller structures like glass walkways and bus stop shelters also pose a threat (USFWS 2024). Bird-building collisions can happen at any time of the day and year but tend to increase during migration and when young birds are fledging. Therefore, migration seasons and spring and early summer it is important to mitigate for window/bird collisions (Audubon 2020).

Bird-building collisions can be reduced by reducing the use of transparent or reflective surfaces on building facades, by making these surfaces visible to birds, and by reducing artificial light at night. For new construction, architects can consult the American Bird Conservancy's Bird Friendly Design Guide. This resource includes information about both building and lighting design and materials that can reduce the probability of bird collisions. Existing buildings can be retrofit to reduce collision risk. The American Bird Conservancy, U.S. Fish and Wildlife Service, and Audubon Lights Out all have resources on how to

retrofit existing buildings. Retrofits such decals, films or chords make glass visible and are extremely effective; many have been shown to reduce collisions by 90% or more (Klem Jr. 1990, 2009, Klem Jr. and Saenger 2013, Brown *et al.* 2019, 2021, Sheppard 2019, Swaddle *et al.* 2020, Coolidge *et al.* 2021, Groot *et al.* 2022, Leung 2022, Riggs *et al.* 2023, Marler 2024).

Adjustments to lighting also can reduce collisions. Blue and cooler toned lights tend to be more attractive to birds (Zhao *et al.* 2020), thus using warmer toned lights may reduce collisions. Reducing the overall amount of light, by using shields to direct exterior lights down toward the ground, shades to keep interior lights from illuminating windows, and timers or motion sensors so that lights are off when not in use can help to reduce collisions (Ogden 2002, Lao *et al.* 2020, Van Doren *et al.* 2021, Scott *et al.* 2023). Half of all collisions occur in only 15% of days (Scott *et al.* 2023), because of interactions between migration timing and weather (Van Doren *et al.* 2021, Chen *et al.* 2024). Thus, reducing artificial light at night during these high-collision risk nights can avoid many collisions. Audubon's Lights Out Toolkit is a comprehensive resource with everything needed to implement a Lights Out campaign. DarkSky International certifies outdoor lighting, has guidelines for exterior lighting, and sample codes and statutes. Agencies, organizations, businesses and communities can set an example by implementing policies to ensure any new agency construction is bird-safe, retrofitting existing buildings, and communicating this work to the public to increase the impact of these conservation efforts.

Bird collisions are not limited to buildings. Collisions also occur with communication towers, vehicles and wind turbines (Bullock *et al.* 2024) and other lit structures. Solutions for communication tower and turbine collisions include acoustic deterrents (Boycott *et al.* 2021) and using only flashing (rather than steady-burn) lights (Gehring *et al.* 2009). Tower owners can simultaneously reduce tower costs and reduce bird collisions by as much as 70% by extinguishing their steady-burn lights and using only flashing lights at night. The U.S. Fish and Wildlife Service has guidance to reduce bird collisions with different components of the built environment.

Perhaps the most critical threat to avian SGCN species is protection of their out-of-state and often out-of-country wintering habitats and grounds. Southern Wings encourages states to acknowledge the full annual life cycle needs for birds. This program works to conserve and manage habitat and research on stopover sites and the wintering grounds – migrant breeding birds spend up to eight months of the year outside of the United States. Efforts to conserve these critical habitat areas outside of Virginia and the United States are critical to protecting many avian SGCN species. Virginia has participated in Southern Wings since 2013 and will continue to support the research and conservation efforts for the full annual life cycle of Virginia's breeding birds through this and other initiatives with similar objectives.

Illegal Trade - The poaching or taking of protected or managed species and the illegal trade in wildlife and their related parts and products has escalated into an international crisis. Wildlife trafficking is both a critical conservation concern and a threat to global security, with significant effects on the national interests of the United States and the interests of its partners around the world (USFWS 2024). Turtles, bears and several plant species are under exceptional pressure from illegal collection and international trade. Turtles are highly prized in Asian markets as pets and as food items. Bear gallbladders are prized as aphrodisiacs. In 2018, Virginia and other states helped form the Collaborative to Combat the Illegal

Trade in Turtles (CCITT), a coalition to combat the illegal trade of turtles. The intent of this group is to advance efforts to better understand, prevent, and eliminate the illegal collection and trade of North America's native turtles. There is critical need for additional law enforcement and research staff in this realm to prosecute poachers and do the critical health assessments and genetics work to return confiscated turtles to their points of origin (Kleopfer and Sevin, 2024).

Zoonotic diseases and threats - The effects of emerging wildlife diseases are global and profound, often resulting in the loss of human lives, economic and agricultural impacts, declines in wildlife populations, and ecological disturbance. The USGS National Wildlife Health Center (NWHC) is one agency working to safeguard wildlife from diseases by studying the causes and drivers of these threats and by developing strategies to prevent and manage them. Snake fungal diseases, avian influenza, *Batrachochytrium salamandrivorans* ("Bsal") , and white-nose syndrome are just some of the bacterial, fungal and viral threats that impact Virginia's wildlife (USGS 2024). Many of these pathogens are not well understood, and ongoing research is needed to determine causes, possible treatments and how best to protect many SGCN species from their impacts. White-nose syndrome has especially demonstrated how one pathogen can decimate populations of several bat species. Little brown bat (*Myotis lucifugus*) populations in Virginia have declined by over 95% since the disease was detected in the state (Reynolds 2024). **Appendix 1** has a further explanation of fish and wildlife health issues as provided by the Northeast Fish and Wildlife Health Coordinator.

5. Conservation Actions

In reviewing the list of SGCN, DWR 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 1921 SGCN identified for 2025, 406 (21.1%) are classified in Category A. For these species, partners identified 21 overarching management actions that benefited more than just a few species that could be implemented to improve their conservation status. The number following each action listed below represents the number of SGCN to which that action applies. For specific actions identified for each of the 406 species, please see the SGCN Table here.

1. Conserve/ restore wetland habitats (124) Maintain and/or restore natural hydrologic processes within occupied and historic habitats. Research additional ways in which natural wetlands and waterbodies created by natural processes (e.g. beaver dams) can support SGCN species.
2. Restore the natural fire regime within occupied areas. (109) Avoid large scale timber harvests/clear cuts within occupied habitat. (23)
3. Create/ restore/ manage – open habitats (glade, grassland, savanna, shrubland) (86)
4. Address water quality impairments (63)
5. Maintain/restore riparian buffers. (55)
6. Pursue the protection of priority populations and habitats through landowner education. (47)

7. Implement captive propagation/ translocation/ reintroduction (37)
8. Conserve/restore/create beaches, dunes, shoals, sandspits, mudflats and peat banks in a manner that benefits beach-nesting wildlife and migrant and wintering waterbirds. (35)
9. Control invasive plant and animal species (33) and prevent the introduction of species that out-compete SGCN (e.g., variegate darter in candy darter range). Avoid using non-native seed mixes. Plant only locally native species, especially along VDOT right-of-ways and other urban easements and development projects after completion.
10. Restore aquatic connectivity (4). Avoid construction of new dams and remove old, non-functioning dams (29). Dams that cannot be removed should be retrofitted to allow fish passage. Coordinate with the Virginia Department of Transportations to replace and install new culverts that allow movement of aquatic species. Reduce standing stocks of Blue Catfish in Chesapeake Bay rivers.
11. Mitigate for the impacts of sea-level rise using both traditional and novel methods (e.g. purchase and protect upland areas for marsh and shoreline migration, placement of dredge materials on islands, restore eroded shell rake habitats in seaside marshes, etc.) (20)
12. Limit the use of pesticides, anticoagulant rodenticides and neonicotinoids. (19)
13. Regulate legal harvest (6). Continue maintaining "no personal possession" regulations (16).
14. Engage in public education/ outreach (14) (*See Also Appendix 3, page 210*). Educate landowners on the importance of beavers in maintaining fish and wildlife habitat. Provide alternative to dam and beaver removal, such as flow control devices to prevent extreme flooding and damage to property and the improve their understanding of the importance of maintaining submerged vegetation in their ponds and lakes
15. Exclude/ manage human use of habitats or human activities <u>at specific times</u> (19)
16. Engage in predator control (11) Targeted predator control is used for mussels primarily in watersheds with heavy raccoon and muskrat predation in the upper Roanoke and James watersheds where critically imperiled mussels face extreme pressure from significant predator populations. Similar measures are used to maintain minimal predator populations on barrier islands to protect beach nesting birds.
17. Exclude humans from caves occupied by sensitive species (12)
18. Maintain the quality and quantity of water flowing into karst and other groundwater systems (8) Increase partnerships to implement best management practices such as alternate water sources for cattle and protecting/establishing vegetated stream buffers for agriculture and forestry.
19. Continue environmental commenting and engagement with industrial siting for wind energy (12)
20. Continue to maintain a high level of law enforcement presence on key waterbird nesting islands and stopover sites. (10)
21. Protect known fall roosts and swarm areas for bats (7)
22. Conserve/ restore large forest blocks and maintain/restore habitat connectivity between them (5)

Conservation Education and Outreach – Conservation education plays a critical role in advancing plant and wildlife conservation goals. Beyond the natural resource agencies, non-governmental organizations and tribal partners, the public plays an important role in understanding and supporting SGCN and other

wildlife. Private lands make up the majority of available habitats, so landowners are an important partner in maintaining, restoring and protecting critical habitat areas. Appendix 3: Recommendations for Enhancing Conservation of SGCN and their Habitats through Education, Outreach, and Wildlife Viewing addresses many of these issues including the need to incorporate citizen science to greater extent in the important conservation work of agencies and their partners.

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 1921 SGCN, 861 (44.8%) are assigned to Category B. The list of research needs for these species follows, in no priority order. In future budget discussions, it is DWR's intention to use this list to prioritize the research projects funded through State Wildlife Grants and other sources.

- 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 and other animals.
- Determine American woodcock wintering and breeding abundance to facilitate creation of a management strategy.
- Determine the impacts of avian predators on beach nesting birds on Virginia's barrier islands and develop appropriate management actions to ameliorate these impacts over the long term.
- 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 the following species:
    - Variegate darter,
    - Tennessee darter,
    - Atlantic sturgeon.
- Determine if the following species would be suitable candidates for reintroduction into suitable habitats:
    - Duskytail darter,
    - Ashy darter,
    - Greenfin darter,
    - Longear sunfish,
    - River redhorse,
    - Sauger,
    - Blackbanded Sunfish
    - Candy Darter

    - Golden Darter
    - Roanoke Bass
    - Sickle Darter
    - Tennessee Dace
    - Yellowfin Madtom
    - Smallmouth redhorse, and
    - Spotfin chub.
- Determine possible reintroduction streams in the Roanoke drainage with suitable habitat for Roanoke bass and absent of rock bass.
- Determine the distribution and habitat associations of roughhead shiner.
- Determine if or how changing climatic conditions or changing groundwater levels are affecting the Allegheny pearl dace.
- Locate maternity colonies of the eastern big eared 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.
- 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:
    - Crackling pearlymussel,
    - Deer toe,
    - Cumberland monkeyface,
    - Fine-rayed pigtoe,
    - Tennessee clubshell,
    - Rough rabbitsfoot,
    - Shiny pigtoe,
    - Elephant ear,
    - Tennessee heelsplitter,
    - Tennessee pigtoe,
    - Slabside pearlymussel,
    - Northern Lance ,
    - Pimpleback,
    - Pistolgrip,
    - Spectaclecase,
    - Three-ridge, and
    - Pink heelsplitter.
- Resolve taxonomic confusion between the purple bean and the Cumberland bean so that appropriate broodstocks 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 pigtoe.
- Determine if sufficient numbers of slippershell mussels exist to serve as broodstock 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 that appropriate management and conservation strategies can be developed.
- Determine if beaver ponds could support brook trout and other cool and coldwater species.

SGCN Distribution, Abundance, and Life History Information

Of Virginia's 1921 SGCN 34.3% were included in Conservation Opportunity Ranking 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 its 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 threats and conservation actions identified for these species may be included in the list, but either may not be conclusive or, in many cases, conservation actions identified are either not feasible or have not been researched enough to conclusively demonstrate an impact the populations. 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 resource limitations, it is a logistical impossibility that the DWR and partners will ever be able to fully address these needs.

It is the DWR'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 that efforts provide the greatest management utility in terms of keeping species from becoming imperiled.

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, the DWR established the Aquatic Wildlife Conservation Center (AWCC) at its Buller Fish Hatchery near Marion, Virginia, to support the restoration of 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 DWR 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 2016, the DWR has contracted with Conservation Fisheries, Inc. to propagate and release endangered yellowfin madtom (*Noturus flavipinnis*) into the upper reaches of the North Fork Holston River.

It is the DWR'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 the DWR's project planning, annual budget development, and annual work planning efforts.

Translocation – Translocation is utilized to restore species to their previous range, increase genetic diversity of a remnant population and to establish new populations in areas they are likely to persist in to reduce the impact of a catastrophic event in their remaining range. Beyond mussels, Virginia has used translocation in many times to restore populations to the state. In the early 1900s, white-tailed deer and wild turkey populations were extremely low due to extensive logging and habitat degradation across the state. These species were imported from other states and supplemented. Today these species are incredibly abundant across most of the Commonwealth. In terms of SGCN, red-cockaded woodpeckers were translocated from the Carolinas to Piney Grove Preserve and the Great Dismal Swamp National Wildlife Refuge (GDSNWR.) There has been successful breeding in both areas now for several years that the population has now grown from two breeding pairs in 2002 at Piney Grove to 170 individuals combined at Piney Grove and GDSNWR and a successful breeding pair on the Big Woods Wildlife Management Area in 2017. Additional efforts involving loggerhead shrikes and Bachman sparrows are being investigated now, and future efforts for additional translocation are being researched. State Wildlife Grants funds may be dedicated to these efforts if appropriate species and habitats are identified.

As mentioned above under the description of the Savanna habitat, Savannas historically were related to fire-maintained longleaf pine (LLP) ecosystems in Virginia which is at the northern extent of the LLP ecosystem range that stretches from Texas to Virginia. Eighteen Longleaf Implementation Teams (LIT) are organized through the Longleaf Alliance, including the Longleaf Cooperators of Virginia (LCOV). LCOV is a collaboration of public and private land managers that plans and implement conservation actions to benefit longleaf and its species components. Savanna ecosystems and prescribed fire to maintain them is particularly important to 14 animal and 119 plant SGCN in Virginia.

One issue not addressed directly by the Northeast Lexicon that is critical to many species threatened by habitat loss is the need to complete the identification of important habitat corridors and the identification of high risk road locations for species mortality and/or movement and dispersal barriers (VDWR, VDOT, VDCR, Smithsonian Conservation Biology Institute, and George Mason University). By 2027, integrate these results into the revised Wildlife Corridor Action Plan to inform state priorities for where future wildlife crossing infrastructure and wildlife crash countermeasures along roads are needed (VDWR, VDOT, VDCR). The eleven SGCN mentioned under the Transportation Corridors habitat description are just a few examples that require these corridors and additional research to find solutions for impacts from transportation infrastructure corridors. For more information about current statewide efforts to identify important wildlife habitat corridors for biodiversity and SGCN, please see section "Wildlife Habitat Corridors and Connectivity (page 97)" and the Virginia Wildlife Corridor Action Plan.

6. MONITORING, EFFECTIVENESS MEASURES AND RESEARCH NEEDS

Monitoring

In terms of monitoring, a Wildlife Action Plan must describe how each state will monitor the status of species and habitats that have been included within the Plan. Information on monitoring within the Wildlife Action Plan must also identify the mechanisms that will be used to monitor the effectiveness of implemented conservation actions. Finally, each Wildlife Action Plan must describe the mechanisms that will be used to adapt conservation actions in response to new information or changing conditions. While distinct, these concepts are related. Ideally, over time, conservation actions that are implemented will produce detectable improvements for local wildlife populations and/or their habitats. While the benefits of some projects might not be fully realized for years or even decades, monitoring the changes achieved from conservation efforts will make it possible to evaluate the conservation community's ability to achieve conservation goals. Additionally, information from monitoring will allow managers to adapt those efforts to be more effective as experience is gained and changes are observed. The DWR staff and partners used the following mechanisms to address monitoring within Virginia's 2015 Wildlife Action Plan and they remain effective tools for this revision.

Monitoring Species Status

Virginia is home to over 30,000 species, including vertebrates, invertebrates, aquatic, terrestrial, marine, karst, and migratory species. With available resources, it is impossible to maintain an accurate census of this many populations. As an alternative, DWR staff work with multiple partners to collect status and trend data that are incorporated into relevant data management systems and the Wildlife Action Plan. These efforts include:

Population Monitoring by DWR Staff – DWR field staff spend many months each year monitoring wildlife populations. The agency may also contract with academic institutions or private entities to collect these data on the agency's behalf. In many cases, data collection efforts are iterative multi-year projects to ensure annual variability is normalized over time.

Much of the data collected are incorporated into the Virginia Fish and Wildlife Information System (VAFWIS), a publicly available database that provides public access to data and information about Virginia's wildlife. Among other uses, these data inform species management efforts and the

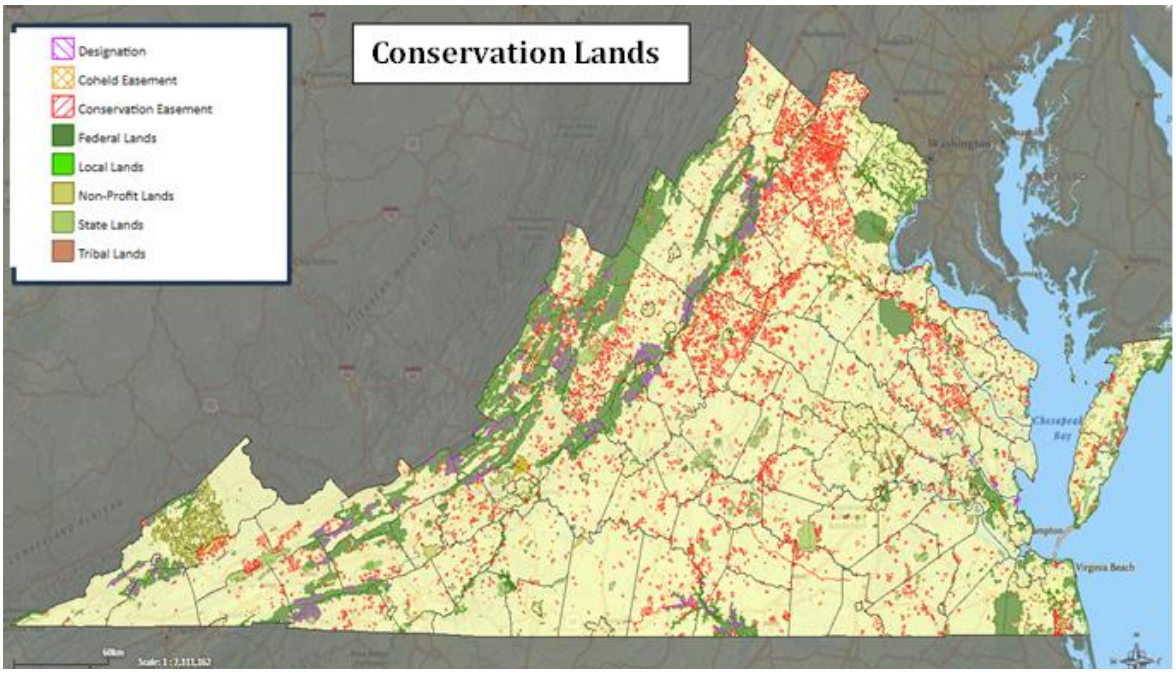


Figure 6.1 - Conservation Lands in Virginia

environmental review process. These data, in conjunction with other information, were used to determine if a species should be included within Virginia's Wildlife Action Plan and how a species should be prioritized within the Tier structure (see Methods – Species of Greatest Conservation Need List Revision). Results of individual data collection and species monitoring efforts are reported in annual reports for State Wildlife Grants and Wildlife Restoration Grants provided to the USFWS. Examples of recent species monitoring efforts funded with State Wildlife Grants and other resources include the black-banded sunfish in southeast Virginia, freshwater mussel populations in Copper Creek and other portions of the Clinch River, the Atlantic sturgeon in the Chesapeake Bay watershed, and beach nesting species on Virginia's beaches and barrier islands.

In addition to DWR field staff, the Virginia Natural Heritage Program within the Virginia Department of Conservation and Recreation conducts a variety of surveys documenting the location and conservation status of rare plant and animal species, unique geological features and outstanding native ecosystems. This ongoing inventory is led by a team of ecologists, botanists, karst scientists, and zoologists who assess the status and condition of these natural heritage resources and prioritize their conservation needs. Field inventories focus on globally rare species, karst features and caves, and natural communities.

Natural Heritage scientists collect information on a large number of natural community types, significant caves, rare vertebrates, invertebrates, and plants representing a significant portion of the state's

vertebrate and plant species. Over 2200 conservation sites, containing more than 6970 rare species populations, significant caves and natural communities have been found to date.

In addition to inventories for specific plants, animals and communities, inventories are conducted to assist private and public land managers. Inventories have included: all National Park Service lands, the Appalachian Trail, all major Department of Defense facilities, selected National Forest lands, many State Park lands, and others.

Scientific Collection Permits – The DWR is responsible for regulating the collection of wildlife by researchers and partner organizations within the Commonwealth. Species distribution data collected under the auspices of scientific collection permits are submitted annually by permittees to the DWR. These data are reviewed for accuracy and then incorporated into the VAFWIS. These data were also used to determine if species should be included within Virginia's Wildlife Action Plan and how a species should be prioritized within the Tier structure (see Methods – Species of Greatest Conservation Need List Revision).

NatureServe Status Rankings – NatureServe is an international nonprofit organization that works to answer four questions: What species and habitats exist? Where are they found? How are they doing? And which are conservation priorities? NatureServe provides a standardized set of global status rankings for species and habitats. These are commonly referred to as the "G&S" ranks. "G" represents "global" status, and "S" represents "state" status. Both the global and the state rankings utilize a 5-point ranking system. A score of 5 indicates a species is "Secure", a score of 4 indicates a species is "Apparently Secure", a score of 3 indicates a species is "Vulnerable", a score of 2 indicates a species is "Imperiled", and a score of 1 indicates a species is "Critically Imperiled." The state ranking might also include SH, which indicates a species is "Possibly Extirpated," or a value of SX indicates a species is "Presumed Extirpated" in Virginia. The S ranks are maintained by the DCR Natural Heritage Program, a member of the NatureServe Network. NatureServe rankings are generally consistent with the Wildlife Action Plan's Tier system. NatureServe rankings were also used as one criterion to determine if species should be included with Virginia's Wildlife Action Plan and how a species should be prioritized with the Tier structure (see Methods – Species of Greatest Conservation Need List Revision).

Monitoring Amphibians

Changing water conditions due to droughts, flooding, or extreme weather events will have an effect on amphibian persistence as many species are dependent on water availability and quality to reproduce successfully. Habitat losses are also of significant concern to amphibian species which are often dispersal limited and temperature dependent. Riparian ecosystems, where many species of amphibians reside, are particularly crucial habitats that are likely to be highly impacted by changing environmental conditions (Capon *et al*. 2013). This can lead to cascading effects for amphibians. For example, reduced riparian forest cover impairs the development of young eastern hellbender salamanders (*Cryptobranchus alleganiensis alleganiensis*) (Funkhouser et al 2025). Unfortunately, amphibian declines have been observed worldwide (Adams *et al.* 2013). Ongoing monitoring efforts, such as the USGS Northeast Amphibian Research and Monitoring Initiative (NEARMI), are vital to continue managing and

sustaining amphibian populations in Virginia. For example, one active NEARMI project evaluates the Shenandoah salamander (P*lethodon shenandoah*), an IUCN-listed Vulnerable species whose range is expected to decrease. The project studies the Shenandoah salamander and its habitat to understand its changing distribution and help guide future decisions on management, most recently facilitating a National Park Service-led discussion on next steps in 2024. Citizen science programs organized by partners like the Loudoun Wildlife Conservancy are also ongoing efforts to monitor and understand current amphibian biodiversity. These monitoring efforts are useful for managers to anticipate impacts of changing environmental conditions on amphibians and identify the best conservation decisions.

Monitoring Habitat Status

Water Quality

The National Clean Water Act requires each state to monitor the quality of its surface and ground waters to determine if they support six designated uses, including aquatic life, fish consumption, public water supplies (where applicable), recreation (swimming), shell fishing, and wildlife (DEQ 2024). Virginia also has instituted subcategories under most of these designated use categories. The U.S. Environmental Protection Agency (USEPA) requires that DEQ prepare biennial reports (305(b)/303(d) Water Quality Integrated Report) describing the status of water quality within the state (DEQ 2024). During the course of their water quality monitoring to prepare these reports, DEQ personnel gather data from over a thousand stations located in Virginia's lakes, reservoirs, rivers, and estuaries. The types of data collected include measurements of temperature, pH, dissolved oxygen, nutrients, suspended solids, bacteria, metals, pesticides, herbicides, and toxic organic compounds. These data allow individual waters to be classified into one of five groups:

- Category 1: Water that fully supports all designated uses.
- Category 2: Water that fully supports some designated uses, but there is either insufficient or no information regarding the remaining designated uses.
- Category 3: There is insufficient information to determine if designated uses are being met.
- Category 4: Waters are impaired or threatened but do not need a TMDL.
- Category 5: Waters are impaired and need a TMDL.

The Water Quality Integrated Report is transmitted to Congress and the USEPA. Based on water quality monitoring and the degree of impairment, a watershed may require a Total Maximum Daily Load (TMDL) figure be calculated (see Statewide Overview; Freshwater Aquatic and Riparian Habitats). The most seriously impaired waters require a Water Quality Improvement Plan (see Statewide Overview; Freshwater Aquatic and Riparian Habitats). Virginia's list of impaired waters and the available water quality improvement plans are available online (DEQ 2024).

Virginia's Healthy Waters Initiative

Virginia's Healthy Waters Initiative, a joint effort of the DCR, Virginia Commonwealth University, and DEQ, is an effort to broaden conservation efforts to maintain critical, healthy resources before they are

compromised. This Initiative is meant to work in concert with water quality programs that focus on repairing degraded systems to protect living resources. The approach encompasses protecting everything from aquatic insect larvae and bugs hidden in gravelly stream bottoms to forested buffers alongside streams to natural stream flows to the water we drink in an effort to maintain ecological balance. Healthy streams in Virginia have been identified and ranked through a stream ecological integrity assessment known as the Interactive Stream Assessment Resource (INSTAR). Streams may be ranked as "exceptionally healthy," "healthy," or "restoration candidate." Developed by the Center for Environmental Studies at Virginia Commonwealth University, INSTAR is an online interactive database application that identifies healthy streams using stream data that includes information about fish communities and insects, in-stream habitat, and riparian borders. Healthy waters are incorporated into DCR's Natural Heritage Biotics Database and used for land conservation and land planning purposes.

Virginia Wetlands Catalog

The Virginia Department of Conservation and Recreation's Natural Heritage Program, working with the federal Natural Resources Conservation Service, the Virginia Department of Transportation, The Nature Conservancy, and Virginia Commonwealth University's Center for Environmental Studies, has developed the Virginia Wetlands Catalog. This tool considers the condition and status of wetlands and ranks them in terms of restoration or conservation priority. Wetland patches are evaluated on several factors,

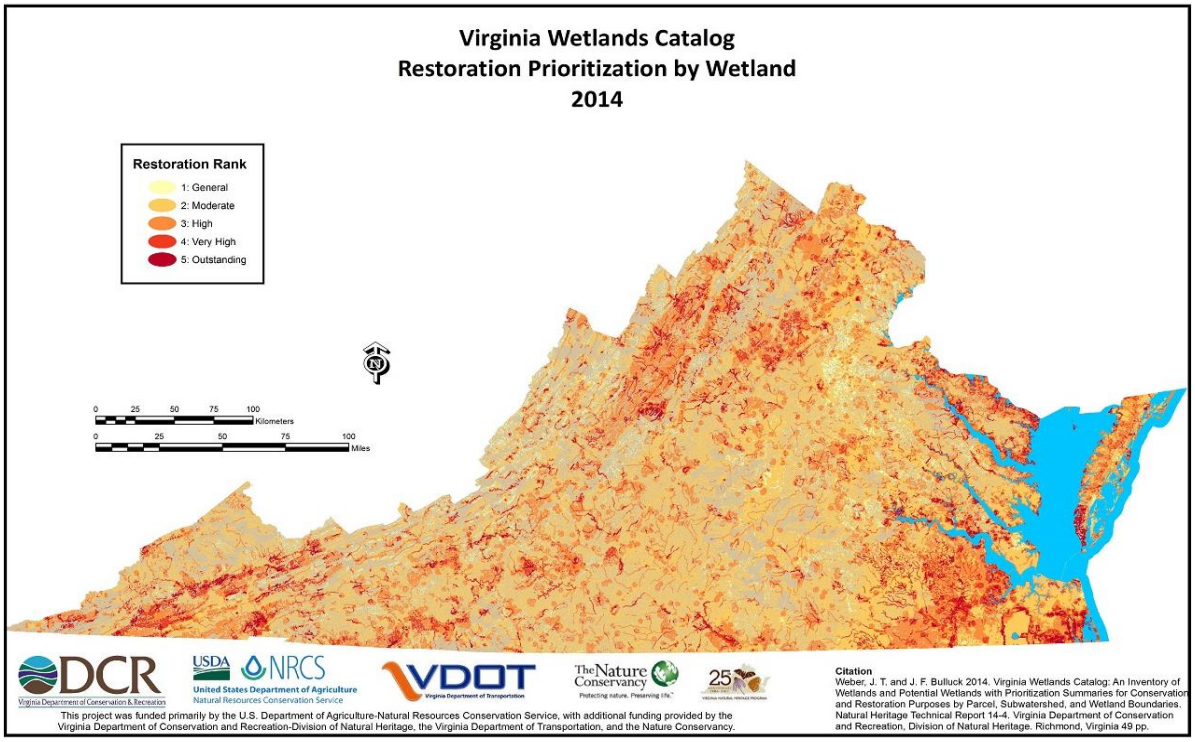


Figure 6.2. Virginia Wetlands Catalog

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, proximity to 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 (Weber and Bulluck 2014). This material provides the most extensive set of habitat quality data available for Virginia's wetlands.

Chesapeake Bay Fish Passage Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool

Many of Virginia's rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. In recent years, two tools have been developed to explore this issue. The Chesapeake Bay Fish Passage Prioritization Tool was designed by The Nature Conservancy in coordination with the NOAA Restoration Center, the U.S. Fish and Wildlife Service's Maryland Fisheries Resource Office, and other partners (Martin and Apse 2013). The Southeast Aquatic Connectivity Assessment Tool was designed by The Nature Conservancy in coordination with the Southeast Aquatic Resource Partnership, the South Atlantic Landscape Conservation Cooperative, and other partners (Martin *et al.* 2014).

Both tools were created to evaluate the ecological return on investment of restoring connectivity in streams and rivers. Dams were assessed in terms of their ability to provide ecological benefits for one or more species if removed or altered to allow fish to bypass. Contributors to these tools prioritized dams for removal throughout the study areas based on benefits to three target groups of species – diadromous fish, resident fish, and brook trout. A wide range of metrics were developed and assessed for each of the three targets to help identify which dams were of highest priority for each of the three targets. Metrics for diadromous fish included amount of upstream river length available; upstream and downstream barriers, amount of impervious surface, amount of natural landcover, stream health, and number of diadromous species in the stream network, etc. The prioritization tool for diadromous fish was used to identify the top 3 tiers (top 15%) of priority dams for removal or alteration within Virginia. Most of these dams fall within the Coastal Plain region. DWR staff have identified several high priority dams for removal and continue to work with partners on these priority projects. Ashland Mill and Rapidan Mills Dam are just two of the current projects under evaluation.

Forest Inventory and Analysis

The United States Forest Service (USFS) monitors forest and woodland habitats across the country. The federal agency conducts an annual census of forests and woodlands with its Forest Inventory and Analysis (FIA) Program 107. The program assesses forests and woodlands by collecting data on tree species composition, size and health as well as tree growth, mortality and removals by harvest. There are 6,952 sample points in the FIA dataset within the Northeast region. The US Forest Service also monitors forests and woodlands via remote sensing and has developed a field sampling protocol to pair with remote sensing data to monitor carbon in forests and woodlands.

Northeast Terrestrial Habitat Map

In 2013, The Nature Conservancy, working on behalf of the Northeast Association of Fish and Wildlife Agencies and the North Atlantic Landscape Conservation Cooperative completed *Northeast Habitat Guides: A Companion to the Terrestrial and Aquatic Habitat Maps* (Anderson *et al.* 2013). This document and the habitat classification system it describes were developed "…as a comprehensive and standardized representation of habitats for wildlife that would be consistent across states and consistent with other regional classification and mapping efforts" (Anderson *et al.* 2013). As part of each habitat's description, the authors indicate in which states the habitat occurs, how many acres occur within each state, and how many of those habitat acres are managed as some form of conserved land. This report also provides tables indicating patch size, age class distribution, likelihood of loss due to development, and degree of fragmentation. These data provide a snapshot of the status for habitats restricted to Virginia and provide a general overview of status information for habitats that occur more broadly across the Northeast. The status information provided within the Terrestrial habitat map report is supplemented by additional information provided within *Conservation Status of Fish, Wildlife, and Natural Habitats in the Northeast Landscape: Implementation of the Northeast Monitoring Framework* (Anderson *et al.* 2011). This project led to an online tool using innovative mapping methods and NatureServe's ecological system classification. The Nature Conservancy's Center for Resilient Conservation Science (formerly the Eastern Conservation Science) team produced the online mapping tool.

Natural Communities of Virginia: Classification of Ecological Community Groups

The DCR's Natural Communities of Virginia: Classification of Ecological Community Groups is a classification system that represents assemblages of co-existing, interacting species, considered together with the physical environment and associated ecological processes that usually recurs on the landscape. DCR's natural community inventory and classification represent an important "coarse filter" approach to biological conservation that ensures the protection of intact ecological systems containing diverse organisms. By identifying and protecting excellent examples of all natural community types in Virginia, the majority of our native plant and animal species, including many cryptic and poorly known ones, can be protected without redundant individual attention (Fleming et al. 2013). More information and detailed classification descriptions and images can be found online at the Natural Heritage website.

In addition to these resources, the Northeast Regional Conservation Synthesis For 2025 State Wildlife Action Plans provides many other resources for inventory and monitoring as part of the synthesis at the NE Synthesis website.

Eastern Brook Trout Joint Venture

In response to a need for guidance in setting wild Brook Trout conservation priorities, the Eastern Brook Trout Joint Venture (EBTJV) completed a range-wide assessment of wild Brook Trout distribution and status at the sub-watershed level (HUC 12) in 2006. While this initial assessment provided Brook Trout resource managers, decision-makers, and the public with an essential understanding of the current "state" of wild Brook Trout in the eastern portion of its U.S. range, many EBTJV partners felt that an

assessment at a finer scale would yield better assistance by establishing a more workable set of wild Brook Trout conservation strategies. Therefore, the EBTJV conducted a second rangewide assessment of wild Brook Trout at the catchment scale, which was completed in 2015. Building from its wild Brook Trout assessment work, the EBTJV has developed strategies that provide the blueprint for Brook Trout conservation actions at multiple scales across the range. In addition to Brook Trout, this work of the EBTJV monitors the status of coldwater habitats throughout the Northeast and works to set conservation goals that maintain and enhance these sensitive and threatened habitats (EBTJV 2018).

Measuring the Effectiveness of Conservation Actions

Since Virginia's original Wildlife Action Plan was completed, monitoring and reporting the effectiveness of conservation actions has become an increasingly important issue. In late 2005, the U.S. House of Representatives initiated a performance review of the USFWS's Wildlife and Sportfish Restoration Programs, including State Wildlife Grants. This report concluded that results, related to the effectiveness of conservation actions, "are not being demonstrated." In subsequent years, funding for State Wildlife Grants has been scrutinized regarding its value to the American public. The USFWS and state wildlife agencies have worked to develop a mechanism to describe the importance and value of this program and the Wildlife Action Plans. In September 2009, the Association of Fish and Wildlife Agencies (AFWA) recruited staff from state wildlife agencies and nongovernmental organizations to develop and test a framework of effectiveness measures to support the State Wildlife Grants program and the implementation of Wildlife Action Plans. This framework of effectiveness measures was designed to:

- *Provide a means to evaluate conservation actions so that successful activities/programs can be continued and communicated and less successful ones improved or abandoned;*
- *Establish a standardized and accessible body of project performance data to inform and guide actions by current and future wildlife managers; and*
- *Provide a cost-effective mechanism for reporting data through regional and national summaries that will help meet congressional reporting expectations and articulate the value of state wildlife grants, and potentially the wildlife action plans, to policy makers, conservation partners, and taxpayers (AFWA 2011).*

The final Effectiveness Measures report identifies 11 basic conservation actions that have been implemented by states to support their Wildlife Action Plans (AFWA 2011). These include:

- Direct Management of Natural Resources;
- Species Restoration;
- Creation of New Habitat;
- Acquisition/Easement/Lease of Land;
- Conservation Area Designation;
- Environmental Review;
- Management Planning;
- Land Use Planning;
- Training and Technical Assistance; and

- Data Collection and Analysis.

For each project type, the working group used a planning tool called a Results Chain to identify intermediate output measures that can be used to evaluate the quantity and quality of work completed during a project's implementation (FOS 2007). Each results chain also identified longer-term outcome measures that are used to evaluate how successful a project is in meeting its intended goals.

This working group's final report was completed and approved by the AFWA Executive Committee in April 2011. Subsequently, the USFWS's Office of Conservation Investment adopted this framework and coordinated with AFWA and state agency partners to incorporate these measures into the Tracking and Reporting on Actions for Conservation of Species (Wildlife TRACS) reporting system. Wildlife TRACS serves as the mandatory, central repository for all projects implemented using State Wildlife Grants and other Office of Conservation Investment grant programs. As the Wildlife TRACS framework was developed to specifically support Wildlife Action Plan implementation and has been integrated into the mandatory project reporting system, the DWR will use these resources to track the effectiveness of conservation actions in the Wildlife Action Plan as outlined by Congress.

Looking beyond the Effectiveness Measures and TRACS outlined above, there are a variety of regional and state level monitoring programs that will consider the ongoing success of the WAP.

The Motus Wildlife Tracking System network is an international program that uses nanotag technology to track and monitor migratory wildlife via telemetry receiver stations at the landscape scale, targeting species that are too small for satellite tracking equipment. As of 2022, there were more than 1550 Motus receiver stations located in 34 countries on five continents. More than 300 species (with more than 36,500 individuals) have been tagged as part of 573 projects. Nearly 1700 partners collaborate as part of the international Motus network. In the eastern United States, the network was initially developed to monitor shorebirds, seabirds, and coastally migrating songbirds, with most of the array located in coastal areas and along the Great Lakes shorelines. Since 2017, the Northeast Motus Collaboration has expanded the array throughout the interior Northeast, filling a geographic gap along a key migratory route in the western hemisphere. More than 470 Motus stations exist in the NEAFWA region as of 2022, the densest concentration of receiver stations in the world. Wildlife that is tracked in the Northeast with the Motus network includes songbirds, seabirds, raptors, bats, bumble bees, Monarch butterfly (*Danaus plexippus plexippus*), and migratory dragonflies. A Motus project in Tennessee tracked the movements of the RSGCN Bog Turtle (*Glyptemys muhlenbergii*).

Multiple partners working under the **Chesapeake Bay Partnership Agreement** monitor conservation efforts, species status, and habitat conditions in the estuary and its watershed. Monitoring information is collated and provided to oversight partners and the public through the Chesapeake Bay Program's Chesapeake Progress. More than two dozen indicators track progress on meeting the goals and outcomes of the Agreement among the six states and the District of Columbia:

- Vital Habitats
- Sustainable Fisheries

- Water Quality
- Toxic Contaminants
- Healthy watersheds
- Land conservation
- Public access
- Environmental literacy
- Stewardship
- Climate resiliency

Additional information about efforts in the Chesapeake Bay region can be found at the Chesapeake Bay Program website.

The **Virginia Coastal Zone Management Program** is known, in the national coastal zone management arena, as a "networked program." To manage Virginia's coastal resources, the program relies on a network of state agencies and local governments to administer the enforceable laws and regulations that protect wetlands, dunes, subaqueous lands, fisheries, and air and water quality – within the Virginia "Coastal Zone."

Since 2011, through annual grants (CZMA Section 309) from NOAA, the Virginia CZM Program has supported comprehensive ocean planning to understand current ocean uses and needs, plan for emerging uses such as offshore energy development, and protect the ocean's habitats, wildlife and overall health. This has become an increasingly difficult challenge as coastal populations have grown, ocean uses have diversified and intensified, and overall ocean health has declined.

The current Section 309 Ocean Resources Strategy (October 2021 – September 2026) prioritizes developing a Virginia Ocean Plan that will provide a framework for communication and coordination between agencies, organizations, and interests that make up Virginia's relationship to the ocean, as well as to the public. The Plan will include many recommendations based on input received to-date around topics like marine mammal/sea turtle conservation, addressing ocean acidification, increasing the resilience of Virginia's blue economy, and minimizing use conflicts. The Plan also proposes an ongoing coordinative body that will provide a forum for cross-jurisdictional planning as new circumstances arise.

In addition, Virginia CZM works closely with the Mid-Atlantic Regional Council on the Ocean (MARCO) to engage on regional ocean planning efforts, particularly when it comes to data collection and sharing. The continued development of the Mid-Atlantic Ocean Data Portal has created an incredibly strong foundation for data driven decision making while providing tools and training to resource managers, industry and the general public.

In addition to MARCO, the VA CZM Program is coordinating the development of the Virginia Ocean Plan and working with the DWR to develop the final Virginia Marine Mammal and Sea Turtle Conservation Plans (See Appendices 4 & 5 once complete.)

The **Mid-Atlantic Fishery Management Council** monitors the status of the Mid-Atlantic marine ecosystems, collaborating with NOAA to issue annual State of the Ecosystem Reports on the Mid-Atlantic shelf systems (NOAA 2024). These monitoring reports assess the trends and status of several indicators related to seascape scale fishery management objectives.

The **NEAFWA Regional Conservation Needs (RCN) Grants** program strategically fills critical monitoring gaps and needs highlighted in SWAPs including surveys, assessments, and monitoring protocols on priority species. The Northeast Association of Fish and Wildlife Agencies 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 by agreement of the Northeast wildlife agency Directors. In one such case, the Directors established the Regional Conservation Needs (RCN) Program, which is managed by the Northeast Fish and Wildlife Diversity Technical Committee.

The RCN Program utilizes four percent of each state's annual State Wildlife Grants apportionment to address the needs of SGCN 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. 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. Example outcome measures include development, adoption and implementation of best management practices and data that drives decisions to not list at-risk species or supports downlisting and delisting. It is the DWR's intent to continue contributing SWG funds and personnel resources to support the RCN Program and the Northeast Fish and Wildlife Diversity Technical Committee. In addition, Virginia will continue to participate in the NEAFWA Northeast Landscape Wildlife Conservation Committee and other landscape and watershed scale conservation partnerships, which provide Virginia with opportunities to implement coordinated conservation action, reduce redundancy, save time and money, and combine resources to conserve landscapes and habitats for the benefit of people and the future of fish and wildlife.

Directed RCN projects have been developed to address these needs for priority RSGCN species and their habitats. RCN grants have supported a variety of monitoring and assessment projects within the last decade. These include:

- Eastern black rail
- Development of Avian Indicators and Measures for Monitoring Threats and Effectiveness of Conservation Actions in the Northeast
- Identification of Tidal Marsh Bird Focal Areas in BCR 30
- Bats and White-nosed Syndrome
- Allegheny woodrat Recovery
- Hellbender Population Assessment and Protocols
- Ranavirus in Amphibian Populations

- Timber rattlesnake Population Assessment
- Strategic Implementation of Regional Conservation Priorities for Freshwater Turtles at Risk in the Northeast
- Tiger beetle Status Assessment
- Coordinated Assessment of the northeastern diamondback terrapin Populations

A complete list of all RCN projects can be found at the Northeast Regional Conservation Needs website.

International Conservation

Dozens of migratory SGCN songbirds, waterfowl, shorebirds, and the monarch butterfly utilize habitats in Virginia as part of their annual life 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.

The DWR currently participates in several multi-stakeholder programs (Joint Ventures, Atlantic Flyway Council, Partners in Flight, Southern Wings) that work to monitor and conserve these migratory species. As part of these collaborative efforts, the DWR may consider using a portion of its State Wildlife Grants apportionment 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. The DWR's participation with such a project would be considered as part of the agency's annual budgeting process and contingent upon an internal review by appropriate agency staff.

Adapting Conservation Strategies

As conservation projects are implemented and effectiveness data are collected, it is likely that projects will need to be modified, because experience will be gained, circumstances will change, or new information will become available. Through Wildlife TRACS system, the DWR will provide a mechanism to monitor effectiveness and identify issues. If issues or concerns are identified, the DWR and partners will update species specific management plans and develop additional research projects to adapt conservation efforts.

Plans or strategies have been developed for several specific SGCN conservation efforts. Examples of plans include the 2011 Canebrake Rattlesnake Conservation Plan and the 2010 Virginia Freshwater Mussel Restoration Strategy: Upper Tennessee Basin (DWR 2011; DWR 2010). These plans are created in collaboration with appropriate partners and contributors. If it is determined that conservation actions are not meeting expectations, or if circumstances dictate that conservation objectives must be altered outside of the scope of the original plan, the DWR will coordinate efforts with partners and stakeholders to amend plans as necessary. A state mussel recovery plan, a sea turtle conservation plan and a marine mammal conservation plan (See Appendices 4 & 5 once complete) are currently under development, and several nongame conservation plans are complete or in process (wood turtle, bog turtle, eastern hellbender, Tennessee dace, variegate darter, blackbanded sunfish and the tiger salamander). In

addition, there are several regional plans that Virginia actively supports for conservation of eastern box turtle, spotted turtle, wood turtle and timber rattlesnake.

Few of these habitat and research efforts are expected to require a more specific or detailed planning document. As these projects are implemented, the Wildlife TRACS system (see above) is expected to provide the necessary effectiveness reporting framework to allow project managers and administrators to track and evaluate project results. Should a program need to be revised to address changing circumstances or new information, the DWR will rely upon its established science teams (see below) to provide program managers with the necessary guidance.

RESEARCH NEEDS

While updating the SGCN list (see Methods), the Technical Advisory Committees, species experts and partners were asked to describe actions that could be taken to conserve each species. Many partners identified research needs that fell into two categories. The vast majority of research needs involved collecting data to determine the distribution, status, and life history of SGCN. In most of these cases, no additional conservation actions were specified, and species were classified as conservation opportunity ranking "C." In other cases, specific research needs were identified that must be addressed before "on the ground" actions can be implemented to benefit a species. Under these circumstances, species were classified in management opportunity category "B." Absent other criteria, State Wildlife Grants funding will be prioritized to address research needs for category "B" species. This is not to indicate that no baseline research will be implemented for category "C" species, but this type of research is expected to be a lower priority unless a compelling rationale can be articulated to explain how such an effort would likely lead to the removal of a species from the Wildlife Action Plan or contribute to a restoration effort. In addition, in this version of the plan, Assessment Priority Species were included in the Plan. As mentioned above, these species are considered rare, but there is not enough currently known to assign either a Tier or Conservation Opportunity Ranking. They have been included to ensure that they are tracked in future plans and to ensure that if their status changes at some point, then a minor revision will be conducted according to USFWS guidelines.

During the implementation of this Wildlife Action Plan, other research needs are likely to be identified as projects are developed and carried out. New research needs will be evaluated and prioritized during DWR's annual budgeting process. If the research involves a species that is not included within the Wildlife Action Plan, the DWR staff will coordinate with staff from the Office of Conservation Investment to ensure compliance with USFWS guidelines.

7. UPDATE OF VIRGINIA'S WILDLIFE ACTION PLAN

Congress requires that each state describe the procedures that will be used to review and update their Wildlife Action Plan at intervals not to exceed ten years (Public Law 106-291). Virginia will complete a comprehensive and formal revision of Virginia's Wildlife Action Plan by October 2035. The exact process for updating this Plan will be determined closer to that deadline. The process will be developed in close consultation with DWR administrators and staff, the USFWS, other agencies, and partners. As indicated

previously, the DWR will continue its annual reporting of projects and accomplishments. When reporting on projects funded via State Wildlife Grants, the DWR will provide data on project outputs and effectiveness measures per the standardized metrics developed by AFWA and the Wildlife TRACS system. If indicated by the effectiveness and project output data, projects and programs may be altered to better address changing conditions. Efforts may also be adjusted as new technologies, data, or conservation strategies become available. If circumstances require the Wildlife Action Plan be revised prior to the 10-year deadline, the DWR staff will coordinate efforts with the appropriate representatives of the USFWS' Office of Conservation Investment .

8. STAKEHOLDER AND PUBLIC PARTICIPATION

Two of the Eight Essential Elements each Wildlife Action Plan must address involve outreach. Element 7 indicates that, "…Federal, State, and local agencies and Indian tribes that manage significant land and water resources within the State or administer programs that significantly affect the conservation of identified species and habitats…" must be afforded the opportunity to participate in the development, implementation, review, and revision of the Wildlife Action Plan (Public Law 106-291). In addition to the Federal, State, and local agencies and Indian Tribes, DWR also worked to involve the many private nongovernmental organizations that own conservation lands and easements in Virginia or implement conservation projects consistent with the Wildlife Action Plan. Collectively, these groups are called conservation partners. Element 8 indicates that, "…broad public participation is an essential element of developing and implementing…" Wildlife Action Plans. Throughout the development of the Virginia's 2025 Wildlife Action Plan, the authors have made a significant effort to engage and address the needs and interests of both the conservation partners and the general public.

Conservation partner lists from the 2015 Plan were used to initiate development a comprehensive list of potential partners. As partners were contacted to determine their willingness to participate in the 2025 revision, additional groups were added. A very few groups had disbanded and were removed from the list. Two stakeholder meetings were held in May 2023 and one stakeholder meeting was held in September 2024. The first meeting in 2023 was held with all of the state, federal and local government agency partners. The second with all of the non-governmental agency partners. Both groups were combined for the 2024 meeting. In addition, staff reached out to the seven federal recognized tribes, four state recognized tribes and seven additional tribes with a historic presence in Virginia. Staff utilized the Virginia Sovereign Nations Conference, the EPA Virginia Tribal Operations Team, and one-on-one meetings or phone calls with the environmental programs at each tribe to coordinate their comments. Stakeholder comments were solicited through an online web portal at each major step of the process (SGCN lists, habitats, threats and conservation actions and the final draft.) Tribes were contacted individually and were provided a separate website for their comments.

Table 8.1. WAP Stakeholders

Federal	State	Regional/NGO
USFWS, Great Dismal Swamp National Wildlife Refuge	**Virginia Department of Health**	**Virginia Association of Planning District Commissions**
NPS, Shenandoah National Park	**Virginia Department of Conservation and Recreation, Natural Heritage Program**	**American Fisheries Society-VA Chapter**

USFWS, Eastern Virginia Rivers National Wildlife Refuge Complex	Virginia Department of Forestry	Audubon Society of Northern Virginia
USFWS, Potomac River National Wildlife Refuge Complex	Virginia Department of Environmental Quality, Coastal Zone Management Program	B.A.S.S. Federation Nation of Virginia, Inc.
USFWS, Ecological Services Staff	Virginia Department of Environmental Quality, Division of Environmental Enhancement	Blue Ridge Land Conservancy of VA
National Park Service – GW Memorial Parkway	Virginia Department of Environmental Quality, Division of Water & Biological Monitoring	Capital Region Land Conservancy
USFS, George Washington/Thomas Jefferson National Forests	Virginia Department of Agriculture and Consumer Services, Plant Protection	Chesapeake Bay Foundation-Virginia Office
USFWS, Back Bay National Wildlife Refuge	Virginia Department of Energy	Coastal Conservation Association
USFWS, Chincoteague National Wildlife Refuge	Virginia Tech, Conservation Management Institute	Dan River Basin Association
U.S. Bureau of Land Management	Virginia Marine Resources Commission	Delta Waterfowl Richmond
USFWS, Eastern Shore National Wildlife Refuge		Discover the James
DoD, Marine Corps Base Quantico		Ducks Unlimited
DoD, Ft. Walker		Friends of Dyke Marsh
DoD, Ft. Barfoot		Friends of the Rappahannock
DoD, Readiness and Environmental Protection Integration Program		Friends of the Rivers of Virginia
DoD, Ft. Belvoir		Garden Club of Virginia
NRCS, Virginia State Office		Healing Harvest Forest Foundation
NOAA, Regional Habitat and Ecosystem Services		Izaak Walton League - Virginia Division
NOAA, Protected Resources		James River Association
		National Wild Turkey Federation, Virginia
		New River Land Trust
		Northern Virginia Conservation Trust
		Piedmont Environmental Council
		Richmond Audubon
		Sierra Club - Virginia Chapter
		The Conservation Fund
		The Wildlife Foundation of Virginia
		The Nature Conservancy-VA Office
		Trust for Public Land -Chesapeake & Central Appalachians Field Office
		Virginia Association of Counties
		Virginia Conservation Network
		Virginia Council of Trout Unlimited
		Virginia Deer Hunters Association, Inc.
		Virginia Farm Bureau
		Virginia Herpetological Society

	Virginia Municipal League
	Virginia Native Plant Society
	Virginia Outdoors Foundation
	Virginia Society of Ornithology
	Wetlands Watch
	Wild Virginia
	Wildlife Center of Virginia
	Virginia Master Naturalist
	Virginias United Land Trusts
	Virginia Associsation of Soil and Water Conservation Districts
	Virginia Forestry Association
	Virginia Working Landscapes (Smithsonian)
	American Farmland Trust
	Cave Conservancy of the Virginias
	Virginia Speleological Survey
	The Wildlife Society of Virginia

Table 8.2. WAP Tribal Contacts

Federally Recognized Tribes
Monacan Nation
Rappahannock Indian Tribe
Upper Mattaponi Indian Tribe
Chickahominy Indian Tribe-Eastern Division
Chickahominy Indian Tribe
Nansemond Indian Tribe
Pamunkey Indian Tribe
State Recognized Tribes
Cheroenhaka Nottoway
Nottaway Indian Tribe
Mattaponi Nation
Patawomeck Indian Tribe
Other Tribes with a Historic/Cultural Presence in Virginia
Piscataway Conoy Tribe
Piscataway Indian Nation
Shawnee Tribe
Eastern Band Cherokee Indians
Occoneechee Band of the Sapponi Tribe
Sappony Tribe
Catawba Nation

On May 19, 2025 the DWR made the draft 2025 Wildlife Action Plan available to conservation partners and then to the general public June 18, 2025 via the DWR website at: and https://dwr.virginia.gov/wildlife/wildlife-action-plan/wildlife-action-plan-2025/

Following the release of the draft 2025 Wildlife Action Plan for review, and the distribution of the announcement emails, recipients suggested that the DWR notify other potentially interested parties. All the partners listed above were sent notice of the final draft being available for comment. In addition, the DWR published the call for public comment on various social media channels and published it in agency newsletters and on the agency website.

In another attempt to create awareness about and engage stakeholders in the revision of the Wildlife Action Plan to a larger public audience, the authors gave presentations to a variety of groups regarding the purpose of the Wildlife Action Plan. The authors requested that DWR staff and other partners help identify opportunities to give presentations to conservation partners and public audiences. Throughout the revision process, DWR staff presented information on the WAP revision, process and call for comments and partners at a variety of professional meetings. These are listed in Table 8.3 below. These presentations all involved discussions of the Wildlife Action Plan which included describing how changing environmental conditions would be addressed, how the updated Wildlife Action Plan would be formatted, types of threats to wildlife and habitats that would be included, and types of actions that can be taken to address these issues. Several of these meetings were with individuals or a small group from the Organization and some were larger meetings open to the public where audiences ranged in size from 20 individuals to 120 individuals. During each presentation, the presenter offered to meet with other groups at other events as needed.

Table 8.3. Presentations to Organizations/Groups on the Wildlife Action Plan

Date	Organization/Group
08/08/22	DWR Watchable Wildlife Staff
8/24/2022	VA DCR/Division of Natural Heritage Staff
10/27/2022	DWR Nongame and Endangered Species Staff
11/17/2022	DWR Outreach Staff
12/13/2022	DWR Nongame and Endangered Species Staff
2/8/2023	VA DCR/Division of Natural Heritage Staff
3/21/2023	Dana Adkins, Chickahominy Tribe
4/6/2023	First Stakeholder Group meeting, NonGovernmental Organizations, DWR HQ, Henrico, VA
4/25-27/23	Virginia Land Conservation and Greenways Conference, Harrisonburg, VA
5/11/2023	First Stakeholder Group meeting, Government Agencies, DWR HQ, Henrico, VA
5/9/2023	EPA Regional Tribal Operations Team (virtual)
5/17/2023	Environmental Staff, Eastern Band of the Cherokee, Cherokee, NC
5/14/2023	Virginia Sovereign Nations Conference (attended/met with tribal representatives), Glen Allen, VA
10/31-11/1/23	Marine Mammal Conservation Plan Meeting, Norfolk, VA
3/6/2024	DWR Fish and Wildlife Information System Staff

4/9 -11/24	Environment Virginia Symposium, Lexington, VA
4/21-24/24	Northeast Association of Fish and Wildlife Agencies, Hyannis, MA
5/8/2024	Joe Capella, Pamunkey Tribe, Pamunkey Reservation, King William, VA
6/25-27/24	Northeast State Wildlife Action Plan Coordinators Meeting, Northampton, MA
9/11/2024	Second Stakeholder Advisory Committee Meeting, Richmond Public Library, Richmond, VA
9/19/2024	Virginia Sovereign Nations Conference, (Attended/met with tribal representatives), Glen Allen, VA
9/30-10/15/24	Tribal Office Visits, met with all 7 federally recognized tribes and the Mattaponi Tribe
10/7/2024	The Nature Conservancy Virginia Office (virtual)
10/17/2024	The Wildlife Center of Virginia, Waynesboro, VA
1/13/2025	Southeast Climate Adaptation Center Staff (virtual)
3/4/2025	Atlantic Flyways Council, Bird Collision meeting (virtual)
3/18-19/25	Virginia Chapter, The Wildlife Society, Richmond, VA
4/8-10/25	Environment Virginia Symposium, Lexington, VA
4/28-30/25	Virginia Land Conservation and Greenways Conference, Lynchburg, VA
6/24/2025	Lunch & Learn for DWR staff
7/3/2025	Interview with WMRA NPR station for NW VA
9/1/2025	Article in Virginia Wildlife Magazine
9/16/2025	Northern Virginia Bird Alliance

The updated Wildlife Action Plan was presented to the Board of the Virginia Department of Wildlife Resources Wildlife and Boat Committee at its public meetings on August 20, 2025. The public was provided an opportunity to comment on the draft Wildlife Action Plan during this event.

DWR Involvement

When Virginia's original Wildlife Action Plan was written, the planning effort was directed by the Wildlife Diversity Division. The Wildlife Diversity Division consisted of programs related to threatened and endangered species, nongame species conservation, environmental commenting, watchable wildlife, geospatial analysis, and data management. During 2010, the DWR executed a significant restructuring of its wildlife resource programs. Per this restructure, the former Wildlife Diversity Division was merged with the former Fisheries Division, which managed sportfish resources, and the former Wildlife Division, which managed terrestrial game species and habitat resources. These three divisions, Wildlife Diversity, Fisheries, and Terrestrial Wildlife, became the Bureau of Wildlife Resources. Functions and procedures within the Bureau were distinctly different from those used during the previous agency structure. These changes were significant in terms of how DWR prioritized projects and allocated State Wildlife Grant dollars.

In 2018, the Bureau was reorganized into 4 divisions and non-game staff were assigned to either the Fisheries or Wildlife Divisions. In 2022, non-game staff were consolidated into a new section within the Executive Office. As part of the 2025 revision, nongame, fisheries and wildlife staff were engaged to lead the taxonomic teams, develop the habitat associations, threats and conservation actions, which were then put out for stakeholder comment at each stage. Staff were also notified when the draft plan went out for public comment.

In updating the Wildlife Action Plan, to develop an effective and comprehensive document, it was imperative to ensure that the diversity of Bureau programs and personnel had the opportunity to participate in this planning effort. DWR staff members are an important conservation partner and, as such, were treated as a target for outreach efforts consistent with the guidance of Element 7.

During development of the WAP, staff met monthly with DWR leadership to discuss the schedule and additional constituent groups that should be contacted. Various parts of plan were presented and revised as needed. Agency leadership provided valuable input to the process and made recommendations to better structure the online tool. When the Nongame Program was reconstituted, the new Nongame Program Manager was added to the team that regularly met to review Plan progress. Ultimately the Nongame Program Manager will be responsible for implementing the approved Plan.

On May 19, 2025, before the draft Wildlife Action Plan was made available to the general public, the draft Wildlife Action Plan was made available to DWR staff for review and comment. This effort provided an additional opportunity to find typographical errors, identify issues with species distributions, and clarify narratives regarding habitats, conservation threats, and actions.

Summary of Comments and Wildlife Action Plan Adaptations

During the comment period, comments were received during each part of the revision process. After the bulk (excluding the bird, plants and invertebrates) of the SGCN species' lists were published we received comments from 17 stakeholders, primarily related to changing a tier ranking for a species, including just a subspecies and a few technical fixes related to species status. In addition, the DWR received an official response from the Rappahannock Tribe requesting that river herring and striped bass be moved to the highest tier of SGCN due to their tribal cultural significance and their populations declining. Agency fisheries biologists responded in a letter directly back to the tribe regarding agency concerns for these species, how the existing tiers were selected, and provided open avenues for future collaboration with the agency in managing these species. During the third comment period, which included the birds, plants and invertebrates, the DWR received three comments, most of which were from the Virginia Society of Ornithology members on a variety species requesting a change in tier or for the inclusion of a few species that were not included. In one case there was concern expressed about the conservation opportunity ranking.

During the second major comment period, stakeholders and each of the tribal nations were asked to review the habitats, threats and conservation actions associated with all of the SGCN except the terrestrial snails which had not been completed yet. Habitat descriptions, written by our habitat teams from various stakeholder experts, were also included and the SAC was asked to review those for accuracy and completeness. All threats and conservation actions were coded to correspond to the NE Lexicon. During this period, the DWR received extensive comments from four stakeholder groups, including the Rappahannock Tribe. Comments related to the inclusion of Data Centers as a specific threat. After consultation with the Northeast SWAP Coordinators, it was decided to update the description for the Commercial and Industrial Development to specifically identify Data Centers,

including their impacts on water withdrawal, power generation and land development. Other comments identified the omission of Back Bay from the description of estuaries in the Commonwealth; the description was updated. One stakeholder requested information that would be included on Marine Mammals. These are addressed in this plan, but at the time of stakeholder comment, the Marine Mammal Conservation Plan had not been completed yet. Finally, the Wildlife Center of Virginia submitted extensive comments on wildlife diseases and the threats they post to SGCN. A section on wildlife diseases was added and an appendix provided by the NEAFWA and SEAFWA Fish and Wildlife Health Coordinators.

The final draft of the Wildlife Action Plan, along with the Online Tool, were posted for Stakeholder Advisory Committee and DWR staff review on May 19, 2025. The DWR received 15 responses encompassing 31 separate comments related to habitats/threats/conservation actions, changes to the SGCN list, missing information in the Plan, and the online tool. One comment was received from the Nansemond Indian Nation. During this comment period the WAP was also reviewed internally by staff and Agency administrators. All comments were reviewed and addressed as appropriate. Specifically, 22 updates were made to the draft Wildlife Action Plan and a paragraph was added that fully explained the importance of wildlife corridors and connections to the Virginia Wildlife Corridor Action Plan (VWCAP). In addition, references were added in several places that referenced the VWCAP.

All comment submittals were responded to directly to inform the stakeholders about how the Technical Advisory Committees addressed their comments and the reasoning behind the actions taken. All tribal comments were addressed with a formal letter to the specific tribe addressing their concerns and providing opportunities for further coordination.

Public Comment Period

On June 18, 2025, the Wildlife Action Plan final draft and online tool were published on the Agency's website for public comment. The DWR received 50 responses were submitted during the 30-day public comment period. Of these, 30 addressed issues related to the Wildlife Action Plan and included 62 separate comments. Seventeen were unrelated to the Plan and were referred to other areas of the DWR. The comments submitted were related to habitats/threats/conservation actions, changes to the SGCN list, missing information in the Plan, and changing the structure of the Plan. Of the 62 submitted comments, almost half related to raising more awareness of the importance of wildlife corridors. All of these were referred to the DWR Wildlife Division and several changes were made to the Wildlife Action Plan to increase the connection between the Plan and the VWCAP. Twelve of the comments referenced information that was already included in the Wildlife Action Plan.

As the updated Wildlife Action Plan is implemented, DWR staff will continue collaborating with Conservation Partners and working to inform the general public about the wildlife conservation efforts implemented on their behalf. These efforts will include working with our conservation partners like the Piedmont Environmental Council, Blue Ridge Prism, The Nature Conservancy and many others. Coordinating with the Virginia Security Corridor Sentinel Landscapes Program is another way that conservation goals outlined in the Wildlife Action Plan will be carried out. Future work will involve

corporate and private partners along the lines of current efforts involving Devil's Backbone Brewery, The Paul G. Allen Foundation, and others through the work of our Agency Community Engagement and External Relations Coordinator. Finally, the Agency has already begun cooperative projects with Virginia's Sovereign Nations and we will continue to engage with them wherever possible to develop cooperative conservation projects that respect their traditional ecological knowledge and advance Wildlife Action Plan conservation actions.

9. CONCLUSION

From a statewide level, reviewing conservation needs in this Wildlife Action Plan may be discouraging as hundreds of species are identified as being of greatest conservation need. Concerns over the loss or degradation of Virginia's aquatic, wetland, terrestrial, subterranean, and coastal habitats are not inconsequential. If we fail to address these issues, more regulatory actions may be needed to further protect and conserve some of these species, which would have profound impacts for people, businesses, and communities, national security preparedness, as well as wildlife.

Alternatively, this document can be viewed from the perspective of implementation. The Plan focuses on what the conservation community, as well as communities, businesses, and private citizens, 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 the DWR and its 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, technologies, and best practices. Finally, and perhaps most importantly, Virginia has a robust and dedicated conservation community, comprised of governmental and non-governmental agencies and organizations, colleges and universities, and talented enthusiasts, who have proven that great things can be accomplished when efforts are focused.

It is the DWR's intent that the revised Wildlife Action Plan will define problems based on areas of common interest. This updated version was created to find ways to keep species from becoming imperiled. While this perspective may seem limited, the majority of conservation issues Virginians 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 through our landscapes. As waters flow from Virginia, these rivers, and their adjacent habitats, support even more species, communities, industries and recreational opportunities. Working to keep species from becoming imperiled benefits our communities, our economy and military readiness, and our quality of life by addressing the problems that exist within our collective habitats and preventing them from becoming a crisis.

The conservation actions defined at the sub-watershed level are not mandates. Rather, they identify shared problems and describe the types of actions that can be taken to address conservation priorities.

Ideally, these actions 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 this document as a means of forging new collaborations that achieve mutual goals.

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 imperiled while also doing beneficial things for human communities.

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APPENDIX 1: SOUTHEAST CONSERVATION ADAPTATION STRATEGY

As Virginia is part of the Northeast Region, coordination with the Southeast Conservation Adaptation Strategy and the southeastern states information came in too late to fully integrate into the 2025 Revision. In addition, since Virginia was trying to stay in line with the Northeast Lexicon and Northeast regional efforts, it was not possible to fully integrate the Southeastern criteria. The SE RSGCN list was used as one criteria for including SGCN species in the 2025 Virginia WAP and some information in the section on changing environmental conditions in Virginia was incorporated from the SE Climate Adaptation Science Center. This appendix is included for future cooperative efforts among the southeastern states.

Virginia: A Regional Perspective

In 2018, the Association of Fish and Wildlife Agencies (AFWA) adopted a resolution on landscape conservation that recognized "the importance of collaborating at landscape scales to help fish and wildlife agencies meet their statutory and regulatory responsibilities to conserve fish and wildlife and their habitats." In response to the resolution, AFWA established a President's Task Force on Shared Science & Landscape Conservation Priorities in 2020, which recommended that State Wildlife Action Plans (SWAPs) serve as a framework for regional coordination and collaboration.

Within this Plan, Virginia has identified Species of Greatest Conservation Need (SGCN) and outlined strategies to sustain them, including conservation actions to promote species recovery and prevent federal listings under the Endangered Species Act. But to sustain the species that are the State's responsibility to protect and that also reflect the rich biodiversity, culture, and history of the state, Virginia must consider its role and the influences of the larger Southeast landscape.

This chapter examines regional, landscape-scale considerations for Virginia and serves as a means for the State to find potential collaborations to best support the State's SGCN and Southeast Regional SGCN (RSGCN). Additionally, some of the threats that impact SGCN (e.g., shifting climates) have consequences locally, statewide, and regionally. Addressing these threats effectively requires aligning conservation strategies across state boundaries. By using consistent regional information shared by other states to inform their own SWAPs, Virginia can better contribute to regional conservation priorities, identify potential landscape-level threats, and help connect the Southeast region's lands and waters.

VIRGINIA'S CONSERVATION PORTFOLIO: CONNECTING THE REGION'S LANDS AND WATERS

Virginia supports a wide diversity of habitats, culturally and historically significant landscapes, and ecosystems that provide benefits to the state as well as the broader Southeast region. The State also plays an important role in connecting the lands and waters of the Southeast Region, as well as hosting some regionally important ecosystems and habitat types like maritime forests, longleaf pine, and

spruce-fir forests. Many regional and local partners and partnerships are working with the Virginia Department of Wildlife Resources (VADWR) to help conserve the state's iconic and important landscapes. According to the Protected Areas Database of the United States (PAD-US, v4.0 considering fee simple, easements, and designation areas), approximately 4.45 million acres (16%) of the state are considered protected. This includes important landscapes like the George Washington and Jefferson National Forests, the Eastern Shore of Virginia and the Great Dismal Swamp National Wildlife Refuges, and state game lands like Chester F. Phelps Wildlife Management Area.

In addition to contributing to the conservation landscape of the Southeast, Virginia's lands and waters also benefit the state's economy. In 2023, the Bureau of Economic Analysis estimated that the outdoor recreation economy generated $13.4 billion in value for the state's Gross Domestic Product and another $6.5 billion in wages and salaries (U.S. Bureau of Economic Analysis for Outdoor Recreation, 2023). Beyond providing recreational value, natural landscapes also support working lands such as agriculture and timber. As of 2023, Virginia supported more than 7.3 million acres of farmland across 39,000 farms (U.S. Department of Agriculture, 2023).

Virginia and the Southeast Conservation Adaptation Strategy (SECAS)

The Southeast Conservation Adaptation Strategy (SECAS) is a regional conservation initiative that spans the Southeastern United States and Caribbean. SECAS brings together diverse partners around an ambitious goal: a 10% or greater improvement in the health, function, and connectivity of Southeastern ecosystems by 2060. The Southeast Conservation Blueprint is the primary product of SECAS. The Blueprint is a living, spatial plan that identifies priority areas where conservation action would make an impact toward creating a connected networks of lands and waters, based on a suite of natural and cultural resource indicators and a connectivity analysis.

So far, more than 2,500 people from over 650 different organizations have been actively involved in developing the Blueprint. At least 14 staff from VADWR alone and many more from the Virginia Natural Heritage Program have participated in workshops to review and improve the Blueprint, along with many other conservation practitioners from across the State. Since 2014, the Blueprint has been used by a broad suite of partners to inform many different conservation actions across the Southeast region including Virginia. For example, staff from the Southern Appalachian Spruce Restoration Initiative used the Blueprint to support a successful proposal to Department of the Interior's Restoration and Resilience Framework to prioritize restoration and improve coordination and monitoring of spruce-fir restoration in western North Carolina and Virginia. The Blueprint was also used in a successful proposal by the Virginia Department of Conservation and Recreation for $5.6 million to acquire 1,900 acres of forest land for biodiversity conservation and recreation in Suffolk through NOAA's Climate Ready Coasts initiative.

Maps of the Blueprint and other regional data are provided within this chapter. These maps also include a boundary that extends beyond the State and includes surrounding HUC8 watersheds within 1.5 kilometers of the State boundary. By looking beyond the State's boundaries, Virginia can consider how to best align conservation actions and identify cross-jurisdictional opportunities with neighboring states to maximize benefits for SGCN with wider ranges.

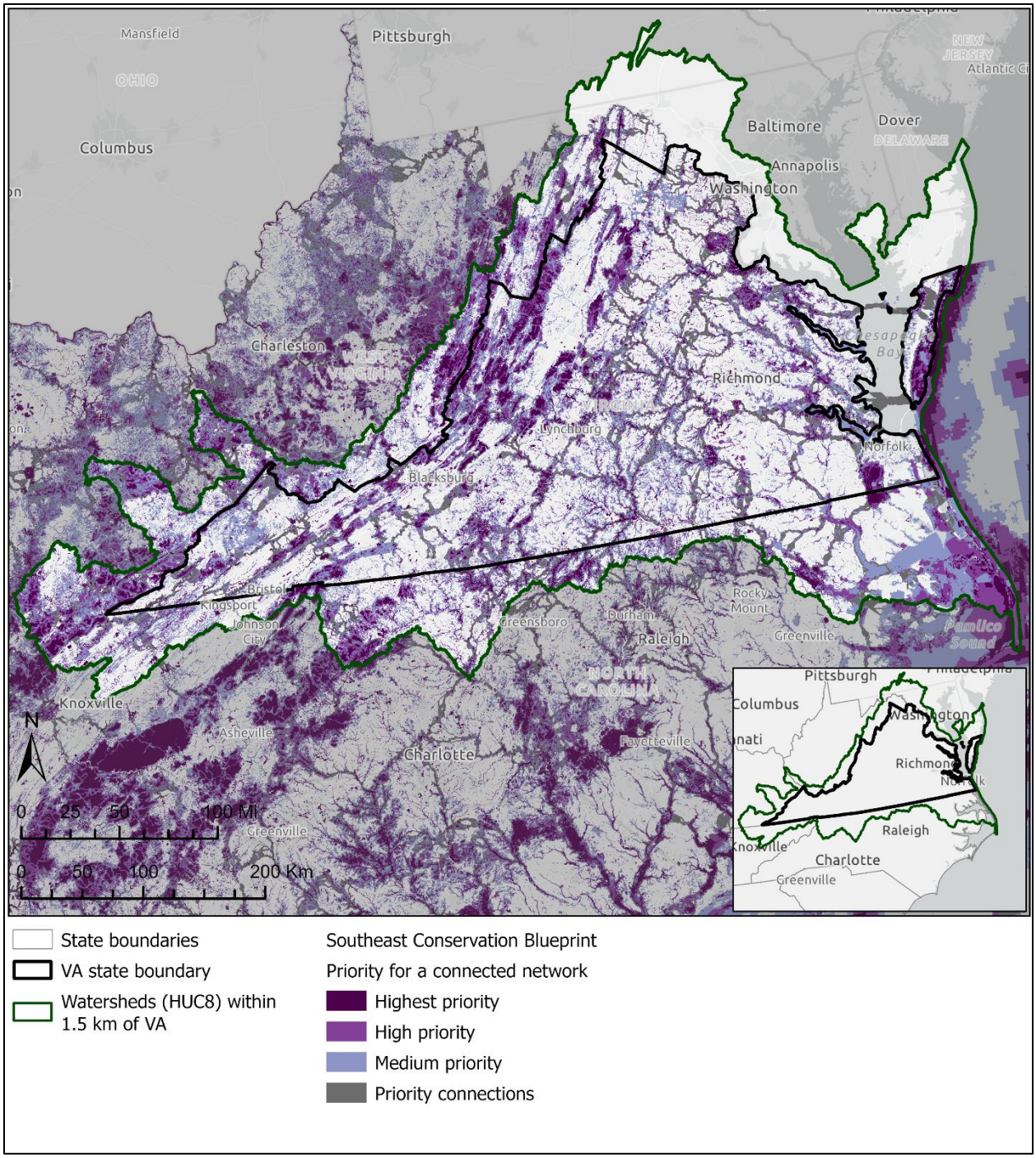


Figure 2. Southeast Blueprint (v2024) priorities within Virginia and surrounding watersheds within 1.5 km of the state line.

The Blueprint recognizes more than 13.1 million acres, or roughly 48 % of the state, as a priority for connecting the region's lands and waters (Table 1, Figure 1). About 5.2 million acres (19.1%) are rated as highest or high priority. An additional 5.3 million acres (19.7%) are rated as medium priority and about 2.5 million acres are considered priority connections, or key linkages between priority areas that can help facilitate the flow of species and ecological processes within the State while also considering

connectivity within the broader region. Together, these classes represent the most important areas for shared conservation action to connect lands and waters and improve ecosystem health. The Blueprint includes more than 60 indicators that represent both natural and cultural resources and collectively represent ecosystem health, function, and connectivity across terrestrial, freshwater, and coastal and marine systems. Examples include imperiled aquatic SGCN, cores of intact natural habitat, natural floodplain landcover, prescribed fire frequency, and more. Indicator data is available on the Blueprint page of the SECAS Atlas.

The Blueprint recognizes the vast majority (77%) of Virginia's protected areas as a priority for connecting the lands and waters of the Southeast (Table 1). This means that while these conserved areas are contributing to the state-wide landscape and represent unique habitats and locally important areas, many of them are also contributing to a wider regional conservation strategy. The State's conservation portfolio exemplifies a complementary landscape-scale approach to conservation that links local actions with conservation outcomes that contribute to a broader geographic scale.

Table 2. Protected areas within VA and how much of those areas that are recognized as priority places within the Southeast Conservation Blueprint 2024. Percentages are provided to show of the total protected lands, what percentage of them fall within Blueprint categories. For example, the Blueprint recognizes about 11% of NC's lands and waters as the highest priority for connecting lands and waters. However, 23% of VA's protected lands and waters are considered highest priority by the Blueprint.

Priority for a connected network	Acres of each Blueprint (v2024) priority category within VA	Acres of conserved lands (PAD-US 4.0) recognized as Blueprint priority and what percentage of the total protected lands are prioritized
Highest	2,054,303 (7.5%)	1,004,145 (23%)
High	3,182,311 (11.6%)	1,171,737 (26%)
Medium	5,394,371 (19.7%)	1,536,606 (34%)
Priority connections	2,480,115 (9.1%)	143,970 (3%)
Lower priority	14,249,179 (52.1%)	599,608 (13%)
Total	27,360,280 **(100%)**	**4,456,067 (100%)**

The Southeast Blueprint also includes a least-cost path connectivity analysis that identifies corridors that link coastal and inland areas and span climate gradients (Figure 3). The corridors connect hubs across the shortest distance possible, while also routing through as much Blueprint priority as possible. The hubs that anchor the connectivity analysis are large patches of highest priority Blueprint areas and/or protected lands. About 9.2 million acres (34%) within Virginia are considered a hub or corridor within this analysis, providing many conservation opportunities to support species movement and migration—an important strategy for helping wildlife adapt to landscape-level changes (Figure 2).

Virginia has also done a lot of great work at the state level to develop corridors that are important for wildlife. The Virginia Wildlife Corridor Action Plan (see Page 97 for a discussion on wildlife corridors) emphasizes protecting important wildlife habitat corridors and reducing wildlife-vehicle conflicts, such as collisions (Virginia Department of Wildlife Resources, 2023). These wildlife corridors also help connect fragmented habitats. Many of the State's corridors align with the Blueprint connectivity analysis both within and outside the state (Figure 2).

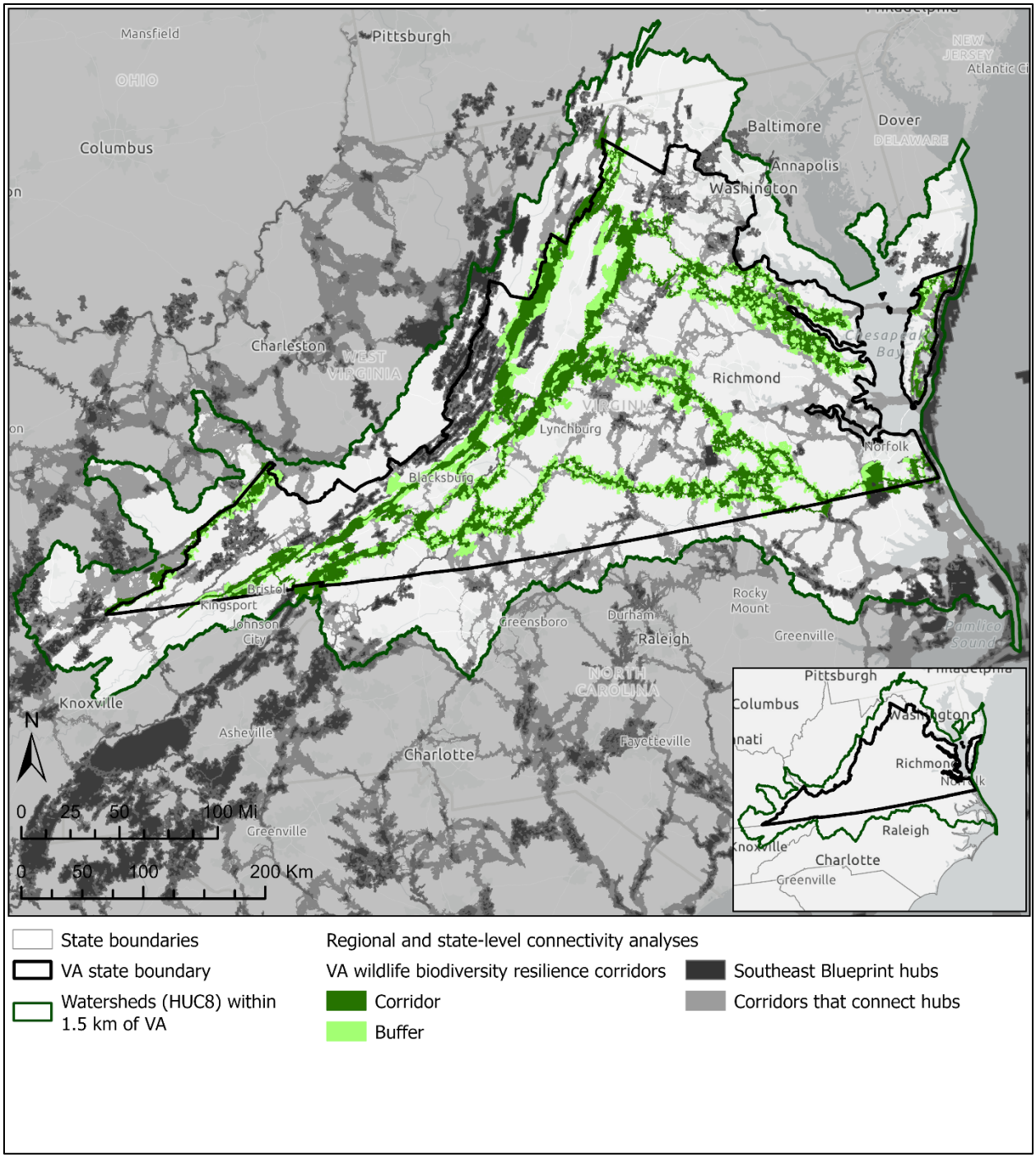


Figure 3. The Virginia Wildlife Corridor Action Plan resilience corridors and the Southeast Blueprint connectivity analysis showing hubs and corridors in Virginia and surrounding watersheds shared with Virginia and West Virginia. The Virginia wildlife corridors connect fragmented habitats separated by human activities or infrastructure and is considered vital to the long-term sustainability of wildlife biodiversity. The Blueprint uses a least-cost path connectivity analysis to identify corridors that link hubs across the shortest distance possible, while also

routing through as much Blueprint priority as possible. In the continental Southeast, hubs are large patches (~5,000+ acres) of highest priority Blueprint areas and/or protected lands.

Ensuring landscape connectivity across jurisdictional boundaries is becoming increasingly important for species management as changes in land use, climate, and weather patterns shift species distributions. Collaborating with the neighboring states of Maryland, West Virginia, Kentucky, Tennessee, and North Carolina to identify cross-boundary species migration and habitat pathways can increase regional connectivity for state SGCN and RSGCN. It is also important to consider potential barriers to connectivity such as existing and future urbanization.

One lens to characterize the landscape of Virginia is by its ecoregions as defined by the Level III ecoregions of the continental US (Omernik 1987, 1995): the Central Appalachians, Ridge and Valley, Blue Ridge, the Piedmont, the Middle Atlantic Coastal Plain, and the Southeastern Plains (Figure 3). Ecoregions are identified by analyzing areas where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar. Evaluating ecoregions that Virginia shares with its neighbors is one way to identify cross-boundary conservation opportunities, as these areas share similar mosaics of biotic, abiotic, terrestrial, and aquatic ecosystems.

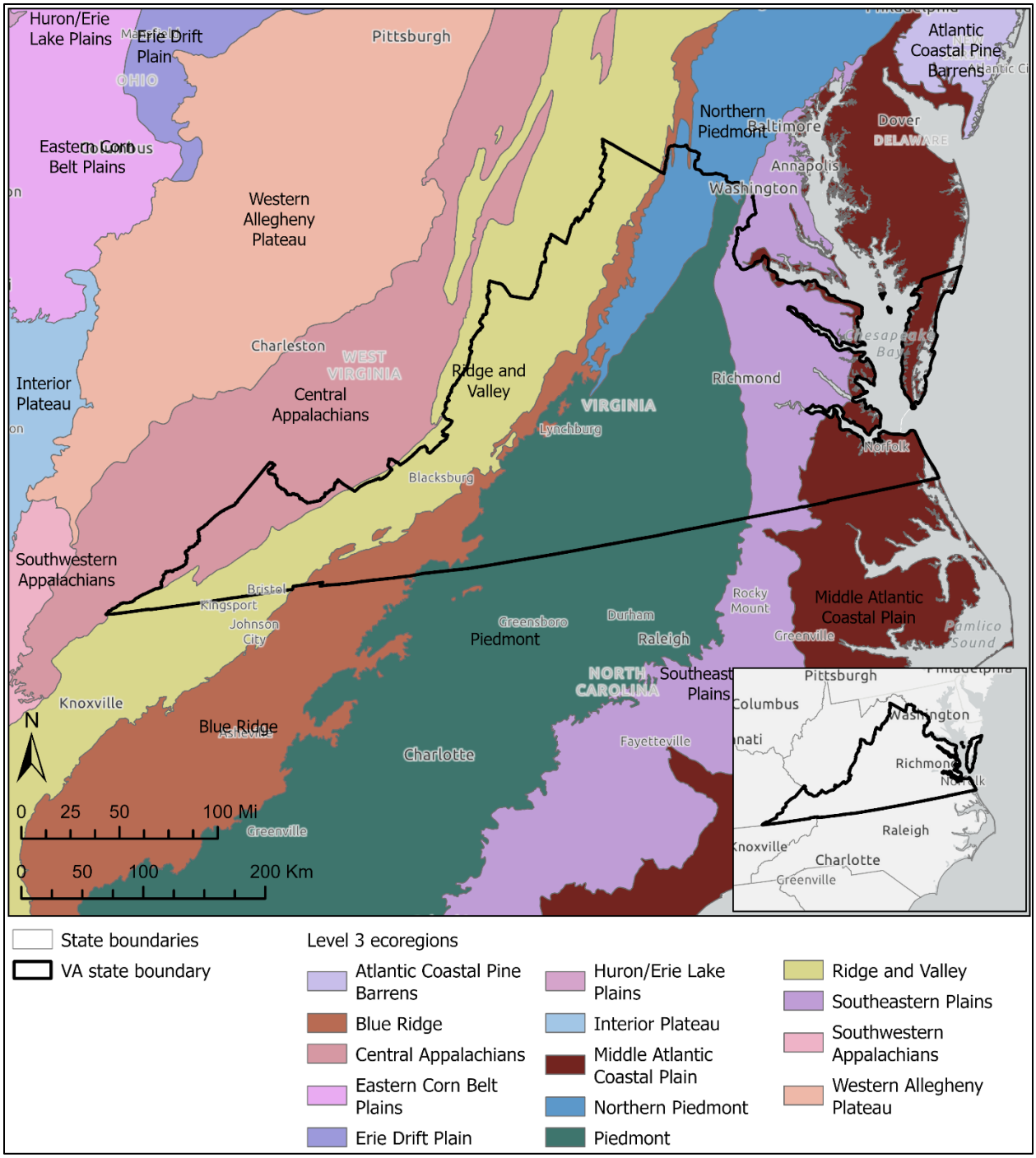


Figure 4. Omernik Level III ecoregions that occur within Virginia.

VIRGINIA AND THE SECAS GOAL

Through SECAS, partners work together to design and achieve a connected network for the benefit of ecosystems, species, and people, and to achieve the SECAS goal: a 10% or greater improvement in the health, function, and connectivity of Southeastern ecosystems by 2060. The work of the VADWR and conservation partners within the State help advance this goal. In addition to the

Southeast Blueprint, SECAS releases an annual report—*Recent Trends in Southeastern Ecosystems*—that assesses progress toward the SECAS goal using the best available data. This report assesses progress toward the SECAS goal using information from existing monitoring programs and is intended to facilitate discussion around conservation actions needed to meet the goal.

Recent Trends in Southeastern Ecosystems (2024) synthesizes 13 different assessments to evaluate indicator trends. Assessments ranged from remotely sensed data like the National Land Cover Database to long-term citizen science monitoring programs like the eBird. States can use this SECAS goal report to assess their own progress and overall trends for the broader Southeast Region.

Recent trends in ecosystem indicators in Virginia compared to the Southeast US

Table 3. *Overview of recent trends in ecosystem indicators comparing Virginia and the Southeast US. Indicators shown in green are on track to meet the goal (≥1% increase every 4 years); indicators shown in yellow (<1% increase) and red (declines) are not.*

Ecosystem	Type	Indicator	Virginia yearly % change	Southeast yearly % change
Terrestrial				
	Health	Areas without invasive plants	0.84% decline	0.33% decline
		Beach birds	1.16% decline	1.42% decline
		Forested wetland area	0.1% increase	0.08% increase
		Forested wetland birds	1.27% increase	2.85% increase
		Grassland & savanna area	0.65% decline	0.31% decline
		Grassland & savanna birds	0.4% decline	2.2% decline
		Salt marsh area	0.12% decline	0.03% decline
		Upland forest birds	0.43% decline	0.98% increase
	Function	Working lands conservation	9.7% increase	11% increase
	Connectivity	Landscape condition	0.01% decline	0.02% decline
		Undeveloped land in corridors	0.02% decline	0.02% decline
Freshwater				
	Health	Natural landcover in floodplains	0.005% decline	0.008% decline
	Function	Water quality	0.01% decline	0.003% increase

Like other states in the Southeast, Virginia has:

- Increases in forested wetland area, forested wetland birds, and working lands conservation
- Declines in areas without invasive plants, beach birds, grassland & savanna area, grassland & savanna birds, salt marsh area, landscape condition, undeveloped land in corridors, and natural landcover in the floodplain

Unlike other states in the Southeast, Virginia has:

- Declines instead of increases in upland forest birds and water quality
- Steeper declines in areas without invasive plants, grassland & savanna area, and salt marsh
- Shallower declines in grassland & savanna birds (primarily due to increases in red-cockaded woodpeckers)

Beach birds

Table 4. Goal status by state for each beach bird species from 2012-2022, abbreviated for space. "Increase/off track" indicates a small increase insufficient to meet the goal, while "increase/on track" indicates a larger increase. "High" indicates higher confidence and "low" indicates lower confidence in the trend. Selected bird species are Southeast Regional Species of Greatest Conservation Need (SGCN) associated with this habitat and with sufficient data for eBird trend analysis.

	American oystercatcher	**Black skimmer**	**Gull-billed tern**	**Least tern**	**Piping plover**	**Royal tern**	**Willet**
AL	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Decline | Off track | Low	Decline | Off track | High
AR				Decline | Off track | High			
FL	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | Low	Decline | Off track | High
GA	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Decline | Off track | High	Decline | Off track | High
KY				Decline | Off track | Low			
LA	Increase | On track | Low	Decline | Off track | High	Increase | On track | High	Decline | Off track | High		Increase | On track | High	Decline | Off track | High

MO				Decline | Off track | High			
MS	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | High		Decline | Off track | High	Decline | Off track | High
NC	Increase | On track | Low	Decline | Off track | High	Increase | On track | Low	Increase | Off track | Low	Decline | Off track | High	Increase | On track | High	Decline | Off track | High
OK				Decline | Off track | High			Decline | Off track | High
SC	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Decline | Off track | High	Decline | Off track | High
TN				Decline | Off track | High			
TX	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Increase | On track | High	Decline | Off track | High
VA	Decline | Off track | Low	Decline | Off track | Low	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High
PR	Increase | On track | High		Increase | On track | Low	Increase | On track | High		Increase | On track | High	Decline | Off track | High
VI	Increase | On track | High			Increase | On track | High		Increase | On track | Low	

Forested wetland birds

Table 5. Goal status by state for each forested wetland bird species from 2012-2022, abbreviated for space. "Increase/off track" indicates a small increase insufficient to meet the goal, while "increase/on track" indicates a larger increase. "High" indicates higher confidence and "low" indicates lower confidence in the trend. Selected bird species are Southeast Regional Species of

Greatest Conservation Need (SGCN) associated with this habitat and with sufficient data eBird trend analysis.

	Prothonotary warbler	Swainson's warbler	Swallow-tailed kite	Yellow-throated warbler
AL	Increase | On track | Low	Increase | On track | High	Increase | On track | High	Increase | On track | High
AR	Increase | On track | High	Increase | On track | High		Increase | On track | High
FL	Decline | Off track | High	Decline | Off track | Low	Increase | On track | High	Increase | On track | Low
GA	Increase | Off track | Low	Increase | On track | High	Increase | On track | High	Increase | On track | High
KY	Increase | On track | High	Increase | On track | High		Increase | On track | High
LA	Decline | Off track | Low	Increase | On track | High	Increase | On track | High	Increase | On track | High
MO	Increase | On track | High	Increase | On track | High		Increase | On track | High
MS	Increase | On track | High	Increase | On track | High	Increase | On track | High	Increase | On track | High
NC	Decline | Off track | Low	Increase | On track | High	Increase | On track | High	Increase | On track | High
OK	Increase | On track | High	Increase | On track | High		Increase | On track | High
SC	Decline | Off track | Low	Increase | On track | High	Increase | On track | High	Increase | On track | High
TN	Increase | On track | High	Increase | On track | High		Increase | On track | High
TX	Increase | On track | High	Increase | On track | High	Increase | On track | High	Increase | On track | High
VA	Decline | Off track | Low	Increase | On track | High		Increase | On track | High
WV	Increase | On track | High	Increase | On track | High		Increase | On track | Low

Grassland & savanna birds

Table 6. Goal status by state for each grassland and savanna bird species from 2012-2022, abbreviated for space. "Increase/off track" indicates a small increase insufficient to meet the goal, while "increase/on track" indicates a larger increase. "High" indicates higher confidence and "low" indicates lower confidence in the trend. Selected bird species are Southeast Regional Species of Greatest Conservation Need (SGCN) associated with this habitat and with sufficient data eBird trend analysis.

	American kestrel	Eastern meadowlark	Grasshopper sparrow	Loggerhead shrike	Northern bobwhite	Prairie warbler	Red-cockaded woodpecker	Scissor-tailed flycatcher
AL	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | Low	Decline | Off track | High
AR	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Increase | On track | High	Decline | Off track | High
FL	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	
GA	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High
KY	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Decline | Off track | High
LA	Decline | Off track | High	Decline | Off track | High		Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High
MO	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Decline | Off track | High
MS	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | Low	Decline | Off track | High
NC	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Increase | On track | Low	Increase | On track | Low
OK	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Increase | On track | High	Increase | On track | High	Decline | Off track | High
SC	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | Low
TN	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High		Decline | Off track | High
TX	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Increase | Off	Increase | On track | Low	Decline | Off track | High

						track | Low		
VA	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Increase | On track | High	Decline | Off track | High
WV	Decline | Off track | Low	Decline | Off track | High	Decline | Off track | High	Decline | Off track | High	Decline | Off track | Low	Decline | Off track | High		Decline | Off track | High
PR	Decline | Off track | Low		Decline | Off track | High					
VI	Decline | Off track | Low							

Upland forest birds

Table 7. Goal status by state for each upland forest bird species from 2012-2022, abbreviated for space. "Increase/off track" indicates a small increase insufficient to meet the goal, while "increase/on track" indicates a larger increase. "High" indicates higher confidence and "low" indicates lower confidence in the trend. Selected bird species are Southeast Regional Species of Greatest Conservation Need (SGCN) associated with this habitat and with sufficient data eBird trend analysis.

	Cerulean warbler	**Louisiana waterthrush**	**Wood thrush**	**Worm-eating warbler**
AL	Decline | Off track | High	Increase | On track | High	Increase | On track | High	Decline | Off track | High
AR	Increase | On track | High	Increase | On track | High	Increase | On track | High	Decline | Off track | Low
FL		Decline | Off track | Low	Increase | On track | High	
GA	Decline | Off track | High	Increase | On track | High	Increase | On track | High	Decline | Off track | High
KY	Decline | Off track | High	Increase | On track | Low	Increase | On track | High	Decline | Off track | High
LA		Increase | On track | Low	Increase | On track | High	Increase | On track | Low
MO	Decline | Off track | High	Decline | Off track | Low	Increase | On track | High	Decline | Off track | High
MS	Decline | Off track | Low	Increase | On track | High	Increase | On track | High	Decline | Off track | High

NC	Decline | Off track | High	Increase | On track | Low	Increase | On track | High	Decline | Off track | High
OK	Increase | On track | Low	Increase | On track | High	Increase | On track | High	Decline | Off track | High
SC	Decline | Off track | High	Increase | On track | High	Increase | On track | High	Decline | Off track | High
TN	Decline | Off track | High	Increase | Off track | Low	Increase | On track | High	Decline | Off track | High
TX		Increase | On track | High	Increase | On track | High	Increase | On track | High
VA	Decline | Off track | High	Increase | On track | Low	Increase | On track | High	Decline | Off track | High
WV	Decline | Off track | Low	Increase | On track | High	Increase | On track | High	Decline | Off track | High

Virginia Regional Species of Greatest Conservation Need

Each state's wildlife action plan identifies SGCN, or the species most in need of proactive conservation attention (see Chapter XX and Appendix XX for a list of Virginia's SGCN identified for this SWAP revision). After the 2015 SWAP revision cycle, the combined lists of SGCN for the 15 states that fall within the SEAFWA geography included more than 7,000 species. However, many SGCN occur across multiple states. Effectively managing and conserving these species requires actions and management strategies that will best allow for species movement and ensure the availability of key ecological attributes provided by different habitats across the landscape at different times. To help support long-term conservation goals for imperiled plant and animal species conservation partners have developed a Southeast Regional Species of Greatest Conservation Need (RSGCN) list.

Southeast Animal RSGCN

In 2019, the National Wildlife Federation, as part of the Vital Futures project funded by the U.S. Geological Survey, prioritized the large number of SGCN collectively identified in the previous iteration of 15 Southeastern SWAPs. Across the 15 southeastern states, the combined lists of SGCNs totals nearly 6,700 species (National Wildlife Federation 2023). The Southeastern Association of Fish and Wildlife Agencies (SEAFWA) Wildlife Diversity Committee collaborated with the National Wildlife Federation and other partners to evaluate these species and produce a list of 960 regional priority species (1,034 including subspecies), or animal RSGCN. A report, "Regional Species of Greatest Conservation Need in the Southeastern United States," was written to detail the methodology used to develop the RSGCN list (Rice et al. 2019) and this is list is hosted on the Georgia biodiversity portal available at georgiabiodiversity.org/portal/regional_conservation_info (GADNR 2024). This effort aligns with the

Northeast Association of Fish and Wildlife Agencies' similar project to develop a RSGCN list for the Northeast Region.

Identifying Southeast animal RSGCN drew upon a collaborative process among state fish and wildlife agencies and partners that involved more than 100 experts and used a set of consistent criteria to review current scientific information and evaluate state-identified SGCN. Species were evaluated based on several primary factors, including: 1) the level of conservation concern (i.e. extinction risk), 2) regional stewardship responsibility (i.e. importance of the Southeast in conservation of the species), and 3) biological or ecological significance (e.g., unique evolutionary lineages). The regional assessment focused on species in key taxonomic groups, including vertebrates (mammals, birds, reptiles, amphibians, and fishes) as well as several better-known groups of invertebrate animals (freshwater mussels, crayfish, and bumblebees). Scientific experts in each of these groups convened to evaluate and identify those species that warranted identification as a regional priority. Additionally, the science teams characterized the level of conservation concern for each regional priority, ranging from moderate to high and very high concern. Through this established process, the RSGCN list can be updated as the States' SGCN lists change over time.

Table 8. List of RSGCN by taxa and their level of concern (very high, high, or moderate). Fish taxa have the most species categorized as "very high concern" and comprise 30% of all RSGCN within the Southeast region. This list totals 1,034 (versus 960) because it includes subspecies.

RSGCN taxonomic group	Very high concern	High concern	Moderate concern	Total
Amphibians	26	52	34	116 (11%)
Birds	10	56	18	84 (8%)
Bumblebees	2	1	2	5 (.4%)
Crayfish	53	86	34	173 (17%)
Fishes	101	120	96	317 (30%)
Mammals	18	37	30	85 (8%)
Mussels	69	55	13	139 (13%)
Reptiles	18	58	39	115 (11%)
Total	302	466	266	1,034 (100%)

Out of the total animal RSGCN list, two-thirds are freshwater fish, crayfish, and freshwater mussels. The number of RSCGN that are considered the stewardship responsibilities of each state varies widely. These patterns can reflect the underlying diversity of species in each state–particularly the number of imperiled and/or limited range species–which is also influenced by a state's size and diversity of habitats. These patterns are also influenced by the "regional stewardship responsibility" criterion in the assessment of priority species.

Nearly 70% of regional priority species are endemic to the 15-state SEAFWA region. Overall, more than half (55%) of Southeast RSGCN are shared by three or more states, presenting opportunities for cross-state conservation collaboration. The remaining 45% of RSGCN have narrow ranges and are found in just one or two states. By taxa, fish and crayfish represent 47% of all RSGCN within the region. Many aquatic habitats and ecosystems within the Southeast are highly fragmented, resulting in severe limitations to ecosystem integrity and species persistence regionwide. Habitat fragmentation in rivers and streams is a

determining factor in the decline in abundance of numerous species such as Eastern brook trout, freshwater mussels, and fully aquatic amphibians such as Eastern hellbender.

Several regional datasets can help Virginia identify lands and waters that support animal RSGCN and find opportunities to collaborate with other states. For example, habitat maps at the species level from the USGS Gap Analysis Project (GAP) are available for approximately 290 animal species, and 90 sub-species, on the RSGCN list. While GAP does not include species habitat maps for invertebrates or plants, it does include a high percentage of vertebrate RSGCN (93% of amphibians, 92% of birds, 76% of mammals, and 77% of reptiles). Figures 4 through 7 show Southeast RSGCN richness using GAP species habitat models. This data, in combination with other tools like the Southeast Blueprint or with data representing the Northeast RSGCN, can help identify areas where conservation actions are likely to yield co-benefits for RSGCN as well as other species, habitats, and ecosystem services. As recommended by AFWA, cross jurisdictional or regional strategies can enhance ecosystem resiliency, function, and connectivity– especially in the face of climate change. All data, including model inputs, are available from the USGS Gap Analysis Project Species Habitat Maps on their website: https://www.usgs.gov/programs/gap-analysis-project.

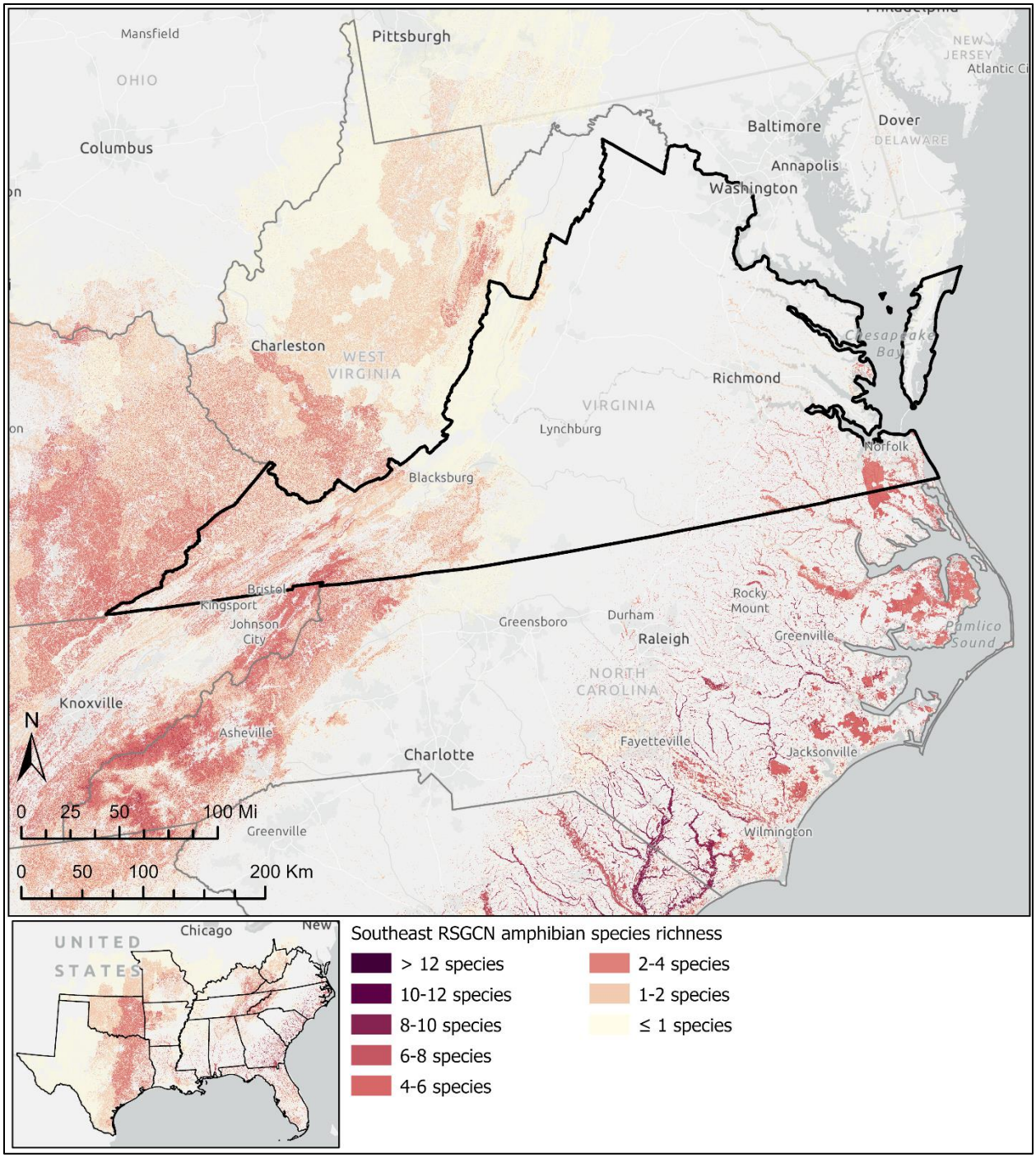


Figure 5. Species richness for amphibian RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (using 2016 NLCD).

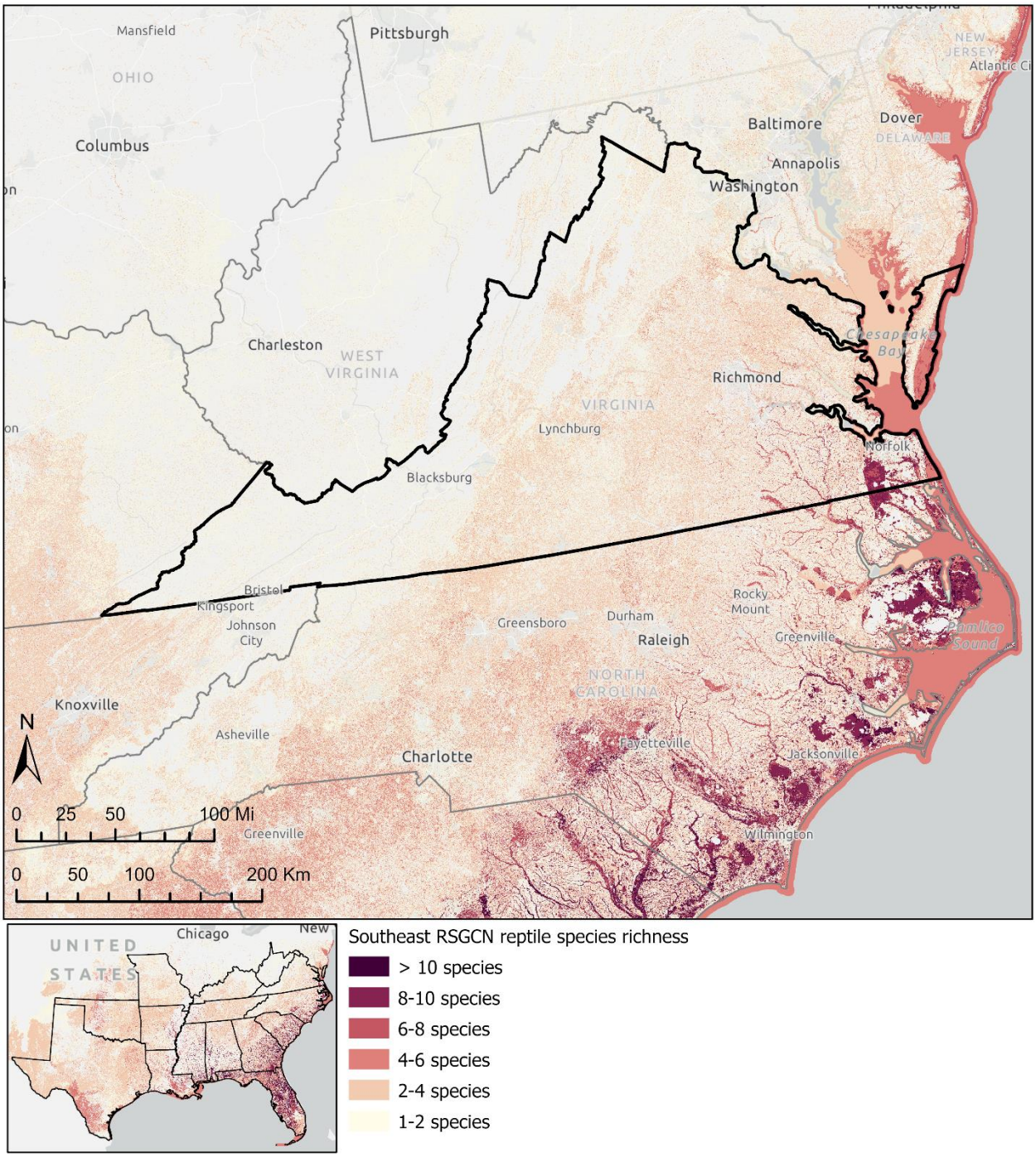


Figure 6. Species richness of reptile RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (using 2016 NLCD).

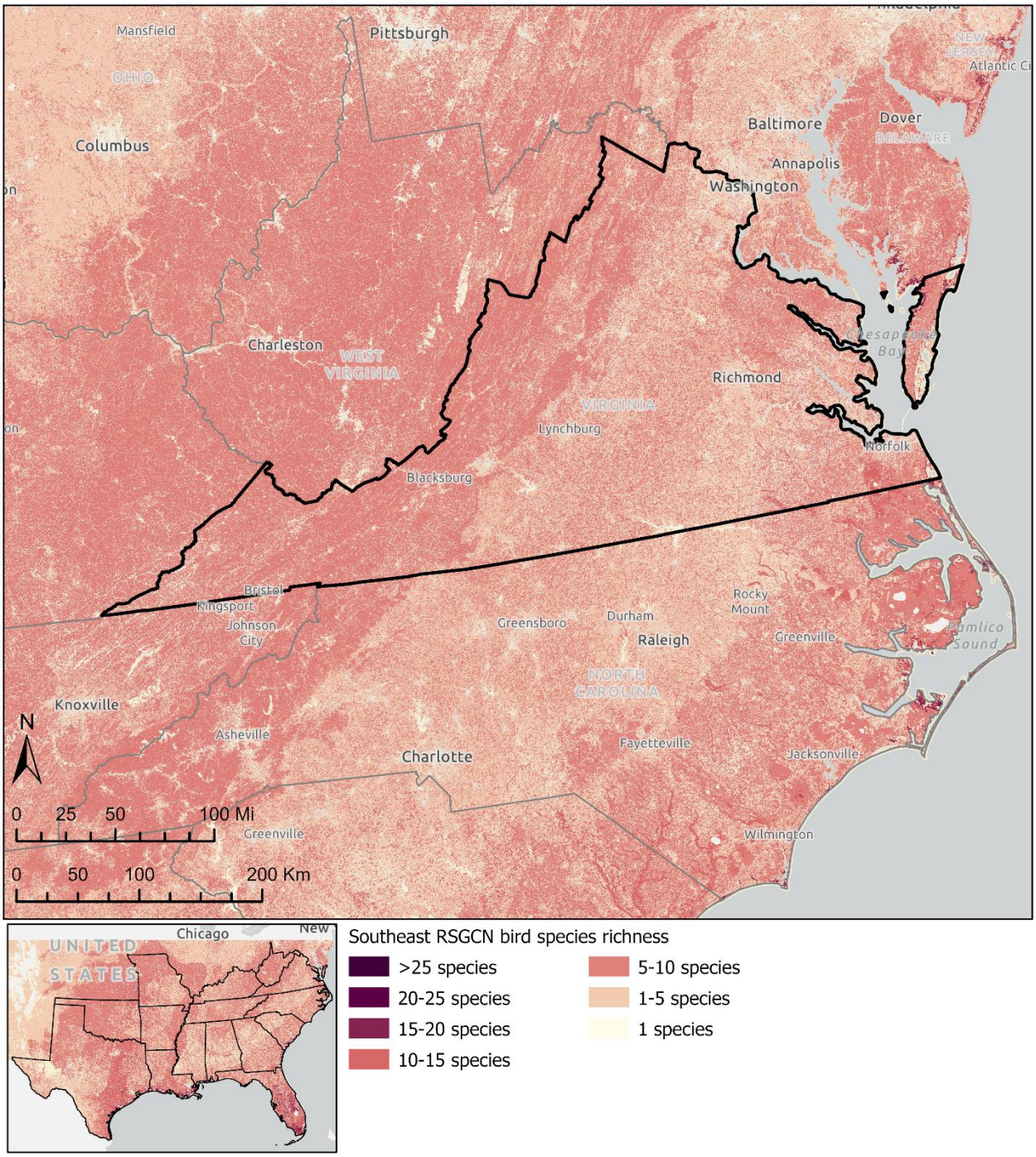


Figure 7. Species richness of bird RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (using 2016 NLCD).

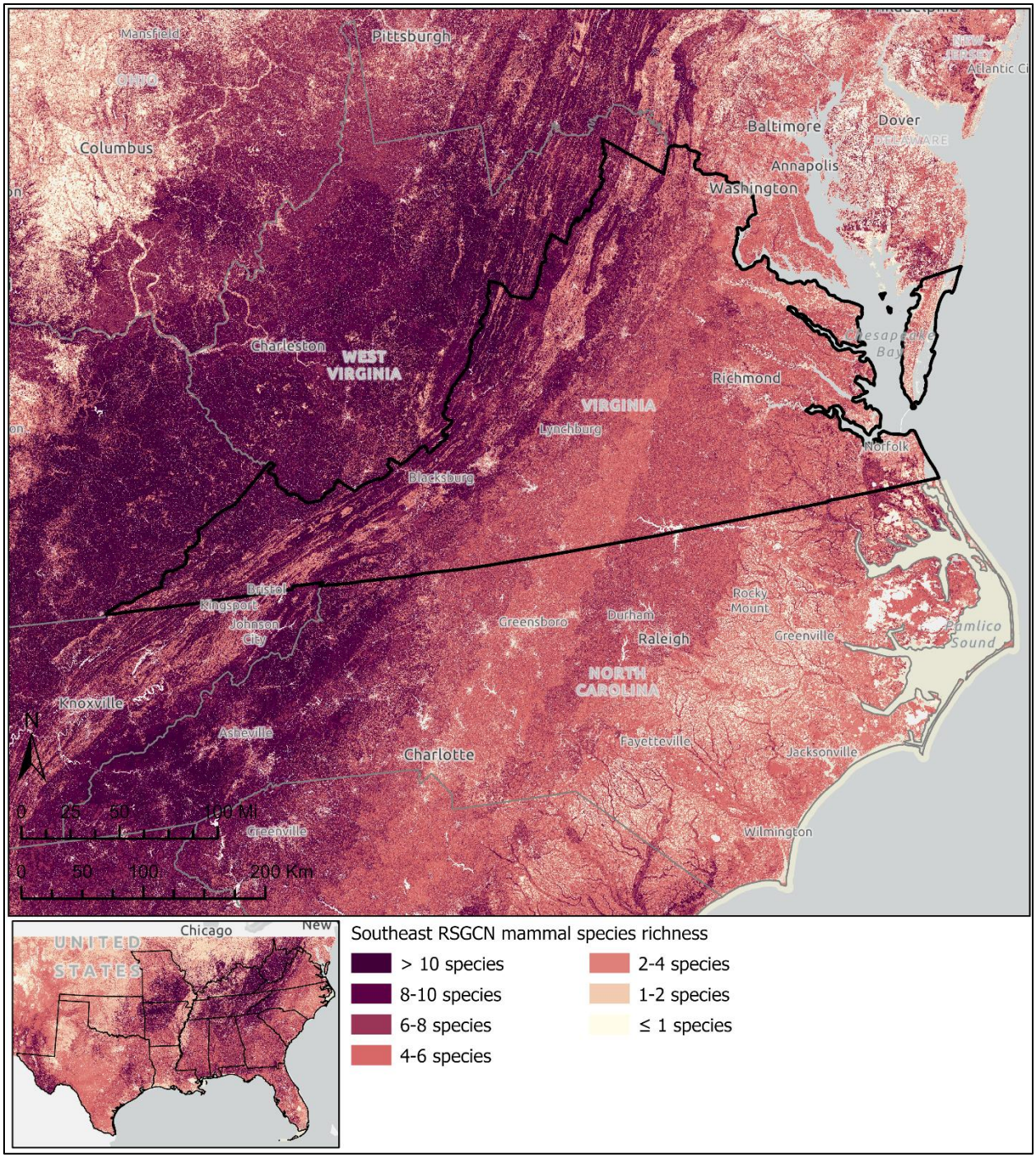


Figure 8. Species richness of mammal RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (using 2016 NLCD).

SOUTHEAST PLANT RSGCN

The Southeast is home to more than 11,000 native plant species, 30% of which are regional endemics (i.e., found only in the Southeast). In 2023 the Southeast Plant Conservation Alliance (PCA) released the first plant RSGCN list in the nation. The PCA worked with a broad coalition of

partners including the Atlanta Botanical Garden, NatureServe, and Terwilliger Consulting, and received funding from the U.S. Fish and Wildlife Service. This list narrows down the vast number of plants native to the Southeast to 1,824 species that are a regional conservation priority based on criteria such as rarity, threats, and needed conservation actions. The plant RSGCN list complements the Southeastern animals RSGCN list developed in 2019 to create a more complete picture of the region's exceptional biodiversity. The report, "Southeastern Plants Regional Species of Greatest Conservation Need (Radcliffe et al. 2023)," and the dataset of plant RSGCN are available online at https://www.se-pca.org/southeastern-plants-rsgcn/.

To develop a pool of potential species to draw from, the PCA worked with NatureServe to compile a list of more than 10,000 vascular plants native to any of the SEAFWA considering each species' G-Rank (global rarity), S-Rank (state rarity) and endemism. Unfortunately, due to data limitations, plants native to Puerto Rico and the U.S. Virgin Islands could not be included.

The full list received extensive review from botany experts, a technical team composed of representatives from each state, and NatureServe. Based on partner feedback, the technical team assigned each species a level of conservation concern rating ranging from low to very high or "manual review needed". Any plant scoring moderate or above was ultimately considered an RSGCN. After cleaning the data to remove redundancies, the complete Southeastern plant list evaluated 9,271 species and prioritized 1,824 as RSGCN. Southeast endemic species make up 72% of the plant RSGCN list (Figure 8)

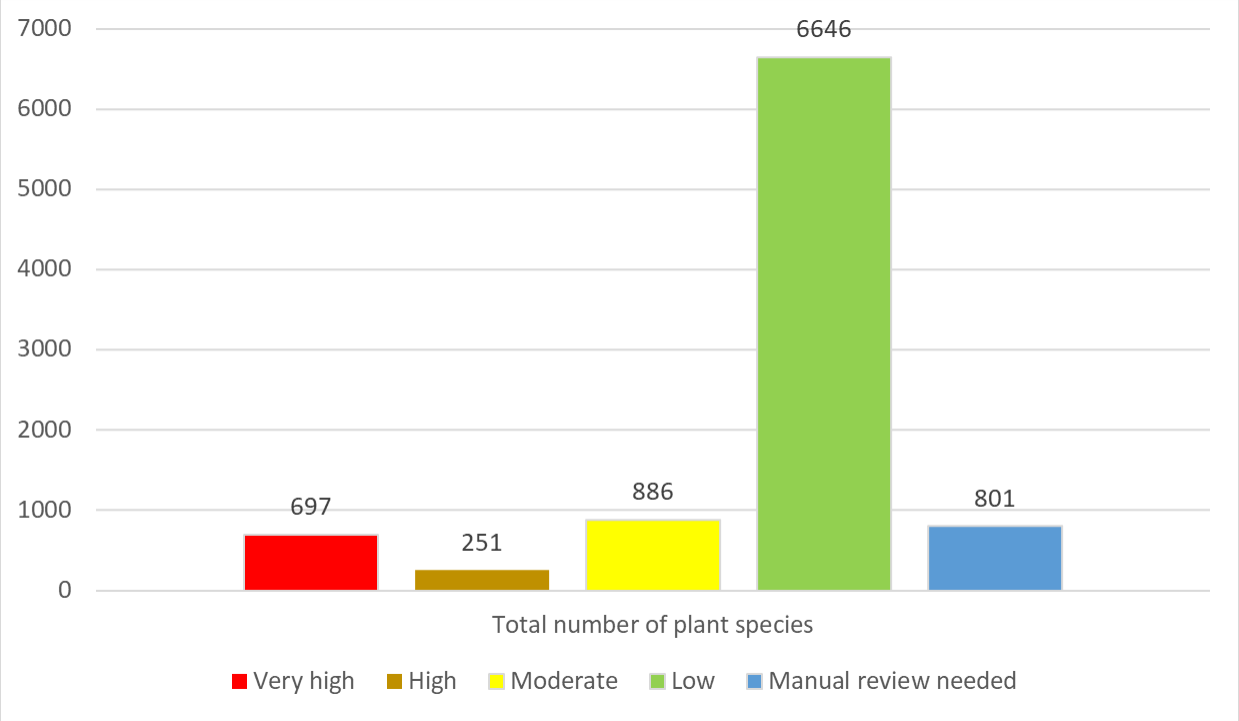


Figure 9. Plants with a very high, high, or moderate level of conservation concern are considered plant RSGCN.

To better understand shared plant needs and threats at the ecosystem level, the PCA crosswalked each plant RSGCN to its primary habitats using U.S. National Vegetation Classification (USNVC) "Groups" (Table 8). The USNVC provides a widely-used, standardized system of classifying vegetation types and habitats. The distribution of RSGCN across ecosystems demonstrates their diversity and broad geographic extent. A total of 31 USNVC Groups contained at least 10 plant RSGCN, indicating that many of the region's ecosystems support plant species of conservation need. As many of these same habitats tend to provide crucial habitat for animal RSGCN as well, conserving these ecosystems can safeguard regional biodiversity more broadly.

Table 9. The top 15 U.S. National Vegetation Group Assignments for all Southeast plant RSGCN, showing longleaf ecosystems supporting this highest number of priority plants.

USNVC groups serving as primary habitat	Number of plant RSGCN
Wet-Mesic Longleaf Pine Open Woodland	80
Xeric Longleaf Pine Woodland	43
South Florida Slash Pine Rockland	29
Central Interior Alkaline Open Glade & Barrens	29
Appalachian - South-central Interior Mesic Forest	28
Tamaulipan Dry Mesquite & Thornscrub	28
South Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie	22
Blackland & Coastal Tallgrass Prairie	21
Florida Xeric Scrub	18
South Atlantic & Gulf Coastal Dune & Grassland	17
Atlantic & Gulf Coastal Plain Seep	16
Southern Coastal Plain Mixed Evergreen Swamp	13
Southern Mesic Beech - Oak - Mixed Deciduous Forest	12
Southern Appalachian Rocky Outcrop	11
Southeastern Coastal Plain Barrens & Glade	9
Central Interior-Appalachian Riverscour Barrens & Prairie	9
Caribbean Hardwood Hammock & Coastal Strand Forest	9
Coastal Live Oak - Hickory - Palmetto Forest	9
Appalachian Mafic Barrens	8
Central & Southern Appalachian Seep	8

Table 9 lists the USNVC groups serving as primary habitat that support the most Southeast plant RSGCN in Virginia. By far the USNVC group that supports the most Southeast plant RSGCN within the State is Appalachian - South-central interior mesic forest. These forest that are composed of a diverse suite of deciduous broad-leaved trees occur within coastal plains and includes wet pine flatwoods and wet pine savannas (NatureServe Explorer, 2024). These habitats are typically dominated by tulip poplar (*Liriodendron tulipifera*, black cherry (*Prunus serotina*), sugar maple (*Acer saccharum*), basswood (*Tilia americana*) and American beech (*Fagus grandifolia*) (NatureServe Explorer, 2024).

Table 10. USNVC groups serving as primary habitat that support the most Southeast plant RSGCN in Virginia.

USNVC groups serving as primary habitat in Virginia	Number of plant RSGCN
Appalachian - South-central Interior Mesic Forest (G020)	13
Wet-Mesic Longleaf Pine Open Woodland (G190)	6
Central Appalachian - Northeast Pine - Oak Rocky Woodland (G906)	6
Southern Mesic Beech - Oak - Mixed Deciduous Forest (G166)	4
North Atlantic Coastal Tidal Freshwater Marsh (G914)	4
Central Interior Alkaline Open Glade & Barrens (G179)	3
Central & Southern Appalachian Seep (G184)	3
Southern Appalachian Rocky Outcrop (G670)	3
Xeric Longleaf Pine Woodland (G154)	2
Southeastern Coastal Pocosin & Shrub Bog (G186)	2

VIRGINIA'S STEWARDSHIP OF RSGCN

Roughly 265 RSGCN occur within Virginia and 226 of those species are also included in the state's list of SGCN. The most common RSGCN taxa type represented in Virginia are fishes (97), birds (49), and mussels (36) (Figure 9). Virginia is also home to multiple species that are not only endemic to the SEAFWA region but are not often found in many other states within the region. Virginia shares the highest amount of RSGCN with North Carolina, Georgia, Tennessee, and Alabama. In particular, Virginia shares RSGCN stewardship responsibility for 18 mussels that are considered very high concern with Tennessee. Identifying these shared RSGCN can help Virginia collaborate with other states on conservation actions that not only provide local benefits but support a regional landscape.

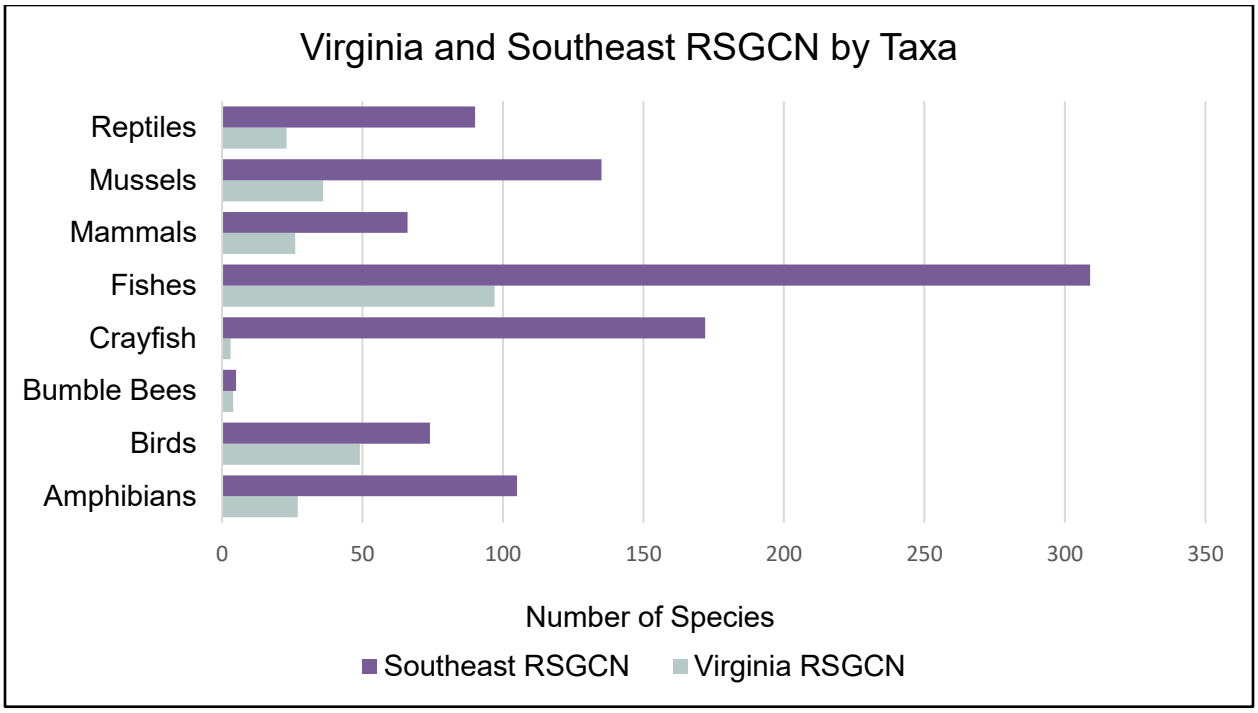


Figure 10. Virginia's Regional Species of Greatest Conservation Need (RSGCN) vs. the Southeast's RSGCN.

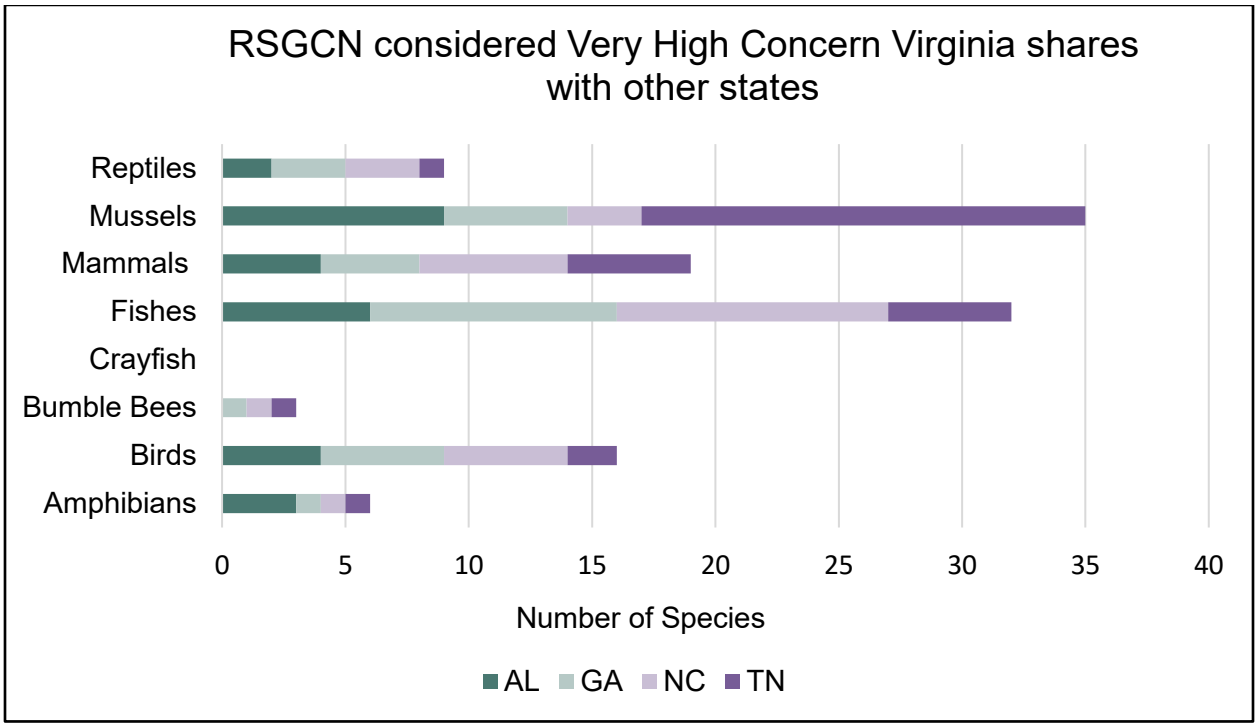


Figure 11. Southeast RSGCN that are considered very high concern and shared by Virginia, Tennessee, North Carolina, and South Carolina.

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APPENDIX 2: WILDLIFE HEALTH

WHAT IS WILDLIFE HEALTH?

Wildlife health is a complex, dynamic topic that can be difficult to define and measure. Wildlife health encompasses more than simply the presence or absence of disease caused by pathogens, parasites, and toxicants (e.g., contaminants or other poisonous substances produced by animals, plants, or people); rather, wildlife health is defined by a population's ability to withstand stressors and challenges, such as climate change, habitat loss, the emergence of disease-causing agents, and other environmental, climatic and anthropogenic threats. The term "resilience" can be used instead of "health" and, as such, health is the result of interacting biological, social, and environmental determinants (Stephen 2014).

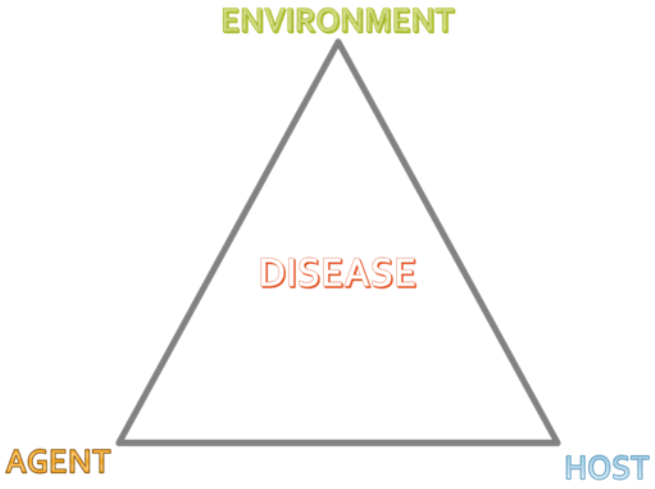
Why is wildlife health important?

The health of wildlife populations determines their ability to persist in the wild at sustainable levels for the long term. Wildlife health is linked to environmental and ecosystem health, as well as the health of humans and domestic animals. Monitoring wildlife health provides important information about population, community, and ecosystem dynamics and can inform measures needed to protect human and domestic animal health, as well as other wildlife populations. Further, wildlife health is linked with ecosystem health, and healthy ecosystems provide a plethora of services, from supporting productive agriculture to facilitating enjoyment of natural areas through recreation to mitigating the effects of severe weather and climate events, among many others. Healthy, resilient wildlife populations contribute to biodiversity, which also supports healthy ecosystems.

How does disease relate to wildlife health?

Disease occurs when a host responds to the presence of a pathogen, parasite, or toxicant and it can be both a determinant of health, as well as a stressor. Disease-causing agents can have significant impacts on wildlife populations. Diseases can have direct (e.g., causing overt morbidity and mortality) and indirect (e.g., decreased fitness) impacts on populations, both of which can result in or exacerbate population declines.

The development of disease depends on factors related to the host organism, the environment and climate, and the disease-causing agent (see epidemiologic triad at right). In healthy wildlife populations, pathogens (e.g., bacteria, fungi, viruses, parasites) and toxicants are present, and disease associated with these pathogens and toxicants typically occurs at low levels that do not have population-level impacts; however, when the host (i.e., wildlife) population experiences additional stressors or threats, the prevalence of disease may increase.



How do emerging diseases and other health threats impact wildlife populations?

An emerging disease is defined as "one that has recently been discovered; has recently increased in incidence, geography, or host range; or is newly evolved" (Rachowicz et al. 2005). Two hypotheses can apply to an emerging disease: the novel pathogen hypothesis states that the disease has recently spread into new geographic areas, whereas the endemic pathogen hypothesis suggests that it has been present in the environment but recently has affected new hosts or increased in its ability to cause disease (Rachowicz et al. 2005).

Diseases pose unique challenges to the conservation of wildlife populations, particularly in many species that are already experiencing other stressors. Disease may be the primary cause of population declines, or it may exacerbate population declines. Although in many instances we lack full comprehension of the impacts of diseases on wildlife populations, the impact of disease is well-documented in certain populations. For example, in North America, chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis*, and white-nose syndrome, caused by the fungus *Pseudogymnoascus destructans*, have emerged following pathogen introduction and have had devastating impacts on amphibian and bat populations, respectively.

The role of wildlife health in One Health

There are numerous definitions of One Health, but generally, One Health is considered a collaborative approach that recognizes that the health of humans, domestic and wild animals, and the ecosystems/landscapes they inhabit are interconnected (AFWA 2023). For example, sometimes disease-causing agents/toxicants that impact wildlife health may also threaten human (e.g., zoonotic diseases) or domestic animal health and vice versa. Further, anthropogenic changes to the landscape can also affect wildlife populations. Discussions of wildlife health should consider linkages with humans, domestic animals, and ecosystems through a variety of measures and collaborations.

How do we measure wildlife health?

Many different approaches can be used to measure health and evaluate health outcomes in wildlife. In a population of interest, potential health threats should be evaluated, followed by estimating the possible subsequent health outcomes. The health of wildlife populations (i.e., a population's resilience to stressors) is difficult to measure without the presence of an obvious challenge or threat that causes overt mortality. Evaluating potential threats to the health of wildlife populations will inform and guide the best way(s) to measure, evaluate, and subsequently manage health outcomes, which may vary by individual species, population, threat, and scenario.

Factors that may influence the health of populations include: genetic diversity; population demographics; climate change and weather events; resource availability; habitat continuity/quality; exposure to toxicants, pathogens, or parasites; and other stressors. These factors may directly affect population health or may work in conjunction with other factors to affect populations. For example, climate change may alter the geographic distribution of certain pathogens, leading to exposure of naive wildlife populations to novel pathogens. Additionally, decreased resource availability or poorer quality

and/or quantity of habitat may weaken a population's ability to respond to pathogens, thus resulting in more significant impacts of pathogens in certain populations.
Factors that may be reflective of the health of individuals and populations, and thus the resilience of a population, include: genetic diversity; immune function; reproductive fitness; population parameters; body condition; organ function; active infections; parasite loads; and causes of morbidity and mortality. These lists are not meant to be exhaustive but do provide good examples of various factors to consider when evaluating both potential health threats and measuring/evaluating health outcomes and the health of wildlife populations.

COMPONENTS OF WILDLIFE HEALTH

Morbidity and mortality events

Wildlife morbidity and mortality events often occur unexpectedly and may be highly visible and variable in scale. These events may include a few individuals of one species or a large number of multiple species or any combination of these and occasionally may involve a legal component (e.g., poisoning). Management agencies must be prepared to respond quickly and efficiently to investigate the cause of such events and to address the media and the public, should there be interest. They should also be prepared to communicate their findings and coordinate their response with other state, regional, and federal partners. The overarching goal of wildlife mortality investigations is to identify the cause(s) of such an event and identify any factors that may have contributed. Successfully investigating wildlife mortality events requires planning, preparation, flexibility, and often cooperation among agencies and other organizations (e.g., diagnostic laboratories).

Steps and considerations during investigation of wildlife mortality events should include: obtaining sufficient and relevant history; field evaluations; safe collection of sick and dead wildlife and/or samples; diagnostic laboratory analyses; communication of results to stakeholders; determination if any management actions are necessary; and implementation of such management actions, as appropriate. There are many resources that provide additional details on these steps (e.g., Friend and Franson 1999; Franson et al., 2015).

Emergency disease outbreak preparedness

An agency's ability to appropriately respond to morbidity and mortality events and disease outbreaks largely depends on the agency's emergency disease outbreak preparedness, meaning how well they have planned and prepared for potential future disease outbreak scenarios. Often, disease outbreaks occur rapidly and with minimal to no forewarning. Disease outbreaks may involve endemic or emerging/novel pathogens, parasites, or toxicants and may occur in a variety of scenarios. Emergency disease outbreak preparedness is necessary to respond rapidly and appropriately to these events and can encompass many different elements that are tailored to each specific agency and region's needs. Foundational elements of emergency disease outbreak preparedness and response may include: planned coordination among all involved agencies/organizations, including established contracts with diagnostic laboratories; dedicated funding to enable swift and appropriate responses; predetermined agency response plans and protocols for field investigation of disease outbreaks and morbidity/mortality events; biosecurity protocols; and kits with all necessary field investigation supplies. Agencies may consider conducting regular table-top exercises with staff; developing an Incident Command and

Management System; engaging in long-term planning regarding potential management decisions; developing internal and external communication plans; and evaluating specific needs for prolonged/future surveillance and/or monitoring, depending on the outcome.

Prevention

While many threats to wildlife health cannot be prevented, certain steps can be taken to reduce the risk of them occurring and/or their effects on wildlife populations. For example, avoiding the transport of animals, plants, or environmental substrates (i.e. water and soil) between different areas can help to reduce the risk of moving disease-causing agents or diseased animals to naive areas. Regular inspections of facilities that temporarily house animals may reduce risk. Adhering to biosecurity measures when handling animals or biological material also reduces risk. Such measures may include: disinfection of field equipment; cleaning boots; and wearing personal protective equipment such as gloves, masks, and/or disposable aprons or boot covers. Previous knowledge of the potential disease-causing agents in a particular area can also help managers be prepared for outbreaks and prevent their spread.

Surveillance, monitoring, and management

It's important to understand the differences between surveillance, monitoring, and management when dealing with wildlife health. Surveillance can be active (intentional, planned collection of specific samples) or passive (opportunistic collection of samples as they are available) and involves testing for specific pathogens, toxicants, diseases, or other markers. While surveillance is typically aimed at prevention or early detection of health threats, monitoring aims to measure the threat and its impacts once present in the population. Finally, management is action taken to reduce the risk, spread, or impacts of a health threat. Merely conducting surveillance for the presence of a threat is not management, but monitoring is necessary to evaluate whether management actions are effective. Strategies for pathogen surveillance are described for herpetofauna populations in a paper by Gray et al (2017). While there are limited available published surveillance strategies for other taxa, similar strategies can apply to a broad range of species. Further, fish and wildlife health specialists are an excellent resource to collaborate with to develop species-, state-, and region-specific surveillance and monitoring strategies, as these may vary spatially and by population.

INTEGRATING WILDLIFE HEALTH INTO STATE WILDLIFE ACTION PLANS: ACTION ITEMS FOR CONSIDERATION*

***At the discretion of state fish and wildlife agencies**

Action: Recognize the importance of wildlife health and its role in supporting *resilient* wildlife populations and **i**ncorporate wildlife health into management plans.

Action: Work with academic and other partners to address emerging diseases through surveillance and research, including determining causes of death and/or population declines in species of greatest conservation need.

Action: Develop agency-specific morbidity and mortality event protocols and emergency disease outbreak and response protocols, including appropriate biosecurity measures, to better respond and address morbidity/mortality events and emergency disease outbreaks, as necessary.

Action: Work collaboratively and cooperatively with adjacent state fish and wildlife agencies, regional fish and wildlife associations, national fish and wildlife associations and agencies, agricultural and public health agencies, and others to address wildlife health issues at a regional and national scale.

Action: Provide opportunities for wildlife biologists, managers, agency personnel, and the public to expand their knowledge of wildlife health and improve wildlife health communication, as necessary.

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APPENDIX 3: RECOMMENDATIONS FOR ENHANCING CONSERVATION OF SGCN AND THEIR HABITATS THROUGH EDUCATION, OUTREACH, AND WILDLIFE VIEWING

Engaging Virginians in outdoor recreation is critical to the conservation of the state's Species of Greatest Conservation Need (SGCN) and their habitats. Numerous studies have shown that participation in outdoor recreation fosters a sense of responsibility for natural resources in both adults and children. As the population increases, so does the demand for more and better access to outdoor recreational opportunities that allow the public to sustainably engage with nature.

The work of the DWR's Watchable Wildlife Program (WWP) and Outreach Division (OD) is vital to connecting the public to Virginia's SGCN and illustrating the relevancy of DWR's conservation efforts for SGCN and the habitats they depend on. Protecting, enhancing, and increasing recreational opportunities throughout the state plays an important role in the agency's mission and serves to leverage support for SGCN conservation. Through the provision of opportunities that allow the public to contribute to on-the-ground habitat initiatives as well as citizen/community science programming, the WWP and OD are directly connecting constituents to the state's SGCN and tangible actions that anyone can take to conserve imperiled species. Further, this connection to SGCN is fostered more fundamentally through the agency's efforts to increase public knowledge, awareness, and appreciation of Virginia's SGCN and their habitat needs which ultimately inspires the public to conserve them. DWR's programming for both educators and public audiences aims to generate a more informed and connected public perspective that is supportive of conservation measures and the relevancy of DWR in SGCN management.

The following list of actions are intended to preserve SGCN and their habitats while engaging and informing constituents about DWR's conservation actions. This list was comprised by staff within DWR's WWP and OD and is made up of specific recommendations with a tangible education, stewardship, and/or outreach components for SGCN identified within this plan. The recommendations are organized by general category with a list of specific actions applicable to each recommendation.

EDUCATION AND AWARENESS INITIATIVES

Recommendation: Increase the public's general awareness and support for conservation needs and initiatives pertinent to SGCN.

Specific Actions:

- Develop Virginia specific field guides (e.g. butterflies, darters, freshwater mussels) which incorporate 'Call to Action' suggestions for designated SGCN.
- Launch a 'Tern Cam' which would showcase Virginia's largest nesting seabird colony (comprised of five SGCN). In addition to showcasing these species, supplemental materials would be developed which highlight the management techniques applied at this site to conserve the colony.

- Support the development of nature centers (either DWR-owned/maintained/managed or others via provision of additional resources) to foster a greater appreciation of local flora and fauna to communities.
- Produce more materials that educate the public as to what the Wildlife Action Plan is and how it connects to the Agency's mission.
- Develop landowner workshops that promote natural processes such as beaver dams and wetlands that benefit SGCN.

Recommendation: Develop programs and initiatives that will garner more public knowledge and awareness about conservation needs specific to urban localities.

Specific Actions:

- Develop a list of SGCN that commonly occur in urban areas. Especially those for which tangible management actions have been identified and are feasible to implement at a local level.
- Develop workshops to increase awareness about urban conservation actions for municipal governments, Planning District Commissions, city/county planning commissioners, and developers as well as digital media resources/outreach efforts; e.g. lights out and bird-safe buildings, the seven simple actions, etc. which would support the conservation of SGCN bird species
- Regularly host beginner birding workshops and walks across the state to recruit and engage new audiences with birding.
- Identify and build partnerships with urban localities, parks and rec departments, businesses, and schools, etc. to create simple habitat improvements and enhancements that would support SGCN (e.g. pollinators and birds) and help keep common species common.
- Fund a grant/cost-share program that can provide funding for design and implementation of habitat projects benefitting SGCN within these urban areas.
- Provide technical assistance in the implementation and maintenance of these habitat practices.
- Within urban localities, identify opportunities for new VBWT sites to be designated. At these new sites and already existing VBWT sites:
    - Conduct an assessment of habitats; rate each according to condition, suitability for enhancement, SGCN known or likely to occur in the area, and proximity to underserved communities. The highest-ranked projects will provide the greatest benefits to SGCN and opportunities to engage local communities.
    - Leverage local contractors and community organizations (e.g., Master Naturalists, Master Gardeners, school groups, civic associations) to implement projects and provide local engagement in the completion of the identified enhancements.
    - Provide interpretive signs or other educational materials to increase public awareness and knowledge of the SGCN on the enhanced properties.

Recommendation: Develop programs and initiatives geared specifically towards youth and families that promote a more holistic understanding of wildlife/habitat management, SGCN, and the role of state wildlife management agencies.

Specific Actions:

- Expand existing education and outreach programs to inform Virginians about SGCN species, their habitats, and non-consumptive wildlife-related recreational opportunities (e.g. Bird by Bird program).
- Support trainings for the statewide Mater Naturalist Program so they can educate their communities about Virginia's natural resources and the role of wildlife management agencies
- Grow the official environmental education school recognition program of the Commonwealth, Virginia Naturally Schools, which recognizes the wonderful efforts of many Virginia schools to increase the environmental literacy of our youngest citizens.
    - Expand the current number of schools recognized by the program.
    - Develop materials that support schools in their efforts to achieve recognition.
    - Expand on the SGCN collection of Virginia Naturally School's Program awards, which includes education about the SGCN species for recognized schools.
- Develop educational materials focused on SGCN species that correlate to the Virginia Department of Education's Standards of Learning.
- Adapt existing educational materials, such as Project WILD activities and workshops, to focus on SGCN species.
- Conduct additional educational workshops for educators to improve environmental understanding and the role of wildlife management agencies.
- Conduct additional local workshops for youth and adults to improve environmental understanding and the role of wildlife management agencies.

RESEARCH AND STEWARDSHIP OPPORTUNITIES

Recommendation: Offer new or bolster support for existing participatory science opportunities which harness volunteers to augment the DWR's data collection needs related to SGCN and habitat conservation.

Specific Actions:

- Work with DWR biologists and Land Management staff to identify data needs that could be fulfilled through volunteer engagement and determine the best ways to meet these goals.
- Expansion of Diamondback Terrapin Monitoring and Reporting Project; utilizes volunteers to annually conduct standardized headcount surveys as part of a larger multi-state initiative to identify priority areas in Virginia.
- Shrike Force (Loggerhead Shrike survey project); volunteers conduct surveys to locate shrikes and then monitor banded shrikes (a pre-designed project implemented in other states that we would implement with partners here in Virginia)
- Conduct species inventories, targeting SGCN, on DWR properties to inform WMA management plans and SGCN species conservation efforts across Virginia; the opportunities here are numerous and could include volunteers conducting targeted surveys for a specific SGCN species of interest (e.g. Swainson's Warbler at Cavalier WMA) or conducting broad inventories of birds at WMAs to document the more common SGCN and generate a species list for the WMAs, or inventories of butterflies to serve this same purpose as well as to provide data to the larger NABA national database.

- Allegheny Woodrat camera trap monitoring in Virginia's mountains; would utilize volunteers to assist with setting up and monitoring trail cameras to monitor the presence of woodrats. DWR has a number of historic locations where "trapping" is needed. Typically, 6-10 cameras are placed at a site and run for a week. Volunteers could run the cameras, download pictures, ID species, enter in a datasheet, and upload photos to DWR.
- Development of an online portal on the DWR website for the public to report bald eagle nests in the mountains and piedmont.
- Bat box monitoring project; a replication of Vermont's project for big brown bats here in Virginia. This would generate baseline data for the species in Virginia.
- Indiana Bat box monitoring project - a potential future project after other pilot projects and mapping efforts are completed.
- Expansion of acoustic bat monitoring for North American Bats (NA BATS); seeks volunteers to collect acoustic data through road surveys or at stationary points.
- Administer a centralized invasive species reporting system for the agency that can be utilized by the public to report invasive species observations.
- VA Candid Critters Program: A statewide camera trapping program (modeled after the NC program) that utilizes volunteers to deploy trail cameras on public and private properties across the state and review/analyze the collected footage. The program would engage/educate the public and improve our understanding of many understudied species distribution in VA.
- Long term box turtle monitoring program modeled after NC's Box Turtle Connection project, volunteers would be trained to collect data and conduct long-term monitoring of box turtle populations in priority areas. This would generate critical baseline data for the state, monitor population trends, identify threats, and assess the effectiveness of applied conservation management techniques for the species.
- Sea turtle stranding monitoring: volunteers could regularly patrol certain areas for stranded, cold-stunned turtles (would need to partner with the Virginia Aquarium on this project)
- Statewide Reptile and Amphibian Atlas; following the 1999 Mitchell Atlas, substantial need exists to conduct another statewide reptile and amphibian atlas. This project could be developed exclusively by DWR or in conjunction with the Virginia Herpetological Society. Volunteer involvement would be critical to meet the data collection needs associated with this project.
- Virginia Wildlife Mapping Project: a statewide project that utilizes the iNaturalist platform as a database that anyone may submit observations of Virginia wildlife into from any location in Virginia–from the backyard to the backcountry; it provides an educational and recreational opportunity for its participants and provides observations of SGCN to the DWR
- Incorporate volunteer data collection opportunities into livestreaming wildlife camera programming. Examples include:
    - Shad Cam: Utilize volunteers to review footage and collect information on American shad, American eel, and other migratory fish passage in the James River.
    - Falcon Cam: Utilize volunteers to review footage and collect behavioral data on urban-nesting peregrine falcons.

Recommendation: Develop and implement habitat stewardship projects which harness volunteers to supplement the DWR's habitat work at agency-managed properties across the state.

Specific Actions:

- Invasive species removal (utilizing manual, low-risk techniques)
- Supplemental plantings to augment habitat for SGCN on DWR properties.
- Provision of aquatic habitat (e.g. deployment of artificial fish habitat and establishment of aquatic natives)
- Implement citizen science monitoring of DWR habitat treatments to track long term impacts and progress towards identified desired future conditions.

Recommendation: Bolster current and develop new initiatives that work to conserve SGCN and relevant habitats on private land/around the home.

Specific Actions:

- Enhance DWR's Habitat at Home to include data collection regarding applied habitat practices, acreage enrolled and wildlife utilization. Utilize citizen science data collection platforms to track SGCN occurrence Habitat at Home certified properties.
- Offer workshops and trainings that provide information on establishing Habitat at Home for wildlife.
- Fund and develop programs/resources to encourage and help homeowners' associations to mitigate habitat loss and establish green spaces within residential common areas.
- Expand DWR's work to connect constituents to cost share programs (like the Virginia Conservation Assistance Program) that provide assistance to habitat conservation practices on private lands.
- Provide information on bird feeders, bird baths, nest boxes, vernal pools, treefrog hotels, frog ponds, etc. as mechanisms that people can support and view wildlife in their backyards.

COLLABORATION AND PARTNERSHIP BUILDING

Recommendation: Increase collaboration and partnerships with State, Federal and local agencies and organizations that promote conservation of SGCN and their habitats.

- Expand on DWR's efforts to provide training for State and Federal Agencies and Conservation NGOs pertaining to habitat and SGCN. Ensure that SGCN information is included in management plans and public facing materials.
- Support additional requests from partners to provide programming for events such as festivals, bird walks, presentations, and demonstrations.
- Partner with conservation organizations to produce and enhance materials that inform the implementation of habitat practices that benefit SGCN. DWR to provide support and expertise in the development of the materials. Examples include the Plant Virginia Natives Campaign, and the James River Association's buffer planting guide.
- Continue as a project partner for the Pollinator Smart Program, this seeks to create/enhance habitat value related to industrial solar development. This program highlights the potential value for SGCN species, especially pollinators. Increase the scope of this effort to include brown fields, utility corridors and other lands.

- Bolster sponsorship and agency recognition opportunities to relevant partnership organizations such as VMNs, VSO, VHS, and VBS.
- Continue to fund organizations getting youth outdoors and prioritizing programs that place an emphasis SGCN.
- Prioritize regular communications with partners for awareness of agency initiatives related to SGCN.

PUBLIC ACCESS

Recommendation: Encourage increased use of agency lands and waters by non-consumptive users, participants that don't hunt or fish, through comprehensive habitat management on DWR properties consistent with the DWR Wildlife Action Plan, benefiting SGCN species**.**

Specific Actions:

- Promote management practices that foster diverse habitat assemblages to support native wildlife.
- Incorporate habitat enhancement and relevance to SGCN species during the planning phase for WMA management strategies.
- Develop communications that clarify the purpose of agency properties and the ability of these lands and waters to support multiple forms of wildlife-dependent recreation.
- Create simple, user-friendly communications about wildlife viewing opportunities for SGCN species on various DWR properties.
- Conduct a thorough investigation of wildlife viewing amenities that could support ethical viewing of SGCN species at WMAs on a site-by-site basis.

Recommendation: Encourage increased use of the Virginia Bird and Wildlife Trail (VBWT) and better utilize these sites for potential wildlife/habitat management actions which could positively impact SGCN**.**

Specific Actions:

- Revitalize partnerships and strengthen communications with VBWT site owners/managers to foster more public awareness of the VBWT and site-specific connections to SGCN viewing opportunities.
- Provide workshops for VBWT site owners/surrounding communities to increase their awareness of local SGCN and actions that benefit them.
- Develop and promote a DWR-sponsored grant program which would provide needed funding for site managers to implement restoration work aligned with the needs of SGCN on VBWT properties.
- Improve online information about the VBWT to address widespread lack of understanding about what the VBWT is and what can be expected when visiting a site.
- More formally connect DWR staff to the VBWT and its numerous properties. Identify specific sites where partnerships could be formed to support SGCN on these lands.
- Utilize VAFWIS to better understand historical reports of SGCN species on VBWT sites and use this to guide on the ground partnerships and initiatives.

- Provide more targeted promotion surrounding the VBWT and its relevance to wildlife viewers and outdoor enthusiasts across the state.
- Support development of trails, wildlife viewing structures, interpretive signage, and additional access to enhance the public's understanding and access to natural environments relevant to SGCN.
- Create an incentive opportunity for both the public as well as partner VBWT sites for visitors

FUNDING GENERATION AND INCREASED AGENCY RECOGNITION

Recommendation: Develop a communication strategy to share both internally and externally the DWR mission, the role of DWR in conservation and outdoor recreation, and the agency's commitment to diverse constituencies including wildlife viewers.

Specific Actions:

- Communicate about the relevance of DWR in wildlife management and its commitment to support non-consumptive user groups (e.g. wildlife viewers, hikers, paddlers, etc.).
- Communicate about the State Wildlife Action Plan, how it focuses on conserving wildlife to benefit people, and how it is a blueprint of strategies for the agency to address SGCN.
- Consider the utilization of targeted marketing as a call to action for users to donate funds for wildlife and habitat conservation specifically earmarked for SGCN.
- Promote documentation from external informative sources to further clarify the role of state agencies and outline policy actions that can support DWR's SGCN conservation work. For example, the North American Bird Conservation Initiative's State of the Birds report typically contains information on the role of U.S. state agencies to bird conservation.
- Increase training and awareness of the ways in which wildlife viewers financially support DWR.
- Train DWR staff about the importance of wildlife viewing to DWR's mission, agency programs that support wildlife viewing, and ways in which viewers support the agency (e.g., donations, licenses, volunteers) and the economy of Virginia through nature tourism.
- Establish and communicate mechanisms through which wildlife viewers can provide input to the agency (e.g., by providing comments on revisions to the Virginia Wildlife Action Plan).
- Highlight the relevance of the DWR's work and Virginia Wildlife Action Plan to wildlife viewers through content published in partner and DWR communication channels.
- Develop corporate and organizational recognition opportunities for their contributions to DWR and wildlife conservation of SGCN

Recommendation: Increase monetary contributions of wildlife viewers to support DWR's work with wildlife and habitat conservation.

Specific Actions:

- Streamline and expand external promotion of existing funding mechanisms through which wildlife viewers can and already do support DWR.
- Communicate about current funding mechanisms that viewers can and already participate in to support the agency (e.g., communicating the role of HB 38 funds to birders and viewers).

- Promote purchase of a Virginia Wildlife license plate as a mechanism for contributing to the agency and wildlife conservation.
- Grow membership for the Restore the Wild program and use the program's funding to support significant and sustainable habitat projects with a specific and measurable outcome for SGCN species. These results will form the basis for outreach efforts to generate further support for Restore the Wild.
    - Streamline and expand promotion of Restore the Wild memberships to communicate the value of this program for wildlife viewers and additional target communities.
- Provide a variety of mechanisms through which constituents can support DWR, from volunteering to donating.
- Develop a set of standardized materials (e.g., logos, presentation slides, handouts) to advertise donation opportunities at major DWR-sponsored events.
- Implement DWR-sponsored events in which registration fees support wildlife or habitat conservation.
- Explore opportunities to work with corporate or retail partners to generate funding for wildlife conservation and viewing-related programming.
- Find new and innovative funding mechanisms and market existing funding mechanisms that provide a source of revenue from non-consumptive wildlife users to generate revenue for statewide initiatives that impact SGCN.
    - Develop and enhance materials to incorporate into all DWR education and outreach programs that explain the importance of funding wildlife conservation programs.

APPENDIX 4: VIRGINIA MARINE MAMMAL CONSERVATION PLAN

2025

Virginia Marine Mammal Conservation Plan



Prepared by

Virginia Department of Wildlife Resources

With

Virginia Coastal Zone Management Program

National Oceanic and Atmospheric Administration

Virginia Marine Mammal Conservation Plan

Virginia Department of Wildlife Resources

This document serves as a final report to the Virginia Coastal Zone Management Program of the Department of Environmental Quality in fulfillment of Award Number NA 21NOS4190152 FY21 Task # 92.03 from the National Ocean Service of the National Oceanic and Atmospheric Administration.

Cover image: Bottlenose dolphins in the ocean off Virginia Beach, Virginia. This species is the most common marine mammal found in Virginia waters. They occur in the ocean, coastal bays, and in the Chesapeake Bay estuary. Bottlenose dolphins calve in late spring and early summer, and calves stay with their mothers for several years.

2025
Virginia Marine Mammal
Conservation Plan

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES V

DISCLAIMER VII

RECOMMENDED CITATION VIII

ACKNOWLEDGEMENTS VIII

LIST OF ACRONYMS AND ABBREVIATIONS VIII

EXECUTIVE SUMMARY 1

INTRODUCTION 3

Background 3

Regulations and Management of Marine Mammals in Virginia 4

Federal Agencies and Regulations 4

Federal Endangered Species Act (ESA) 4

Federal Marine Mammal Protection Act (MMPA) 5

USFWS and NOAA Fisheries Section 6 Cooperative Agreements 7

Virginia Agencies and Regulations 7

Virginia ESA 9

Virginia's Wildlife Action Plan 9

Virginia Marine Mammal Stranding Network 10

Virginia Ocean Plan 10

Tribal Nations in Virginia 11

Relevant Species and Species Descriptions 11

Odontocetes (Toothed whales) 12

Bottlenose Dolphins (Tursiops sp.) 12

Description 13

Status 13

Occurrence, Distribution, and Abundance in Virginia Waters 13

Strandings 16

Diet and Foraging in Virginia Waters 20

Reproductive Activity in Virginia Waters 21

Harbor Porpoise (Phocoena phocoena) 21

Description 21

Status 21

Occurrence, Distribution, and Abundance in Virginia Waters 22

Strandings 23

Diet and Foraging in Virginia Waters 27

Reproductive Activity in Virginia Waters 27

Short-Beaked Common Dolphin (Delphinus delphis delphis) 27

Description 27

Status 27

Occurrence, Distribution, and Abundance in Virginia Waters 28

Strandings 29

Diet and Foraging in Virginia Waters……..32
Reproductive Activity in Virginia Waters……..32
Other Delphinids……32
Other Toothed Whales (Physeteriids, Kogiids and Ziphiids)……33

Mysticetes (Baleen whales)…… 33
North Atlantic Right Whale (Eubalaena glacialis)……33
Description……..33
Status……34
Occurrence, Distribution, and Abundance in Virginia Waters……34
Strandings……36
Diet and Foraging in Virginia Waters……37
Reproductive Activity in Virginia Waters……..37
Humpback Whale (Megaptera novaeangliae)……38
Description……..38
Status……38
Occurrence, Distribution, and Abundance in Virginia Waters……38
Strandings……40
Diet and Foraging in Virginia Waters……43
Reproductive Activity in Virginia Waters……..43
Minke Whale (Balaenoptera acutorostrata)……43
Description……..43
Status……43
Occurrence, Distribution, and Abundance in Virginia Waters……44
Strandings……45
Diet and Foraging in Virginia Waters……..46
Reproductive Activity in Virginia Waters……...46
Fin Whale (Balaenoptera physalus)…… 46
Description……...46
Status……46
Occurrence, Distribution, and Abundance in Virginia Waters……47
Strandings……48
Diet and Foraging in Virginia Waters……49
Reproductive Activity in Virginia Waters……...49
Sei Whale (Balaenoptera borealis)……49
Description……...49
Status……49
Occurrence, Distribution, and Abundance in Virginia Waters……49
Strandings……50
Diet and Foraging in Virginia Waters……..51
Reproductive Activity in Virginia Waters……...51

Pinnipeds (True seals)…… 51
Harbor Seal (Phoca vitulina)……51
Description……...51
Status……51
Occurrence, Distribution, and Abundance in Virginia Waters……51
Strandings……52
Diet and Foraging in Virginia Waters……55
Reproductive Activity in Virginia Waters……..55
Other Phocids……55

Sirenians (Manatees) …… 56
Florida Manatee (Trichechus manatus latirostris)……56

Description……...56
Status……56
Occurrence, Distribution, and Abundance in Virginia Waters……56
Strandings……57
Diet and Foraging in Virginia Waters……..57
Reproductive Activity in Virginia Waters……...57

Limiting Factors, Causes of Mortality, and Other Threats to Marine Mammals in Virginia 57

Limiting Factors.....58
Causes of Mortality and Serious Injury.....58
Anthropogenic Mortality and Morbidity……58
Disturbance and Harassment 58
Fishery Interactions 59
Vessel Strikes 61
Pollution 63
Debris.....63
Noise 64
Contaminants.....66
Natural 66
Disease.....67
Injury (Infanticide, Predation, Incidental Foraging) 67
Harmful Algal Blooms (HABs).....68
Cetacean Mass Stranding(s) 68
Other Threats.....68
Changing Environmental Conditions……...69
Habitat Degradation……70

MARINE MAMMAL CONSERVATION STRATEGY 71

Conservation Outline..... 72
The overarching goal of this Plan is to enhance the survival of marine mammals and conserve their habitats in Virginia.....72
Conservation Goal 1: Maintain a permanent and effective Marine Mammal Stranding Network in Virginia……72
Conservation Goal 2: Identify, assess, and mitigate risks to marine mammal populations and habitats in Virginia through cost-effective monitoring, research, and best practices……73
Conservation Goal 3: Promote marine mammal conservation in Virginia through social marketing and information dissemination……75

Conservation Narrative..... 76
Conservation Goal 1: Maintain a permanent and effective Marine Mammal Stranding Network in Virginia 76
Conservation Goal 2: Identify, assess, and mitigate risks to marine mammal populations and habitats in Virginia through cost-effective monitoring, research, and best practices.....80
Conservation Goal 3: Promote marine mammal conservation in Virginia through social marketing and information dissemination.....88

SUMMARY 92

LITERATURE CITED 93

APPENDICES..... 114

Appendix I: 2022 – 2025 VAQS Federal Marine Mammal Stranding Response Agreement 114

Appendix II: List of all marine mammal species sighted or stranded in Virginia inshore, nearshore, offshore, and pelagic waters..... 151

LIST OF TABLES AND FIGURES

Figure 1. Modeled annual mean bottlenose dolphin density along the US Atlantic coast (Roberts *et al.* 2023). 14
Figure 2. Modeled seasonal mean bottlenose dolphin density along the mid-Atlantic Bight (Roberts *et al.* 2023). 15
Figure 3. Average number of bottlenose dolphin strandings in Virginia from 1988 to 2022, summarized in five-year increments. The 2013 to 2017 increment encompassed a bottlenose dolphin Unusual Mortality Event (UME) that was in effect from 2013 to 2015, which caused strandings to increase to a level well above average in 2013. To illustrate the impact of the UME on bottlenose dolphin strandings in 2013, two averages were calculated: one that includes the total number of strandings in 2013 and one that excludes it..... 16
Figure 4. Density map of bottlenose dolphin strandings per square kilometer in Virginia from 1988 to 2022. Offshore points represent carcasses discovered floating offshore. 17
Figure 5. Number of bottlenose dolphin strandings per season in Virginia from 1988 to 2022. . 18
Figure 6. Density map of seasonal bottlenose dolphin strandings per square kilometer in Virginia from 1988 to 2022..... 18
Figure 7. Number of bottlenose dolphin strandings per month in Virginia from 1988 to 2022... 19
Figure 8. The percentage of human interaction (HI) cases and linear trend documented among stranded bottlenose dolphins in Virginia from 1988 to 2022. 20
Figure 9. Density map of bottlenose dolphin strandings with evidence of human interaction per square kilometer in Virginia from 1988 to 2022. 20
Figure 10. Modeled annual mean harbor porpoise density along the US Atlantic coast (Roberts *et al.* 2023). 22
Figure 11. Modeled seasonal mean harbor porpoise density along the mid-Atlantic Bight (Roberts *et al.* 2023). 23
Figure 12. Average number of harbor porpoise strandings in Virginia from 1988 to 2022, summarized in five-year increments. 24
Figure 13. Density map of harbor porpoise strandings per square kilometer in Virginia from 1988 to 2022. 25
Figure 14. Number of harbor porpoise strandings per season in Virginia from 1988 to 2022. 26
Figure 15. Density map of seasonal harbor porpoise strandings per square kilometer in Virginia from 1988 to 2022..... 26
Figure 16. Number of harbor porpoise strandings per month in Virginia from 1988 to 2022. 27

Figure 17. Modeled annual mean short-beaked common dolphin density along the US Atlantic coast (Roberts *et al.* 2023). 28
Figure 18. Average number of short-beaked common dolphin strandings in Virginia from 1988 to 2022, summarized in five-year increments. 29
Figure 19. Density map of short-beaked common dolphin strandings per square kilometer in Virginia from 1988 to 2022. There were six mass stranding events documented in Virginia during this period of time, involving between two and 18 dolphins, and each individual's stranding location is depicted in the map. Offshore points represent carcasses discovered floating offshore. 30
Figure 20. Number of short-beaked common dolphin strandings per season in Virginia from 1988 to 2022. 31
Figure 21. Map of seasonal short-beaked common dolphin stranding locations in Virginia from 1988 to 2022. 31
Figure 22. Number of short-beaked common dolphin strandings per month in Virginia from 1988 to 2022. 32
Figure 23. Modeled annual mean North Atlantic right whale density along the US Atlantic coast (Roberts *et al.* 2024). 35
Figure 24. Modeled seasonal mean North Atlantic right whale density along the mid-Atlantic Bight (Roberts *et al.* 2024)..... 36
Figure 25. Map of North Atlantic right whale stranding locations in Virginia from 1988 to November 2024. 37
Figure 26. Modeled annual mean humpback whale density along the US Atlantic coast (Roberts *et al.* 2023). 39
Figure 27. Modeled seasonal mean humpback whale density along the mid-Atlantic Bight (Roberts *et al.* 2023). 40
Figure 28. Average number of humpback whale strandings in Virginia from 1988 to 2022, summarized in five-year increments. 41
Figure 29. Density map of humpback whale strandings per square kilometer in Virginia from 1988 to 2022. Offshore points represent carcasses discovered floating offshore. 41
Figure 30. Number of humpback whale strandings per season in Virginia from 1988 to 2022. .. 42
Figure 31. Map of seasonal humpback whale stranding locations in Virginia from 1988 to 2022. 42
Figure 32. Number of humpback whale strandings per month in Virginia from 1988 to 2022. .. 43
Figure 33. Modeled annual mean minke whale density along the US Atlantic coast (Roberts *et al.* 2023). 45
Figure 34. Average number of minke whale strandings in Virginia from 1988 to 2022, summarized in five-year increments. 46
Figure 35. Modeled annual mean fin whale density along the US Atlantic coast (Roberts *et al.* 2023). 48

Figure 36. Modeled annual mean sei whale density along the US Atlantic coast (Roberts *et al.* 2023). 50
Figure 37. Average number of harbor seal strandings in Virginia from 1988 to 2022, summarized in five-year increments. 53
Figure 38. Density map of harbor seal strandings per square kilometer in Virginia from 1988 to 2022..... 53
Figure 39. Number of harbor seal strandings per season in Virginia from 1988 to 2022. 54
Figure 40. Map of seasonal harbor seal stranding locations in Virginia from 1988 to 2022..... 54
Figure 41. Number of harbor seal strandings per month in Virginia from 1988 to 2022. 55
Figure 42. Density map of vessel traffic using AIS for 2022 along the Virginia coastline (Fontenault 2023). 63
Figure 43. Map of active wind energy areas and future wind planning areas, with cable and turbine (inset) locations, along the mid-Atlantic Bight, with the 200-m isobath (BOEM 2023). Dominion Energy has acquired leases for the two areas on the Virginia continental shelf and recently acquired the lease for the northern North Carolina area. Offshore areas (tan) are considered planning areas and, as of early 2025, lease areas and timelines were not finalized. .. 66
Figure 44. Implementation timelines of actions under Goal 1 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing. 80
Figure 45. Implementation timelines of actions under Goal 2 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing. 88
Figure 46. Implementation timelines of actions under Goal 3 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing. 92

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List of Acronyms and Abbreviations

AIS	Automatic Identification System
Bay	Chesapeake Bay
BOEM	Bureau of Ocean Energy Management
CBBT	Chesapeake Bay Bridge Tunnel
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CVOW	Coastal Virginia Offshore Wind
CVW	Clean Virginia Waterways
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DDT	dichlorodiphenyltrichloroethane
DEQ	Virginia Department of Environmental Quality
DPS	Distinct Population Segment
DWR	Virginia Department of Wildlife Resources

EEZ	United States Economic Exclusive Zone, which goes 200 nautical miles from shore
ESVA	Eastern Shore of Virginia
ESA	Endangered Species Act
FR	Federal Register
HAB	Harmful Algal Bloom
HI	Human Interaction
inshore	waters from the coastal bays landward of the barrier islands to the fall line where the Atlantic coastal plain and the Piedmont Plateau converge
ISEN	Interagency Stranding Event Network
IUCN	International Union for the Conservation of Nature
JEA	Joint Enforcement Agreement
LE	Law Enforcement
MARCO	Mid-Atlantic Ocean Data Portal
Mid-Atlantic Bight	section of the U.S. Atlantic continental shelf that extends from Long Island, New York, to Cape Hatteras, North Carolina, that is often used in fishery management actions
MMAP	Marine Mammal Authorization Program
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MRC	Virginia Marine Resources Commission
NARWC	North Atlantic Right Whale Consortium
NCMS	Northern Coastal Migratory Stock
nearshore	waters that extend from the Atlantic Ocean shoreline and COLREG demarcation line to three miles offshore
NEFOP	Northeast Fisheries Observer Program
NEPA	National Environmental Policy Act
NNCESS	Northern North Carolina Estuarine System Stock
NMFS	National Marine Fisheries Service, also known as NOAA Fisheries
NOAA	National Oceanic and Atmospheric Association
NOAA Fisheries	NOAA National Marine Fisheries Service, also known as NMFS
offshore	federal waters that extend from three miles offshore to the edge of the outer continental shelf
OSP	optimum sustainable population
PAM	Passive Acoustic Monitor
PBR	Potential Biological Removal
PCB	Polychlorinated biphenyl
pelagic	federal waters that extend beyond the shelf break
Percentage of HI	Calculation of number of strandings positive for human interaction (HI) divided by the total number of cases positive and negative, excluding the cases where HI was undetermined (HI=CBD) [HI=Yes/(HI=Yes + HI=No)]
PFAs	Per- and polyfluoroalkyl substances

Plan	Virginia Marine Mammal Conservation Plan
RWSC	Regional Wildlife Science Collaborative
SAG	Surface active group (in reference to North Atlantic right whales)
SAR	Stock Assessment Report
SCMS	Southern Coastal Migratory Stock
SGCN	Species of Greatest Conservation Need
SMA	Seasonal Management Area
SOP	Standard Operating Procedure
SWG	State Wildlife Grants
TNC	The Nature Conservancy
TRT	Take Reduction Team
UME	Unusual Mortality Event
US	United States
USACOE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VAMSC	Virginia Aquarium & Marine Science Center
VAQF	Virginia Aquarium & Marine Science Center Foundation
VAQS	Virginia Aquarium Stranding Response Program
VIMS	Virginia Institute of Marine Science
VMMSN	Virginia Marine Mammal Stranding Network
VOP	Virginia Ocean Plan
WAP	Wildlife Action Plan
WEA	Wind Energy Area

EXECUTIVE SUMMARY

Many species of marine mammals utilize Virginia waters, ranging from the commonly observed bottlenose dolphin to large baleen whales, such as the endangered North Atlantic right whale. While all marine mammal species are protected under the federal Marine Mammal Protection Act, state and federally listed species receive additional protection under the Virginia and United States Endangered Species acts, respectively.

Marine mammals are highly mobile marine mega-vertebrates that do not spend the entirety of their lives in Virginia waters. Some species, such as the harbor seal, only occur in state waters from late fall to early spring while others may quickly pass through during their northern and southern migrations. Although bottlenose dolphins are present year-round, their local distribution and abundance is variable and largely driven by water temperatures and prey availability. Regardless of the season, at least one marine mammal species is present in Virginia waters throughout the annual cycle.

Threats to marine mammals in Virginia waters are consistent with those throughout the mid-Atlantic region. Marine mammal injuries and mortality are primarily attributed to anthropogenic activities, including interactions with commercial and recreational fishing gear and vessel strikes. Non-lethal compounding stressors may also compromise animals, making them more susceptible to disease and parasites. These stressors include low levels of contaminants, poor water quality stemming from various types of pollution, harmful algal blooms, and disruptive human activities such as marine construction, harassment from recreational boaters, and in-water military training exercises.

The high diversity of species in Virginia and elevated conservation status (i.e. state and federally threatened or endangered) of some of these species makes the conservation and management of marine mammals and their habitats especially important in the Commonwealth. Because marine mammals occupy wide geographic ranges and exhibit seasonal distribution patterns throughout their ranges, effective conservation cannot be carried out by a single entity and requires coordinated efforts of multiple state, federal, nongovernmental, and international partners. The overarching goal of this Plan is to enhance the survival and conserve the habitats of marine mammals in Virginia in a manner that complements regional and federal management and conservation efforts. The Plan's Conservation Narrative focuses on three goals, under which strategies, actions, entities, and timelines are identified and described, and include:

> Goal 1: Maintain a permanent and effective Marine Mammal Stranding Network in Virginia.
> Goal 2: Identify, assess, and mitigate risks to marine mammal populations and habitats in Virginia through cost-effective monitoring, research, and best practices.
> Goal 3: Promote marine mammal conservation in Virginia through social marketing and information dissemination.

As the agency responsible for conservation and management of protected species, the Virginia Department of Wildlife Resources is responsible for developing state conservation

plans. Coordination and communication between the Virginia Department of Wildlife Resources and the Virginia Marine Resources Commission, the two state agencies responsible for managing protected marine species in the Commonwealth, along with the National Oceanic and Atmospheric Administration National Marine Fisheries Service and the United States Fish and Wildlife Service, the two federal agencies which oversee the protection and management of marine mammals at the federal level, is a key aspect of marine mammal conservation in Virginia. The successful implementation of most of the conservation strategies and actions identified in this Plan rely heavily on the cooperation of many other collaborating agencies, organizations, and partners. Since marine mammal conservation fundamentally involves human beings, the most successful conservation actions will be those aligned with the values, wellbeing, and perspectives of people who will be asked to support and/or adopt many of these actions for the benefit of marine mammals.

This Plan was developed in concert with the 2024 Sea Turtle Conservation Plan, and many of its strategies and actions are similar to those identified for marine mammals. The coordination and implementation of related efforts outlined in both plans should be executed in a way that maximizes limited state and federal resources and provides the greatest conservation benefits for both marine taxa. Lastly, the sea turtle and marine mammal conservation plans will serve as appendices to the 2025 Virginia Wildlife Action and the 2025 Virginia Ocean Plan, both of which are currently under development, and will help ensure that sea turtle and marine mammal conservation will be incorporated into the Commonwealth's future wildlife and ocean resources management priorities.

INTRODUCTION

BACKGROUND

Marine mammals are distributed throughout the global marine ecosystem. Like other mammals, they are warm-blooded, breathe air, have hair (some briefly at birth), and nurse their young. There are four groups of marine mammals: cetaceans (whales, dolphins, and porpoises); pinnipeds (seals, sea lions, and walruses); sirenians (manatees and dugongs); and marine fissipeds (polar bears and sea otters). Cetaceans and sirenians spend the entirety of their lives in the water, while pinnipeds and marine fissipeds spend their lives both on land and in the water.

Over 30 species of marine mammals have been documented in Virginia's state and federal waters and differ in form, lifestyle, and habitat requirements. Some species' presence is seasonal, while other species are strictly transitory. Only bottlenose dolphins are present in Virginia year-round. Some species primarily utilize inshore and nearshore waters, while others only occur in deep offshore waters. The bottlenose dolphin (*Tursiops* sp.) is the most commonly observed marine mammal in Virginia waters and typically comprises over half of the state's annual strandings (VAQS *unpublished data*, October 2023). Other frequently observed cetacean species include the harbor porpoise (*Phocena phocoena*), short-beaked common dolphin (*Delphinus delphis*), and baleen whales such as the humpback whale (*Megaptera novaeangliae*) and North Atlantic right whale (*Eubalaena glacialis*). Other non-cetacean species utilize Virginia waters as well, such as harbor seals (*Phoca vitulina*) and Florida manatees (*Trichechus manatus latirostris*).

Several marine mammal species that utilize Virginia waters are listed as endangered or threatened under the Virginia and United States (US) Endangered Species Acts. Moreover, waters along the entire US Atlantic coast were identified as a high-risk hotspot for over 20 species of marine mammals because of their exposure to anthropogenic threats (Avila *et al.* 2018). All marine mammals are protected under the federal Marine Mammal Protection Act (MMPA), and Virginia state laws also protect all wildlife, including state and federally listed species. To better conserve and manage all marine mammal species, coordinated state and federal conservation strategies have been suggested by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (hereafter referred to as NOAA Fisheries) and the US Fish and Wildlife Service (USFWS). The marine mammal conservation plan for Virginia is designed to conserve and manage marine mammals in state and surrounding federal waters. The Virginia Marine Mammal Conservation Plan (Plan) encompasses all of Virginia's inshore waters from the coastal bays landward of the barrier islands to the fall line where the Atlantic coastal plain and the Piedmont Plateau converge (hereafter referred to as inshore waters). The Plan's coverage also includes state waters that extend from the Atlantic Ocean shoreline and COLREG demarcation line to three miles offshore (hereafter referred to as nearshore waters), federal waters that extend from three miles offshore to the edge of the outer continental shelf (hereafter referred to as offshore waters) and federal waters that extend beyond the shelf break (hereafter referred to as pelagic

waters). Lastly, this Plan also encompasses terrestrial seal haul-out sites and manatee freshwater habitats.

The Virginia Marine Mammal Conservation Plan will serve as an appendix to the 2025 Virgina Wildlife Action Plan and the Virgina Ocean Plan, which is currently in preparation.

REGULATIONS AND MANAGEMENT OF MARINE MAMMALS IN VIRGINIA

FEDERAL AGENCIES AND REGULATIONS

All marine mammals are federally protected under the Marine Mammal Protection Act (MMPA) of 1972, as amended, making it illegal to "take", import or export marine mammals and their parts in the US. Two federal entities are responsible for implementing marine mammal protection under the MMPA: NOAA Fisheries which oversees protection of whales, dolphins, porpoises, seals, and sea lions, and the USFWS which oversees protection of manatees, polar bears, walruses, and sea otters. Other marine vertebrate species or non-marine aquatic and terrestrial mammals are not covered under the MMPA.

Some marine mammal species receive additional protection under the Endangered Species Act of 1973 (federal ESA), as amended, and the Convention on International Trade in Endangered Species of Wildlife Flora and Fauna (CITES). The ESA is not specific to marine mammals and only provides protections to species deemed threatened or endangered. CITES is an international agreement between governments enacted to ensure international trade of animals and plants is legal, traceable, sustainable, and does not threaten their survival in the wild. CITES is also not specific to marine mammals but provides protection to species deemed threatened or endangered in the US. Species may be listed under one of three appendices according to their conservation status, which designates how much, if any, trade is permitted. Those species listed in Appendix I receive the most protection; those listed in Appendix III receive the least protection (CITES 2019). For example, harbor seals are not listed as threatened or endangered under the ESA and are not currently regulated under CITES but are still federally protected under the MMPA. North Atlantic right whales, on the other hand, are endangered under the ESA, a CITES Appendix I species, and federally protected under the MMPA.

Federal Endangered Species Act (ESA)

In 1973, Congress passed the federal ESA (16 U.S.C. 1531 et. seq.), which enhanced federal abilities to protect endangered species and develop measures for their recovery. The federal ESA offers endangered and threatened species comprehensive protection as administered jointly by the USFWS and NOAA Fisheries. The USFWS has authority over terrestrial and freshwater fish, wildlife, plants, and insects, while NOAA Fisheries has authority over marine and anadromous fish and wildlife. Section 4 of the federal ESA provides for the listing and recovery planning process, including the determination of critical habitat and the issuance of regulations deemed necessary and advisable to further the conservation and recovery of listed species. Section 6 allows for the establishment of cooperative agreements with states that give state fish and wildlife agencies shared authority over the recovery and conservation of federally listed species within state boundaries (see below). Federally-permitted, -funded, or -conducted actions known to impact federally listed marine mammals, such as dredging and in-water military training activities, are addressed under Section 7

through incidental take statements for intergovernmental consultation. Section 10 provides for the development of habitat conservation plans and incidental take permits for non-federal actions that may impact listed species, such as state commercial fishery operations.

During each reauthorization of the federal ESA, amendments have been added which reflect the experience and knowledge gained in administering its provisions. The 1978 amendments required the USFWS and NOAA Fisheries to develop and implement recovery plans for species under their jurisdictions. Between 1991 and 2020, recovery plans were completed for all federally listed Northwest Atlantic large whales: the North Atlantic right whale (NOAA Fisheries 1991a, 2005), humpback whale (NOAA Fisheries 1991b), blue whale (*Baleanoptera musculus*; NOAA Fisheries 1998, 2020), fin whale (*Baleanoptera physalus*; NOAA Fisheries 2010a), sei whale (*Baleanoptera borealis*; NOAA Fisheries 2011), and sperm whale (*Physeter macrocephalus*; NOAA Fisheries 2010b). Recent five-year status reviews were completed for the sperm whale (2015), fin whale (2019), blue whale (2020), sei whale (2021), and North Atlantic right whale (2022). Following the 2015 five-year humpback whale status review, the Gulf of Maine stock of humpback whales, the primary stock present in Virginia waters (Barco *et al.* 2002), was de-listed in 2016 and no longer receives protection under the ESA. In addition to the above large whales, the West Indian manatee is currently listed as threatened under the ESA following its reclassification from endangered in 2017 (82 FR 16668). A petition to re-classify them as endangered in 2022 was found to be warranted and triggered a status review (88 FR 70634). In January 2025, the review resulted in a proposed rule to separate the Florida manatee subpopulation from the Caribbean subpopulation (Antillean manatee) and to keep threatened status for Florida manatees, which are found in Virginia, and list the Antillean manatee as endangered (90 FR 3131). A final ruling on the proposed rule will likely be available in late 2025 or the first half of 2026.

Federal Marine Mammal Protection Act (MMPA)

The MMPA was enacted on October 21, 1972, and established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. The MMPA prohibits the "taking" of marine mammals and enacts a moratorium on the import, export, and sale of any marine mammal, along with any marine mammal part or product, within the US. Under the MMPA, "take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. § 1362(13)). The MMPA goes on to define "harassment" in 16 U.S.C. § 1362(18), including the general definition, harassment in the context of military readiness activity and scientific research, and levels of harassment. Harassment generally means "any act of pursuit, torment or annoyance which (i) has the potential to injure a marine mammal in the wild; or (ii) has the potential to disturb a marine mammal or marine mammal stock by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (16 U.S.C. §1362(18)(A)). NOAA Fisheries, USFWS, and the Marine Mammal Commission (MMC) share responsibility for implementing the MMPA. The MMC provides independent, science-based oversight of domestic and international policies and actions of federal agencies addressing human impacts on marine mammals and their ecosystems. To increase the effectiveness of implementing the MMPA, NOAA Fisheries can partner with state law

enforcement (LE) agencies through Joint Enforcement Agreements (JEA) to perform LE services that support federal regulations (NOAA Fisheries 2025).

The MMPA mandates marine mammal management and conservation by providing stock assessment reports (SARs) on marine mammals that reside in US waters (16 U.S.C. § 1386). Each species is divided into one or many stocks, which is defined under the MMPA as "a group of individuals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature." SARs include information on population trends, minimum population estimates, geographic ranges, status of the stock, Potential Biological Removal (PBR), anthropogenic mortalities, and other sources of mortality. PBR represents an estimate of the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (OSP). PBR is defined as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population" (16 U.S.C. § 1362(20)). PBR is calculated as a product of the estimated minimum population size, half of the maximum theoretical or estimated productivity rate, and a recovery factor (16 U.S.C. § 1362(20)); Wade and Angliss 1997). The default maximum productivity rate used for cetaceans is 0.04. The recovery factor ranges between 0.1 and 1.0 depending on the species' status. In assessing each stock's status in the SAR, stocks are designated as Strategic Stocks if one of the following criteria is met: 1) listed as endangered or threatened under the ESA; 2) declining and likely to be listed under the ESA; 3) considered depleted under the MMPA (below OSP); or 4) exposed to direct anthropogenic mortality exceeding calculated PBR. SARs are reviewed annually for strategic stocks and every three years (or as significant new information is obtained) for non-strategic stocks.

The MMPA allows for exemptions of "take" by commercial fishing operations through NOAA Fisheries' Marine Mammal Authorization Program (MMAP). The MMAP categorizes fisheries into one of three categories. For all Category 1 and 2 fisheries, fishers must obtain a marine mammal authorization certificate each year from NOAA Fisheries or its designated agent, which legally authorizes fishers to incidentally take a marine mammal. Takes are tracked through the Fisheries Observer Program. In addition, all fishers, irrespective of the category of their fishery, are required to report every incidental death or injury that results from commercial fishing operations within 48 hours of the event. When fishery-related mortality of a species or stock exceeds PBR, a Take Reduction Team (TRT) is established to create a Take Reduction Plan to reduce incidental mortality or serious injury from commercial fishing. A species or stock does not have to be listed under the ESA to warrant the formation of a TRT. When a TRT is formed, NOAA Fisheries reaches out to states with populations of the affected stock/species for representation on the Team. In Virginia, staff from the Virginia Marine Resources Commission (MRC) serve on TRTs to represent Virginia fisheries and fish management concerns.

The MMPA was amended in 1981, 1984, 1988 and 1994. The 1994 amendment dictated the creation of the Marine Mammal Health and Stranding Response Program (16 U.S.C. § 1421) and the Unusual Mortality Event Working Group (16 U.S.C. § 1421c). The term "unusual mortality event" means a stranding that (A) is unexpected; (B) involves a significant die-off of any marine mammal population; and (C) demands immediate response (16 U.S.C. § 1421h

(9)). The criteria used to determine and/or declare an unusual mortality event are (71 FR 75234):

A marked increase in the magnitude or a marked change in the nature of morbidity, mortality or strandings when compared with prior records.
A temporal change in morbidity, mortality or strandings is occurring.
A spatial change in morbidity, mortality or strandings is occurring.
The species, age, or sex composition of the affected animals is different than that of animals that are normally affected.
Affected animals exhibit similar or unusual pathologic findings, behavior patterns, clinical signs, or general physical condition (*e.g.* blubber thickness).
Potentially significant morbidity, mortality or stranding is observed in species, stocks or populations that are particularly vulnerable (*e.g.* listed as depleted, threatened or endangered or declining). For example, stranding of three or four right whales may be cause for great concern, whereas stranding of a similar number of fin whales may not.
Morbidity is observed concurrent with or as part of an unexplained continual decline of a marine mammal population, stock, or species.

Virginia has been included in ten marine mammal UMEs since 2004 involving a variety of dolphins, seals, and baleen whales.

USFWS and NOAA Fisheries Section 6 Cooperative Agreements

Section 6 of the federal ESA provides a mechanism for cooperation between states, and NOAA Fisheries and the USFWS, the two federal agencies responsible for overseeing the conservation and recovery of federally threatened, endangered, and candidate species as well as species undergoing review for their status under the federal ESA. Under Section 6, NOAA Fisheries and USFWS are authorized to enter into agreements with any state that establishes and maintains an "adequate and active" program for the conservation of endangered and threatened species. Once a state enters into a cooperative agreement, NOAA Fisheries and USFWS are then authorized to assist in and provide federal funding for implementation of the state's conservation program. The Virginia Department of Wildlife Resources (DWR) entered into a cooperative agreement with the USFWS in 1976 and signed a cooperative agreement with NOAA Fisheries in 2009. These agreements remain in effect. The USFWS cooperative agreement does not include authorization to respond independently to manatee events. Manatee management is authorized on a case-by-case basis with the USFWS Manatee Coordinator.

Virginia Agencies and Regulations

Two natural resource agencies in Virginia have authority over federally listed sea turtles, marine mammals, and marine fishes (hereafter collectively referred to as "protected marine species"): the Virginia Department of Wildlife Resources (DWR) and the Virginia Marine Resources Commission (MRC). The DWR is charged with the management of all wildlife and inland fish in the Commonwealth (§§ 29.1-103(11) and 29.1-109(A) of the *Code of Virginia*). The Virginia Endangered Species Act (Virginia ESA; §§ 29.1-563 – 570 of the *Code of Virginia*) confers the DWR the authority to adopt the federal list of endangered and threatened species (§ 29.1-566 of the *Code of Virginia*); to list additional species as endangered or threatened in the Commonwealth (*id.)*; to manage and protect those species

throughout the Commonwealth (§§ 29.1-564, -566, -567, -568, -569 and -570 of the *Code of Virginia*); and "to prohibit by regulation the taking, transportation, processing, sale, or offer for sale within the Commonwealth of any threatened or endangered species of fish or wildlife" (§ 29.1-566 of the *Code of Virginia*). Via the DWR's Section 6 cooperative agreement with the USFWS, the DWR is also responsible for protection and management of species listed by the Secretary of Interior under the federal ESA. The DWR's Nongame and Endangered Species Program, Aquatics Division, Wildlife Division, and Law Enforcement Division are primarily responsible for program development and implementation regarding protection and management of the Commonwealth's wildlife and inland fish, including endangered or threatened species, that occur throughout the Commonwealth's lands and jurisdictional waters.

The MRC's geographic jurisdiction includes "the Commonwealth's territorial sea and extend to the fall line of all tidal rivers and streams . . . where jurisdiction extends throughout the Commonwealth" (§ 28.2-101 of the *Code of Virginia*). The MRC has "jurisdiction over all commercial fishing and all marine fish, marine shellfish, marine organisms, and habitat in such areas" (Id). This authority includes marine mammals and their prey bases (Id). It has the authority to develop and enforce fishery regulations pertaining to the protection and conservation of state and federally protected marine species (§§ 28.2-201 and -106 of the *Code of Virginia)*. However, the agency is not responsible for developing or enacting state threatened and endangered species laws or regulations and draws no authority from the Virginia or federal ESA. The MRC has regulatory jurisdiction over activities affecting state-owned bottomlands in tidal waters only (§§ 28.2-1200–1209 of the *Code of Virginia*). The MRC has authority over all commercial fishing activities within its jurisdiction and regulates the take of marine finfish and shellfish in Virginia's tidal waters (§§ 28.2-200–244 of the *Code of Virginia*). It is also responsible for establishing finfish and shellfish seasons, size, and possession limits, species-specific landings, harvest quotas, and harvest size restrictions (§ 28.2-101 of the *Code of Virginia*). The Code of Virginia authorizes the MRC to promulgate regulations that conserve and promote the seafood and marine resources of the Commonwealth (§ 28.2-201 of the *Code of Virginia*), establish and limit licenses, *id*., collect fisheries statistics (§ 28.2-204 of the *Code of Virginia*), and prepare fishery management plans (§§ 28.2-201, -203 and -203.1 of the *Code of Virginia*). The MRC's Fisheries, Habitat, and Marine Police divisions are responsible for development and implementation of programs that carry out these mandates.

The DWR Conservation Police Officers and MRC Marine Police Officers share some of the same powers: each is vested with the authority to enforce the criminal laws of the Commonwealth. As it is a criminal offense to violate the provisions of the Virginia ESA (§ 29.1-567 of the *Code of Virginia*), the Conservation Police and the Marine Police have equal authority to enforce the Commonwealth's endangered species laws. Moreover, the MRC has standing law enforcement agreements with NOAA Fisheries and the USFWS, enabling Marine Police Officers to collaborate with their federal counterparts on protected species investigations, patrols, inspections, warrants, and arrests. The MRC has a Joint Enforcement Agreement (JEA) with NOAA Fisheries for MMPA enforcement, including assisting with marine mammal stranding events. The DWR has a standing law enforcement agreement with the USFWS that allows Conservation Police Officers to serve as Deputy USFWS Special Agents and conduct investigations both in-state and across state lines when violations of

federal wildlife laws have been committed. Finally, the MRC Marine Police receive annual funding from NOAA Fisheries to assist with sea turtle and marine mammal stranding response and fishery management in the Commonwealth through its JEA with NOAA Fisheries.

Another state entity, the Virginia Institute of Marine Science (VIMS), has conservation responsibilities as well, but has no authority to enact or enforce state regulations. VIMS is specifically mandated to serve the state in matters of marine research and has marine conservation duties (§ 28.2-1100 of the *Code of Virginia*). VIMS has a three-part mission: to conduct interdisciplinary research in coastal and estuarine science; to educate students and citizens; and to provide advisory service to policy makers, industry, and the public (https://www.vims.edu/about/index.php). VIMS' duties include advising, training, providing technical/scientific assistance, and conducting research for the MRC, federal agencies, and other public and private groups on the conservation and management of marine, coastal, and estuarine resources (§ 28.2-1100 of the *Code of Virginia*). Research at VIMS extends from inland watersheds to the open ocean and is conducted by teams of scientists with diverse expertise in areas such as the following: plankton and nutrient dynamics; shoreline and wetlands processes; fisheries ecology and stock assessment; fisheries gear engineering and bycatch; aquaculture; genetics; immunology; toxicology; biological, chemical, and physical oceanography; aquatic diseases; computational modeling; and marine geological processes.

The Virginia Coastal Zone Management Program (CZM), a network program led by Virginia Department of Environmental Quality (DEQ), has a role in managing coastal and marine resources as a coastal program authorized by the Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. §§ 1451–1465). Virginia CZM provides coordination, capacity, and funding (through annual grants from NOAA) to support projects that advance program goals which include protecting and restoring coastal and ocean resources, habitats, and species of the Commonwealth. Additionally, under Section 307 of the CZMA, federal actions including federal permits that affect a state's coastal resources or uses must be consistent with the enforceable policies of the state's federally approved coastal management program. DEQ's Office of Environmental Impact Review coordinates federal consistency reviews in accordance with the CZMA. Where federal actions or projects requiring federal licenses/permits have the potential to impact marine mammals and other marine species, DEQ coordinates with DWR, MRC, and other state resources agencies to ensure actions are consistent with the program's approved enforceable policies. This process provides an important avenue for state agencies to propose avoidance and mitigation measures during the project development process.

Virginia ESA

Virginia's ESA (§§ 29.1-563–570 of the *Code of Virginia*), administered by the DWR, provides for adoption of the federal endangered and threatened list listing at the state level, id., and protection of those species in the state. Further protective legislation for non-endangered species is found in Section 29.1-521 of the *Code of Virginia*, which provides for the protection of wildlife in general. The DWR Executive Office units, along with the following divisions, are responsible for program development and implementation: Wildlife, Fisheries, Law Enforcement, Outreach, Planning, and Finance.

Virginia's Wildlife Action Plan

On November 5, 2001, President Bush signed the Department of the Interior and Related Agencies Appropriations Act, 2002, which created the State Wildlife Grants (SWG) program. As indicated within this legislation, these grants were established to help fund the development and implementation of programs for the benefit of wildlife and associated habitats, with an emphasis on state-defined Species of Greatest Conservation Need (SGCN). The SWG program receives annual Congressional appropriations that are administered by the USFWS. The USFWS apportions these funds, using a legislated formula based on human population and geographic area, to fish and wildlife management agencies within the 50 states, the five US territories, and the District of Columbia. To receive annual SWG appropriations, Congress stipulated that each fish and wildlife agency must produce a Comprehensive Wildlife Action Plan (WAP), to be updated every 10 years. The latest version of the Virginia WAP was completed in 2025 and includes several marine mammal species covered by this Plan in its list of SGCN as noted in the relevant species' descriptions. This Plan will serve as an appendix to the Virginia WAP.

Virginia Marine Mammal Stranding Network

Nationally, the Marine Mammal Health and Stranding Response Program is overseen by NOAA Fisheries. Virginia is the southernmost state in the Greater Atlantic Region of NOAA Fisheries, which extends from Maine to Virginia. A marine mammal stranding is defined as any marine mammal dead on the beach or in the water, alive on the beach or shore and in need of medical attention, or in US waters but unable to return to its natural habitat without assistance (MMPA 1994). The Virginia Marine Mammal Stranding and Disentanglement Network is organized by the Virginia Aquarium & Marine Science Center's Stranding Response Program (VAQS). The VAQS is authorized under a Stranding Agreement (Appendix I), which dictates the level of response for an organization and its reporting responsibilities. Currently, the VAQS is the sole Stranding Agreement holder in Virginia; however, state agencies can respond to marine mammal events under Section 109h of the MMPA. Both the MRC and the DWR have assisted with marine mammal events primarily at the discretion of the VAQS.

Virginia Ocean Plan

The Virginia Ocean Plan (VOP) is a resource and coordinating document that aims to improve ocean resource management in the waters offshore of Virginia. The VOP was developed with the following goals:

1) Promote a sustainable and growing "blue economy".
2) Document and characterize existing/emerging ocean uses and the existing policies/plans that relate to them.
3) Minimize/mitigate conflicts between existing and emerging ocean uses, and minimize/mitigate impacts to ocean habitat, marine life, and ecosystem functions.
4) Increase resilience of ocean uses, ocean habitat, and marine life to a changing ocean.
5) Develop processes for plan implementation, plan maintenance/updates, ongoing stakeholder collaboration, and conflict resolution.

To do this, input from over 120 experts and experienced ocean users was gathered through six different workgroups focused on topics such as the following: energy and infrastructure; transportation, navigation, and security; and sustainability and conservation. The latter workgroup developed recommendations related to the conservation of marine species and habitats, and the goal of making ocean uses more sustainable. This Plan is included as an

appendix in the VOP as the conservation plan's goals, strategies, and actions are critical components of Virginia's ocean resource management.

Tribal Nations in Virginia

Virginia is home to seven federally recognized and four state-recognized tribes. Many of these tribes are signatories to the Treaty of Middle Plantation, which specifically mentions tribal rights to oystering, fishing, and gathering a series of plants including edible roots, wild oats, rushes, and other species. Several tribes participate in natural resources stewardship through cooperative monitoring of fisheries resources, oyster reef restoration activities, and monitoring water quality on tribal land. A significant effort was made with to invite Virginia's Native American tribes to the workshop and incorporate their comments on drafts of the Plan.

Relevant Species and Species Descriptions

Owing to the considerable variation in knowledge of species occurrence, habitat use, and life-history in the mid-Atlantic region, the following accounts vary from descriptions of individual species, for which there is adequate to considerable data available, to phylogenetically related groups of species, for which data on individual species is either lacking or very limited. Species were listed individually if two or more of the following criteria were met:

1) Species within Virginia's inshore, nearshore, and/or offshore waters that are predictably sighted annually or are predictably present annually in the stranding record;
2) Sufficient regional distribution and/or threat information is available to warrant a species description; or
3) Species meets one of the above criteria *and* is listed as endangered or threatened under the Virginia and federal ESA.

Species were grouped rather than listed individually if one or more of the following criteria were met:

1) Minimal information exists on species life-history;
2) There is poor understanding of species distribution in the mid-Atlantic region; or
3) The species is primarily encountered in pelagic waters

At least 31 marine mammal species have been documented in Virginia's inshore, nearshore, offshore, and pelagic waters, and they are listed by common and scientific name in Appendix II. The information presented for each species or phylogenetic group is specific to Virginia and/or the mid-Atlantic region. The following information is presented in each species account: (1) a general description of the species appearance; (2) the species' conservation status; (3) a description of each species' occurrence, distribution, and/or abundance in Virginia's waters; (4) species-specific stranding data; (5) species-specific diet information; and (6) species-specific reproduction information. Each species' conservation status is presented in the narrative below and summarized in Appendix II. Conservation status includes International Union for Conservation of Nature (IUCN), ESA (all listings from NOAA Fisheries excluding manatees from USFWS), MMPA (*i.e.* strategic stock) listing; whether or not it is an SGCN in the Virginia WAP (DWR 2025), and if there was an active TRT or UME as of November 2024. The Viriginia WAP identifies "the distribution and abundance of species of wildlife, including low and

declining populations as each State fish and wildlife agency deems appropriate that are indicative of the diversity and health of wildlife of the state" (USFWS 2006) and refers to these species as a SGCN. Models for each species' abundance were created along the entire US Atlantic by Roberts *et al.* (2023) using aerial and shipboard survey data from a variety of sources. For North Atlantic right whales only, the model was updated in 2024 to incorporate passive acoustic monitoring (Roberts *et al.* 2024).

For most species, stranding data from 1988 to 2022 that included the species, stranding location, date, sex, length, and Human Interaction (HI) designation was provided by the VAQS. Data through November 2024 were provided for North Atlantic right whales because of concern for population decline in the western North Atlantic. Each stranding was evaluated for findings of HI, such as attached gear, twine, line or rope lesions, or injuries consistent with vessel strike, and designated as 'Yes', 'No', or 'Could Not Be Determined' (Moore and Barco 2013). For each species, strandings were summarized by five-year averages, season, and month. Seasons were defined as: winter (January-March); spring (April-June); summer (July-September); and fall (October-December). Strandings were also analyzed spatially and temporally, generating a point or kernel density map. The scale for kernel density maps is the same for all maps within a species but differs across species to display where strandings were highest for each species. The kernel density maps included in this document provide a visual display of average occurrence, and when multiple points are in a similar area, the density grid may appear to show presence of stranded animals in enclosed inland waters. With the exception of seals, readers should assume all strandings were initially discovered in open water or on a shoreline. It is also important to note that stranding locations represent location of discovery, not necessarily location of injury or mortality. The number of HI cases is also presented. Because bottlenose dolphin strandings involved a substantial number of HI cases, these data are presented spatially, and the percentage of HI [HI=Yes/(HI=Yes + HI=No)] is calculated by excluding 'Could Not be Determined' cases within and across years.

Lack of stranding and/or survey data does not necessarily mean a species is absent from the state or region. There are several reasons why there may be little or no occurrence data for a species whose published range encompasses Virginia waters, including 1) the species is primarily distributed offshore and thus less likely to be captured in the stranding record (*e.g.* offshore dolphin species); 2) the species occurs in small groups or spends very little time at the surface, making detection less likely during aerial or boat-based surveys (*e.g.* pygmy/dwarf sperm whales [*Kogia* sp.]); 3) the species is transitory and only spends a short amount of time in Virginia waters; 4) the species is relatively rare; and/or 5) the species is exclusively pelagic and occurs in the deep waters off the outer continental shelf (*e.g.* deep-diving species). Additionally, there are a few species that have documented strandings in Virginia waters in extremely low numbers but are not included in this Plan (*e.g.* melon-headed whale [*Peponocephala electra*], pygmy killer whale [*Feresa attenuata*]).

ODONTOCETES (TOOTHED WHALES)

BOTTLENOSE DOLPHINS (TURSIOPS SP.)

DESCRIPTION

There are two morphologically and genetically distinct species within the genus *Tursiops* in US North Atlantic waters: the common bottlenose dolphin (*T. truncatus*) and the Tamanend's bottlenose dolphin (*T. erebennus*) (Hersch and Duffield 1990; Kenney 1990; Costa *et al.* 2022). *T. truncatus* is the larger of the two species and used to be referred to as the offshore ecotype, while *T. erebennus* is smaller and tends to inhabit inshore and nearshore waters. Because the two species are difficult to tell apart and their distribution in Virginia overlaps, they are grouped together as *Tursiops* sp. in this Plan (see bottlenose dolphins).

STATUS

The genus is not considered endangered under the state or federal ESA. Bottlenose dolphins are considered species of Least Concern by the IUCN Red List (Wells *et al.* 2019). Bottlenose dolphins vary dramatically in home ranges, habitat, diet and threats and are, therefore, not managed as a single group. Estimates of population sizes exist for specific regions of the world, and management is typically based on local population estimates and threats. Additionally, the two bottlenose dolphin species are often treated differently in management decisions due to their drastically different PBR values and their status (or lack thereof) as a strategic stock. Bottlenose dolphins are an SGCN in Virginia (DWR 2025) largely because of the high percentages of HI cases documented in the state's stranding record.

There are four recognized bottlenose dolphin stocks in Virginia waters: one offshore stock and three coastal stocks, including both the southern and northern migratory stocks (SCMS and NCMS) and the Northern North Carolina Estuarine System Stock (NNCESS), which is believed to extend into the southernmost waters of Virginia (Hayes *et al.* 2021; Urian *et al.* in prep). Abundance estimates for these four stocks vary, ranging from 823 individuals for the NNCESS to 62,851 individuals for the offshore stock. The NCMS and SCMS are estimated at intermediate densities of 6,639 individuals and 3,751 individuals respectively. Both the NCMS and SCMS are considered depleted. Further, all three coastal stocks are considered strategic stocks and managed via a TRT due to fishery-caused mortalities and serious injuries exceeding 10% of the PBR for each stock. The offshore stock is not considered a strategic stock (Hayes *et al.* 2020; Hayes *et al.* 2021).

OCCURRENCE, DISTRIBUTION, AND ABUNDANCE IN VIRGINIA WATERS

Bottlenose dolphins occur in Virginia's inshore, nearshore, offshore, and pelagic waters throughout the entire year (Figure 1). The offshore stock's range extends outward from the continental shelf and slope and shows greater heterogeneity of genetic markers than coastal stocks (Hoelzel *et al.* 1998; Natoli *et al.* 2004). The offshore stock is relevant due to its presence in Virginia's nearshore and offshore waters and occasional stranding along the Commonwealth's coastline.

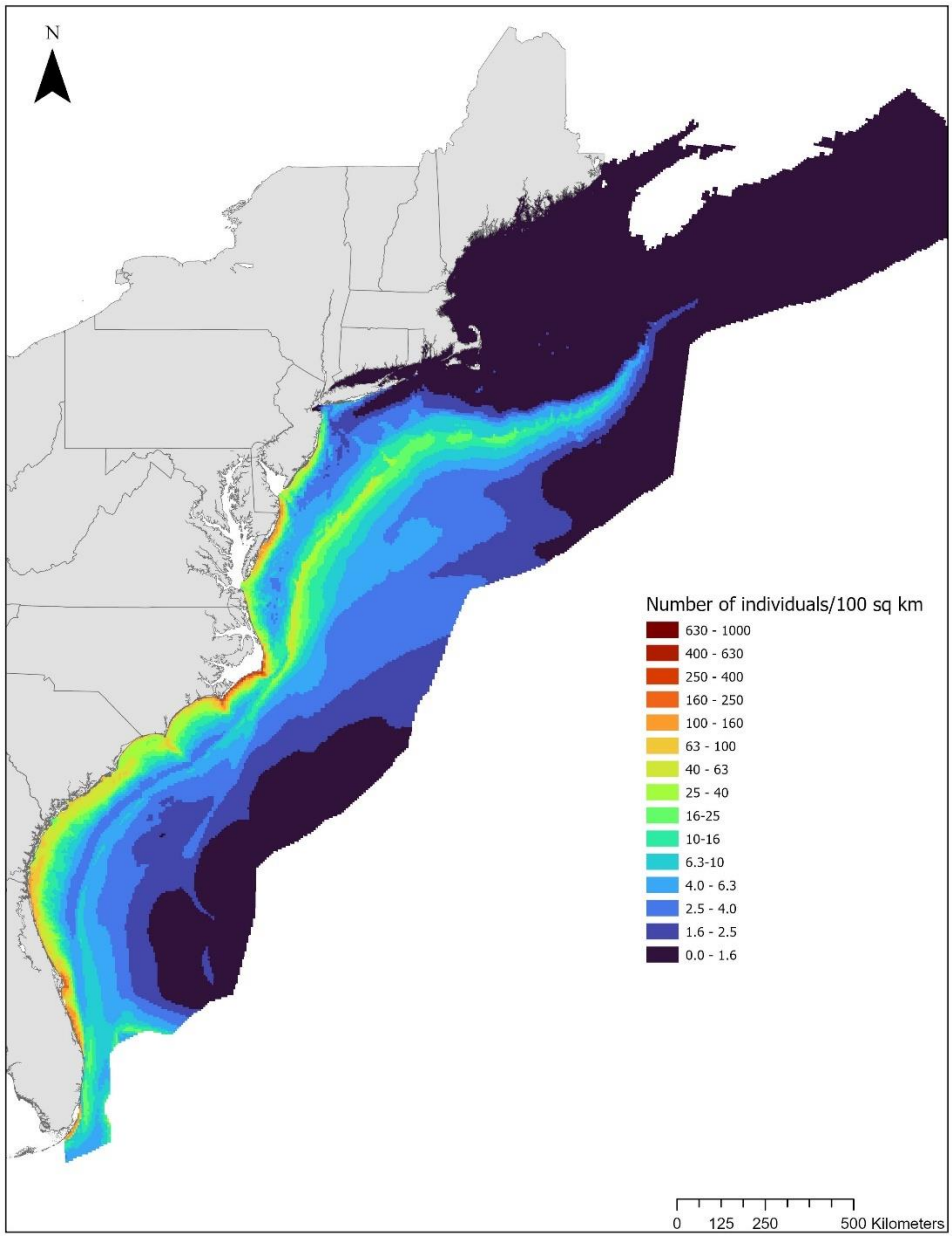


Figure 12. Modeled annual mean bottlenose dolphin density along the US Atlantic coast (Roberts *et al.* 2023).

The coastal stocks primarily inhabit nearshore and offshore waters and vary seasonally in their occupancy of Virginia waters. The NCMS occurs from New Jersey to northern Virginia in the summer, and southern Virginia to southern North Carolina in the winter. The SCMS occurs from southern Virginia to mid North Carolina in summer, and South Carolina to northern Florida in winter. Both coastal migratory stocks are relevant to Virginia conservation efforts due to their seasonal northern and southern coastal migrations through Virginia waters. Photo-identification and satellite telemetry data suggest that the NNCESS also occur in both inshore and nearshore waters along Virginia Beach and in Chesapeake Bay in the warmer months of July and August, though the regularity of their occurrence is unknown (Urian 2016; Garrison *et al.* 2017a; Garrison *et al.* 2017b).

All four bottlenose dolphin stocks in Virginia waters overlap in their ranges, making it difficult to discern which individuals belong to which stock. Although precise ranges have not been defined, Torres *et al.* (2003) found that within 7.5 km of shore, all biopsied dolphins belonged to the coastal species (*T. erebennus*), while all sampled dolphins beyond 34 km from shore or deeper than 34 m were offshore species (*T. truncatus*). Between the two ranges (7.5-34 km), both species occur at undefined frequencies. Based on aerial surveys, Kenney (1990) suggested that coastal bottlenose dolphins north of Cape Hatteras, North Carolina, are restricted to waters shallower than 25 m.

Although bottlenose dolphins are present year-round in Virginia waters, their presence increases dramatically in spring and summer months (Figure 2). Significant dolphin presence in nearshore waters of Virginia typically begins in April or May and appears to be strongly correlated with water temperatures (Barco *et al.* 1999). Consistent *Tursiops* presence commonly extends into September or October, at which point southward migration begins, with dolphin presence significantly reduced by November. Seasonal movement patterns are evident in inshore waters. Vessel-based surveys conducted from 2012 to 2015 revealed that dolphins were present year-round in nearshore waters but did not begin moving inshore until the spring. Peak densities in Chesapeake Bay occurred in the summer (June-August) and fall (September-November), followed by relatively few sightings in the winter (Engelhaupt *et al.* 2016). Bottlenose dolphins are commonly sighted from boat-based and aerial surveys. Sea turtle aerial surveys conducted from May to October in 2011 to 2013 regularly encountered bottlenose dolphins in Virginia's inshore and nearshore waters. Offshore dolphins have been regularly detected year-round along the continental shelf and past the shelf break (McAlarney *et al.* 2016; Mallette *et al.* 2017; McAlarney *et al.* 2017; McAlarney *et al.* 2018; Cotter 2019).

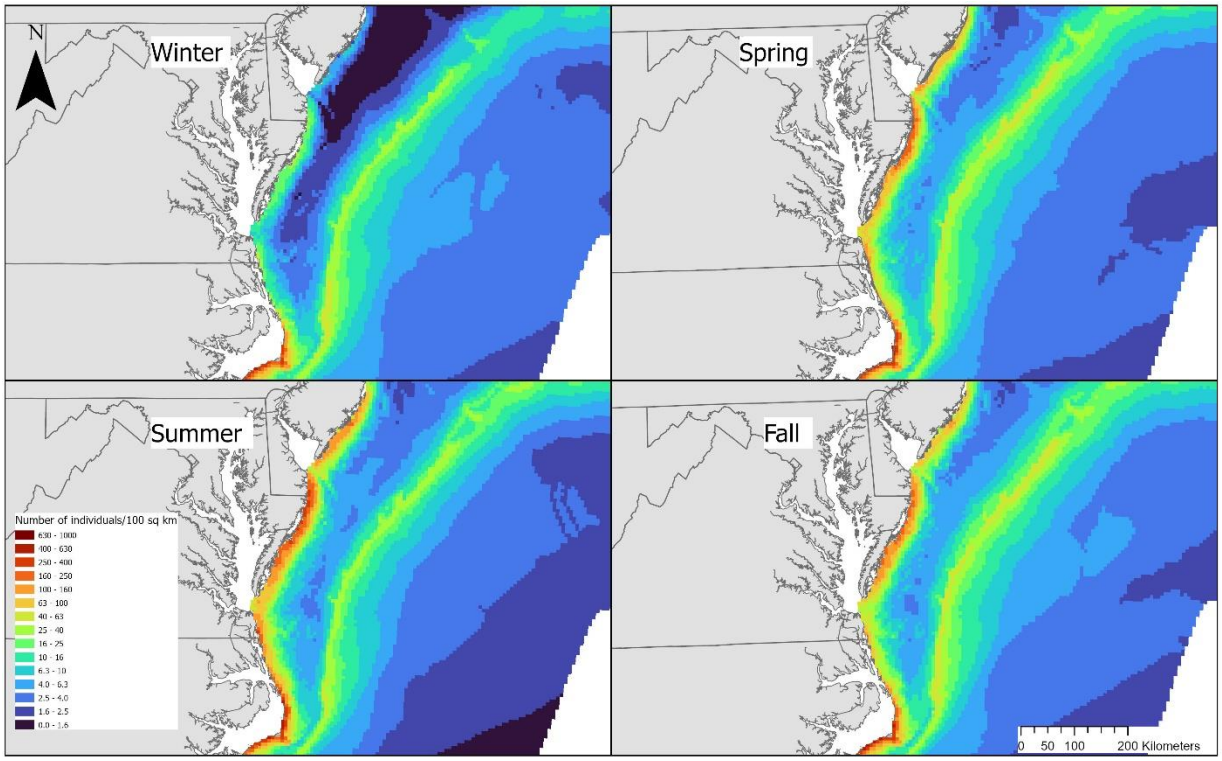


Figure 13. Modeled seasonal mean bottlenose dolphin density along the mid-Atlantic Bight (Roberts *et al.* 2023).

STRANDINGS

The bottlenose dolphin is the most common species in Virginia's marine mammal stranding record, comprising 68% (n = 2,236 strandings) of all reported strandings from 1988 to 2022 (VAQS *unpublished data*, October 2023). An annual average of 64 bottlenose strandings were documented through this period of time. From 2013 to 2015, the Mid-Atlantic Bottlenose Dolphin UME was in effect along most of the US Atlantic coast because of a viral disease outbreak (*i.e.* morbillivirus). The UME peaked in the summer and fall of 2013, and Virginia experienced an almost six-fold increase in strandings that year (n=382; NOAA Fisheries 2023a). The average number of annual strandings showed an increasing trend when summarized in five-year increments, even when the 2013 strandings were excluded from the calculations (Figure 3). Whether this rising trend reflects an actual increase in overall mortality or is the result of more bottlenose dolphins being present in Virginia waters is unknown. Strandings were concentrated along the southern portion of Virginia's ocean-facing coastline and the southern end of Virginia's Eastern Shore (Figure 4).

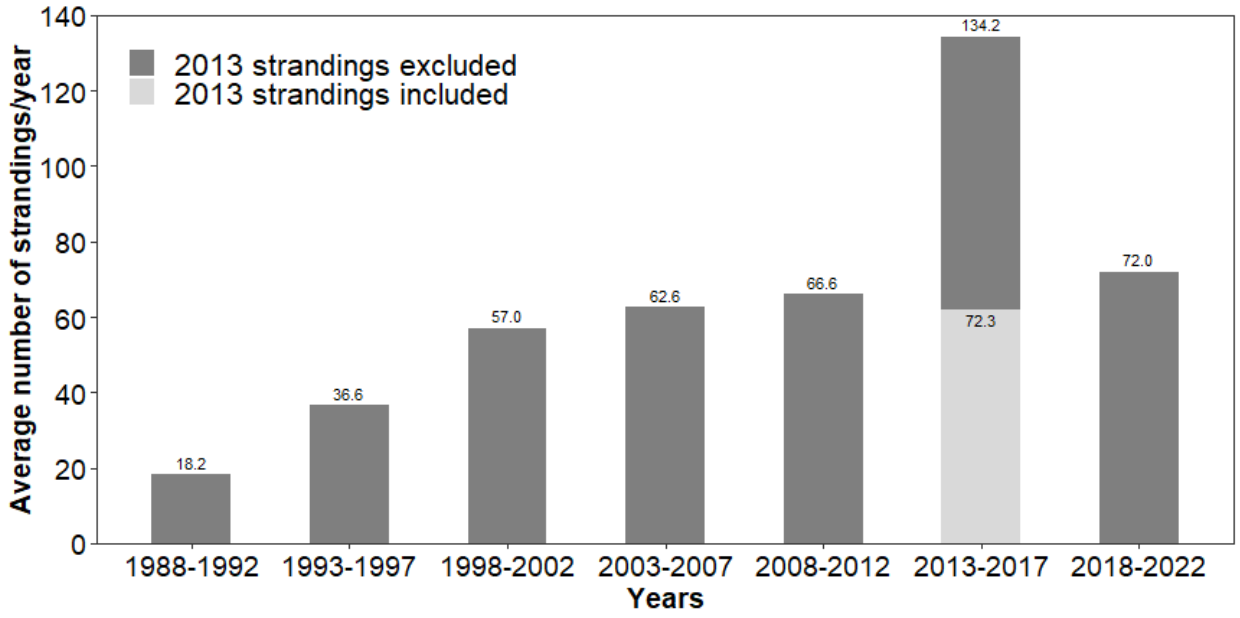


Figure 14. Average number of bottlenose dolphin strandings in Virginia from 1988 to 2022, summarized in five-year increments. The 2013 to 2017 increment encompassed a bottlenose dolphin Unusual Mortality Event (UME) that was in effect from 2013 to 2015, which caused strandings to increase to a level well above average in 2013. To illustrate the impact of the UME on bottlenose dolphin strandings in 2013, two averages were calculated: one that includes the total number of strandings in 2013 and one that excludes it.

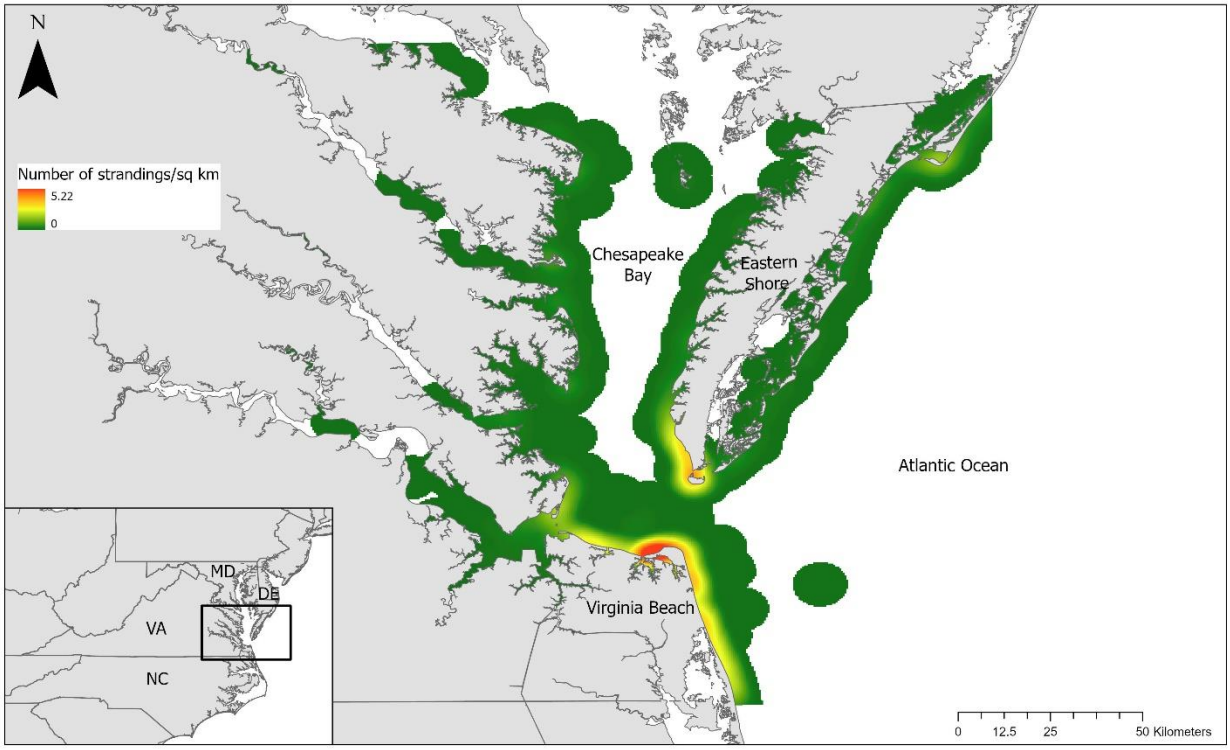


Figure 15. Density map of bottlenose dolphin strandings per square kilometer in Virginia from 1988 to 2022. Offshore points represent carcasses discovered floating offshore.

Seasonally, reported strandings were highest in the summer (43%) and spring (42%), and lowest in the winter (4%; Figure 5). However, when strandings during the 2013 mortality event were excluded, almost half of all strandings occurred in the spring (48%). Seasonal stranding patterns followed boat-based and aerial survey sighting patterns summarized in Barco *et al.* (1999) and Engelhaupt *et al*. (2016), which described dolphins concentrating along the southern oceanfront and the mouth of the Chesapeake Bay in the winter, moving farther into Chesapeake Bay and its tributaries in the spring and summer, and moving out of Chesapeake Bay in the fall (Figure 6).

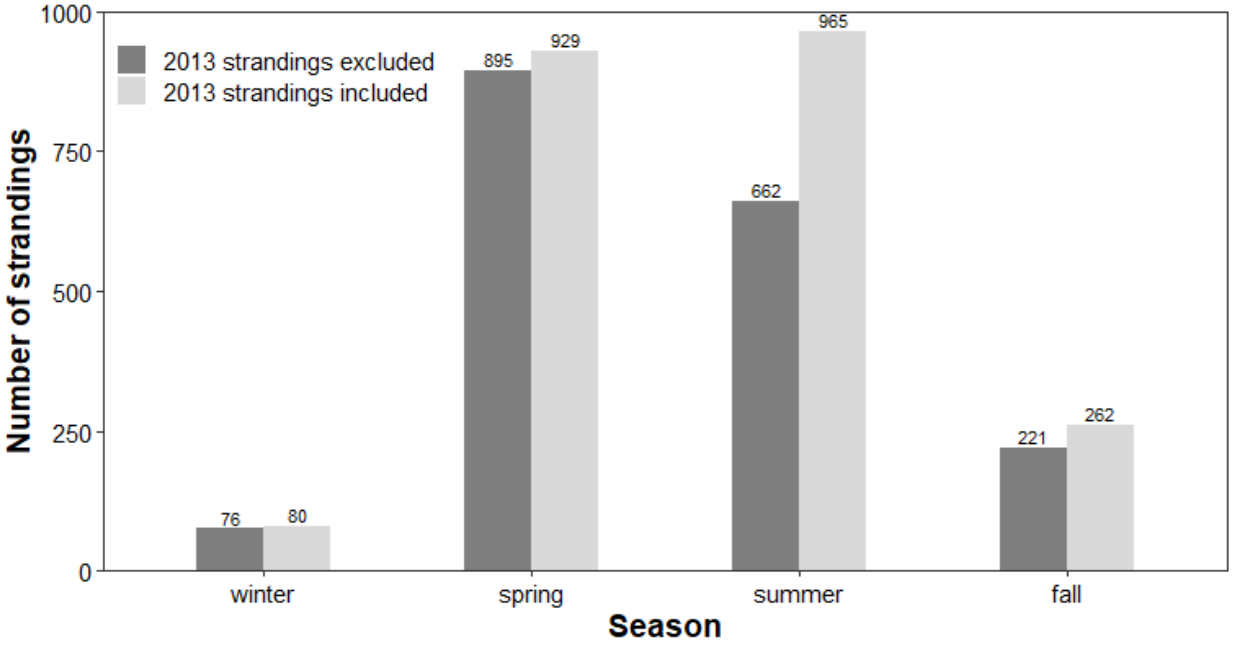


Figure 16. Number of bottlenose dolphin strandings per season in Virginia from 1988 to 2022.

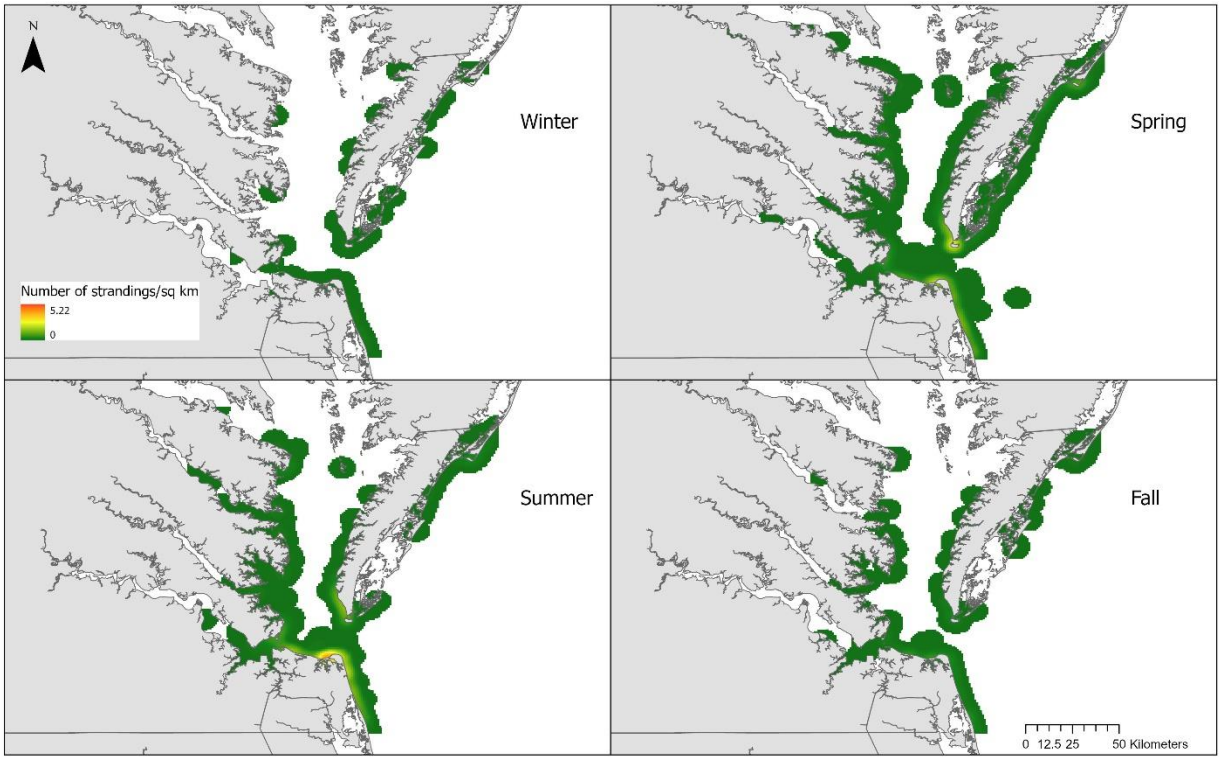


Figure 17. Density map of seasonal bottlenose dolphin strandings per square kilometer in Virginia from 1988 to 2022.

Strandings were highest in the months of May (20%) and August (20%), and lowest in February (0.6%) when including strandings during the 2013 UME (Figure 7). However, monthly stranding patterns varied when excluding strandings from the 2013 UME, peaking in May (24%) and June (18%). Within a calendar year, strandings tend to increase dramatically starting in May and

remain relatively high through October. The May peak appears to be driven by high infant mortality (*e.g.* stillbirth, failure to thrive, infanticide, etc.), as many of the strandings are perinates (near time of birth).

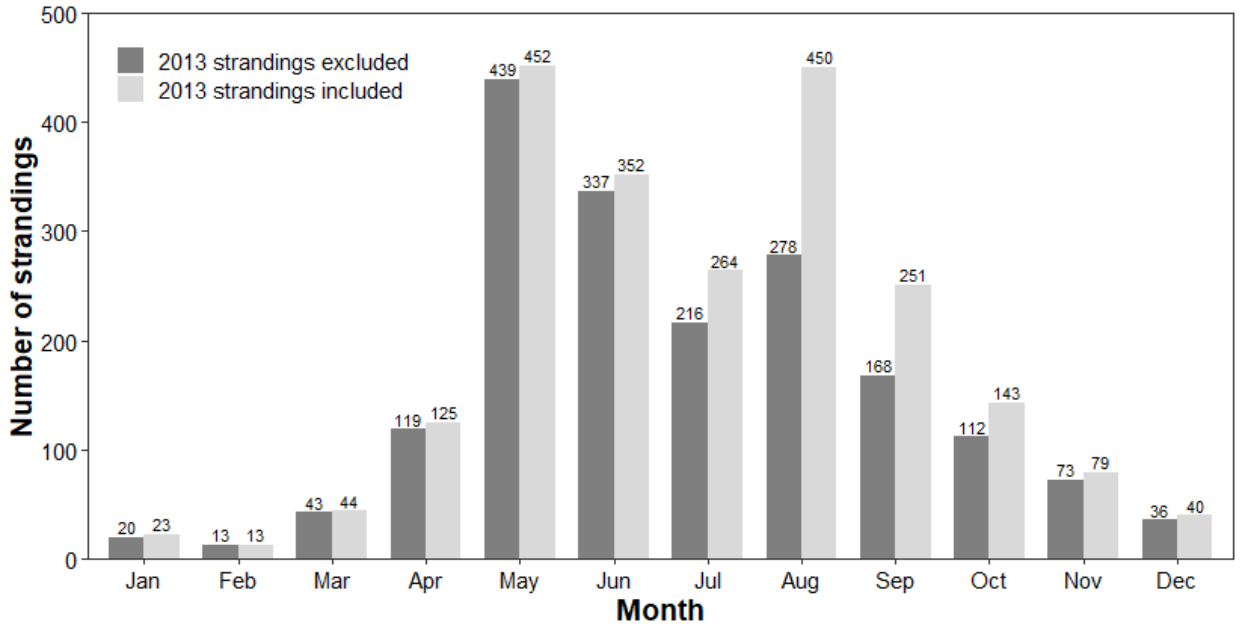


Figure 18. Number of bottlenose dolphin strandings per month in Virginia from 1988 to 2022.

A total of 418 HI cases were detected among strandings that were reported between 1988 and 2022, including numerous fishery interaction cases. For cases in which there was a 'Yes' or 'No' HI designation, the percentage of HI was 60%. The percentage of HI varied annually, ranging from 0% in 1991 to 92% in 2017. Although there was a significant increasing trend in the percentage of HI over time (Spearman rank correlation $S=3648.8$, $p<0.01$; Figure 8), this relationship requires further investigation because data resulting from anecdotal reports where effort was variable may not represent a true statistical trend. The majority of HI cases occurred near Cape Henry and to a lesser extent on the bayside of the Eastern Shore's southern tip (Figure 9).

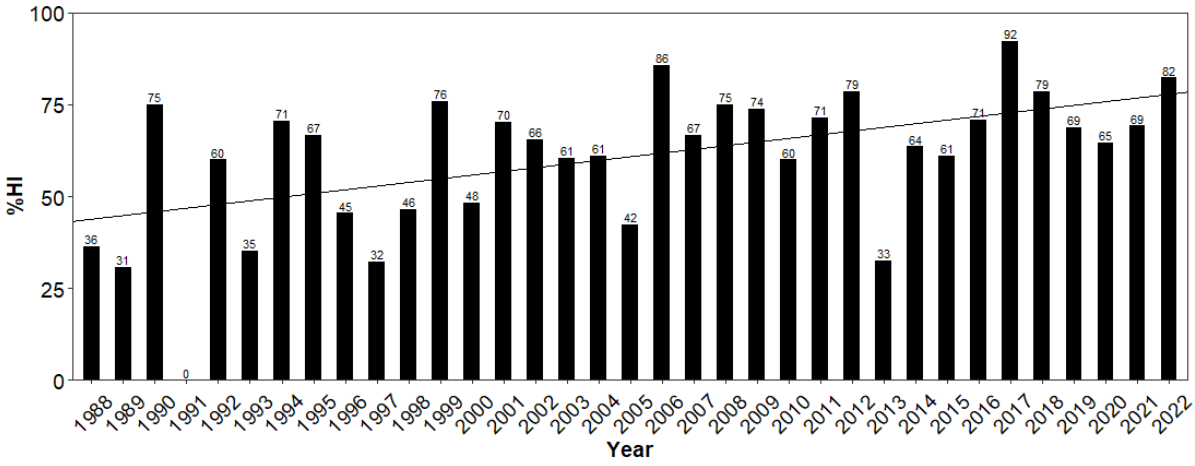


Figure 19. The percentage of human interaction (HI) cases and linear trend documented among stranded bottlenose dolphins in Virginia from 1988 to 2022.

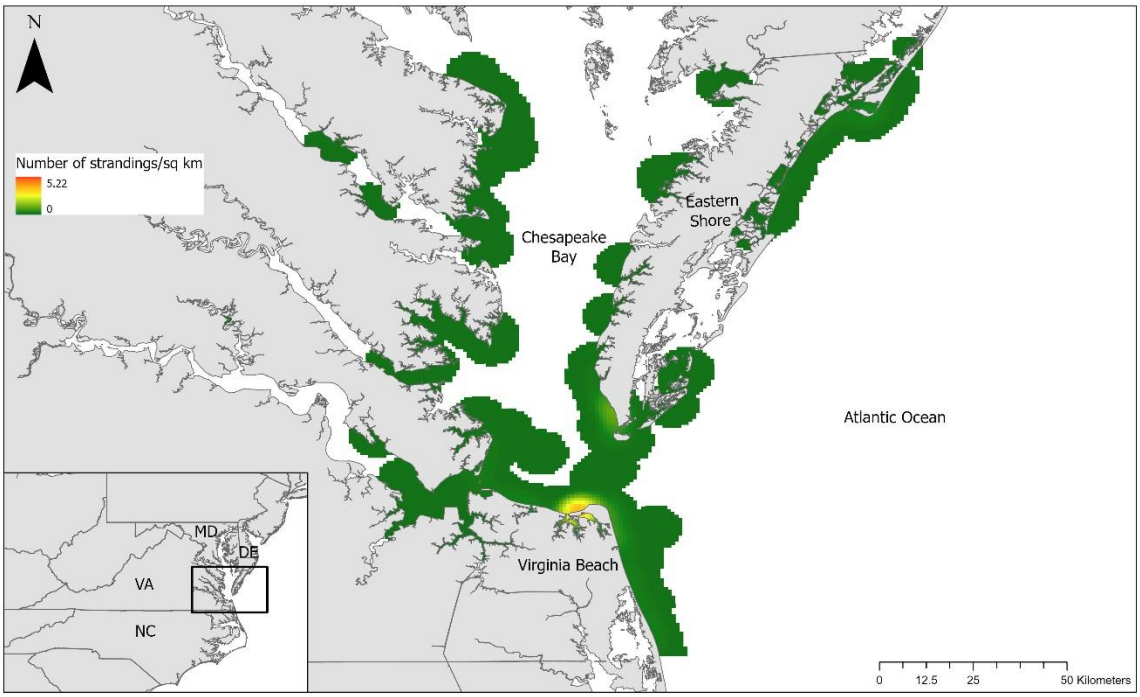


Figure 20. Density map of bottlenose dolphin strandings with evidence of human interaction per square kilometer in Virginia from 1988 to 2022.

DIET AND FORAGING IN VIRGINIA WATERS

Most of what is known about the diet of bottlenose dolphins in Virginia waters is based on stomach content analyses conducted on dead stranded individuals. Volker (2020) analyzed the stomach contents of 200 bottlenose dolphins that stranded between 1998 and 2012. In this analysis, Volker identified 32 prey species from 22 families using hard parts such as otoliths and squid beaks. The family *Sciaenidae* (drums/croakers) dominated the diet, occurring in 93% of dolphin stomachs and accounting for 71% of the diet numerically based on the total number of prey items identified. Other common prey items were in the families Clupeidae, Phycidae,

Engraulidae, Moronidae, and Loliginidae. Atlantic croaker (*Micropogonias undulatus*) was the most important prey species by number, frequency and reconstructed mass, followed by spot (*Leiostomus xanthurus*) and seatrout species (*Cynoscion* spp.). Other, less frequently consumed prey species included the Atlantic menhaden (*Brevoortia tyrannus*), hake (*Urophycis* spp.), anchovy (*Anchoa* spp.), longfin inshore squid (*Doryteuthis pealeii*), silver perch (*Bairdiella chrysoura*), and striped bass (*Morone saxatilis*). While significant differences in the diet did not exist between male and female dolphins, prey size increased with dolphin size. Seasonal diet shifts were also identified numerically, with seatrout spp. (>25%) being the dominant prey species in the spring, and Atlantic croaker (~50%) and spot (22%) being consumed primarily in the summer and fall. Although present in smaller numbers, Atlantic menhaden and striped bass consumption was highest in the spring and hake spp. and anchovy spp. consumption was lowest in the fall (Volker 2020). This study suggested that while many of the aforementioned prey species comprised significant portions of local bottlenose dolphin diet, seatrout, Atlantic croaker, and spot, all of which are commercially important species for Virginia fishers, appeared to be critical prey species at different times of the year. Additionally, the correlation between dolphin size and prey size suggests that robust populations of dolphins in which all age and size classes are well represented depend on prey populations with similar diversity in size classes.

REPRODUCTIVE ACTIVITY IN VIRGINIA WATERS

Reproductive activity is challenging to assess in turbid coastal waters. Although not much is known about *Tursiops* sp. reproductive activity in Virginia waters, a well-known bottlenose dolphin nursery exists along the southern tip of the mouth of the Chesapeake Bay. Mother/calf pairs and groups with numerous perinatal dolphins were seen every year along the Cape Henry-Fort Story coastline, with a peak occurring in July (Barco *et al.* 1999; Engelhaupt *et al.* 2016). These nursing groups tended to preferentially use shallow, low wave energy waters inshore of Cape Henry at the mouth of the Chesapeake Bay.

HARBOR PORPOISE (PHOCOENA PHOCOENA)

Description

The harbor porpoise (*Phocoena phocoena*) is a small, stocky toothed whale with spade-shaped teeth which distinguishes it from delphinids. It is the only member of the porpoise family that is seasonally endemic to the waters of Virginia.

Status

The harbor porpoise is considered a species of Least Concern on the IUCN Red List of Threatened Species (Braulik *et al.* 2023), and it is not listed as threatened or endangered under the state and federal ESA (Hayes *et al.* 2022). They are also not considered an SGCN in Virginia (DWR 2025). There are four proposed populations, or stocks, of harbor porpoises in the western North Atlantic (Gaskin 1984, 1992), and numerous analyses have been conducted which support those population distinctions. While the Gulf of Maine/Bay of Fundy stock is the southernmost one with relevance to Virginia, mitochondrial DNA and microsatellite analyses indicate that the Gulf of Maine/Bay of Fundy population is not the only stock found in the mid-Atlantic in the winter. The Gulf of Maine/Bay of Fundy stock is not considered strategic. The latest population estimate for this stock is 95,543 individuals and a PBR of 851 individuals. Fishery-related

mortality and serious injury from US fisheries is greater than 10% of the PBR and is therefore managed with a TRT (Hayes *et al.* 2022).

Occurrence, Distribution, and Abundance in Virginia Waters

Harbor porpoises are not highly abundant in Virginia waters, and their occurrence is seasonal (Figures 10 and 11). During the summer months, harbor porpoises occur in the northern waters off the Canadian maritime provinces and the US Northeast coast. In winter months, harbor porpoises disperse more widely and can be encountered in waters off Virginia in low densities. Harbor porpoises can be found from shallow nearshore waters to offshore waters with highest densities located over the continental shelf (Westgate *et al.* 1998).

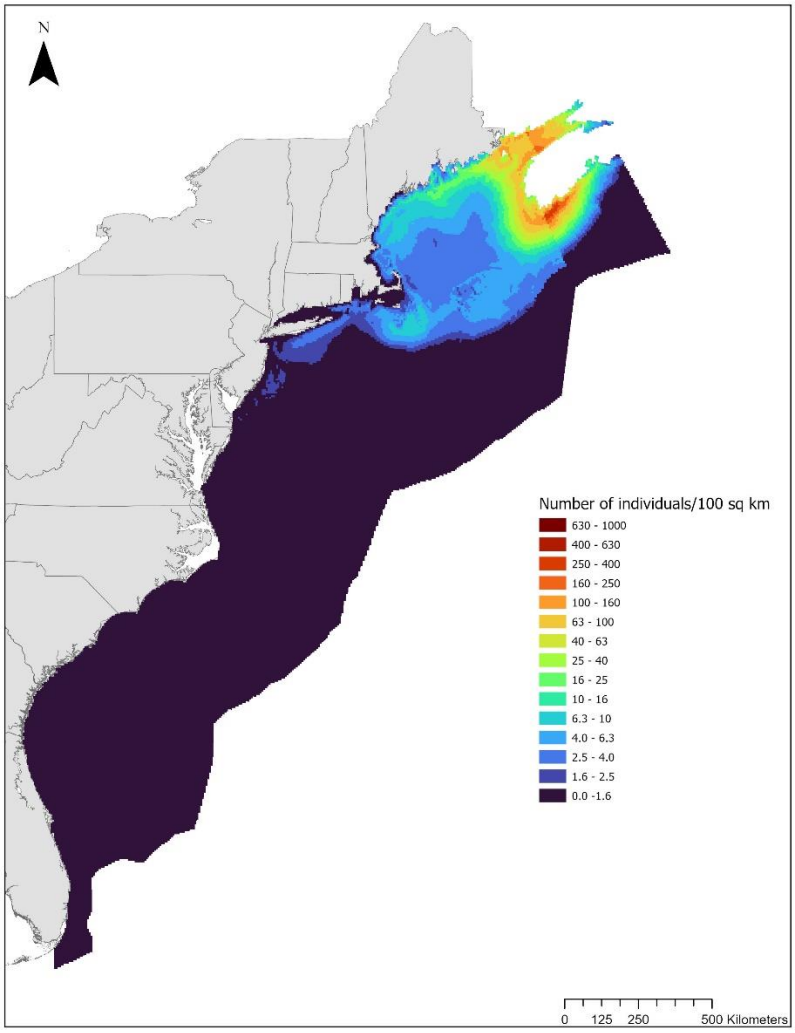


Figure 21. Modeled annual mean harbor porpoise density along the US Atlantic coast (Roberts *et al.* 2023).

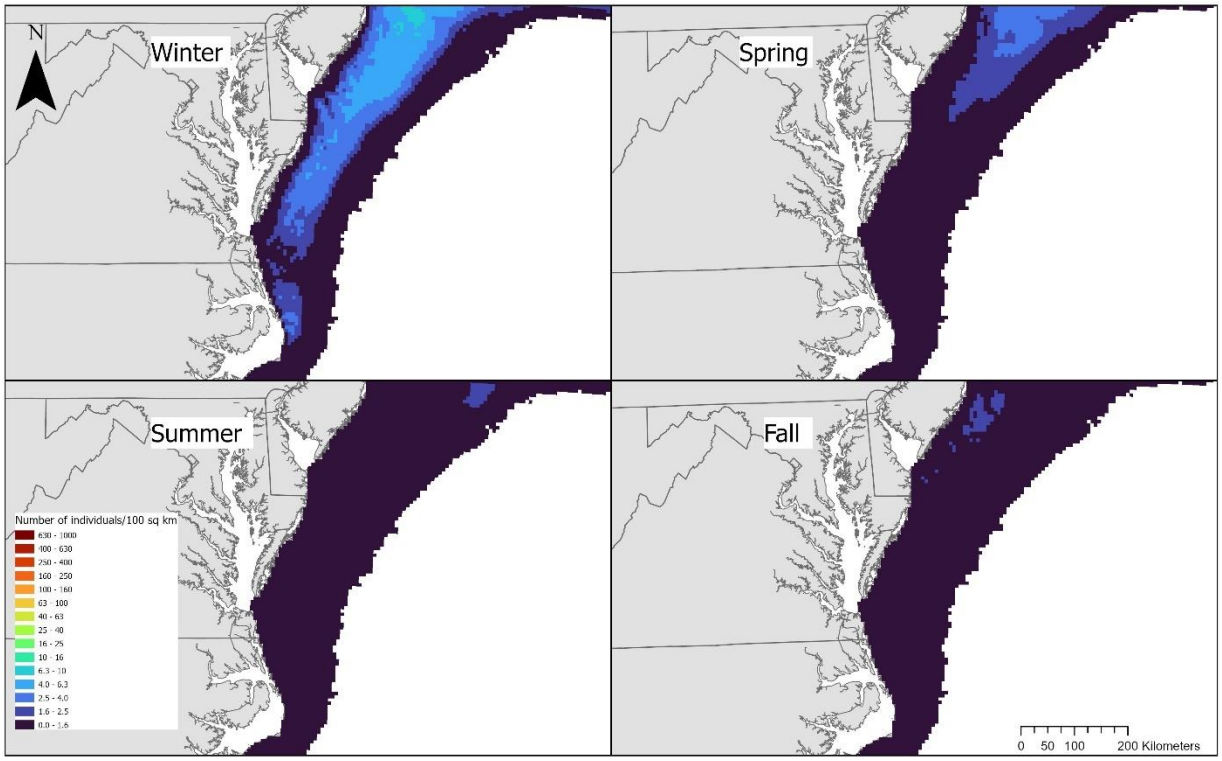


Figure 22. Modeled seasonal mean harbor porpoise density along the mid-Atlantic Bight (Roberts *et al.* 2023).

Harbor porpoise observations in Virginia waters are somewhat rare because this species occurs in small groups and can be cryptic, making them difficult to detect during aerial and boat-based surveys. Winter aerial surveys conducted from 2007 to 2017, during which over 32,706 km were flown over Virginia waters, revealed zero detections of harbor porpoises (VAQS *unpublished data*, October 2023). It is for this reason that most porpoise surveys in the western North Atlantic are conducted using ships as platforms (Hayes *et al.* 2022). Two sightings of harbor porpoise groups occurred in April 2015 from boat-based surveys: one group of two individuals approximately 20 km offshore and one group of four individuals in mid-continental shelf waters (Engelhaupt *et al*. 2016; Engelhaupt *et al.* 2017). Another sighting of one group of two individuals from a boat-based survey occurred in May 2017 in deeper continental shelf waters (Engelhaupt *et al.* 2018). Other methods to detect harbor porpoises include acoustic detections using passive acoustic monitors (PAM). A study conducted off the coast of Maryland detected harbor porpoises primarily in the winter and spring, when waters were cooler and chlorophyll concentrations were high (Wingfield *et al.* 2017), which suggests that harbor porpoises are likely to be present in Virginia waters during the same timeframe and under similar conditions

Strandings

The harbor porpoise is the second most common marine mammal to strand in Virginia after the bottlenose dolphin. Harbor porpoises comprised 10% (n = 340) of the marine mammal strandings reported from 1988 to 2022. The number of annual strandings was highly variable, ranging from zero to 46 with an average of 9.7 strandings per year. Stranding averages have been decreasing over time (Figure 12), and this decrease is likely related to both the decline of the spiny dogfish fishery, which saw an increase in the number of fishers in the early to mid-1990s then later collapsed in the early to mid-2000s, and increasing winter water temperatures

potentially shifting the distribution northward. The harbor porpoise TRT identified the spiny dogfish fishery as the primary contributor to mid-Atlantic fishery interactions, along with the monkfish fishery which, as of 2024, was prosecuted north of Virginia (North Carolina Division of Marine Fisheries, *personal communication*, December 13, 2024). Strandings were concentrated on the ocean-facing beaches of Virginia Beach but were also encountered on the Eastern Shore's barrier islands (Figure 13).

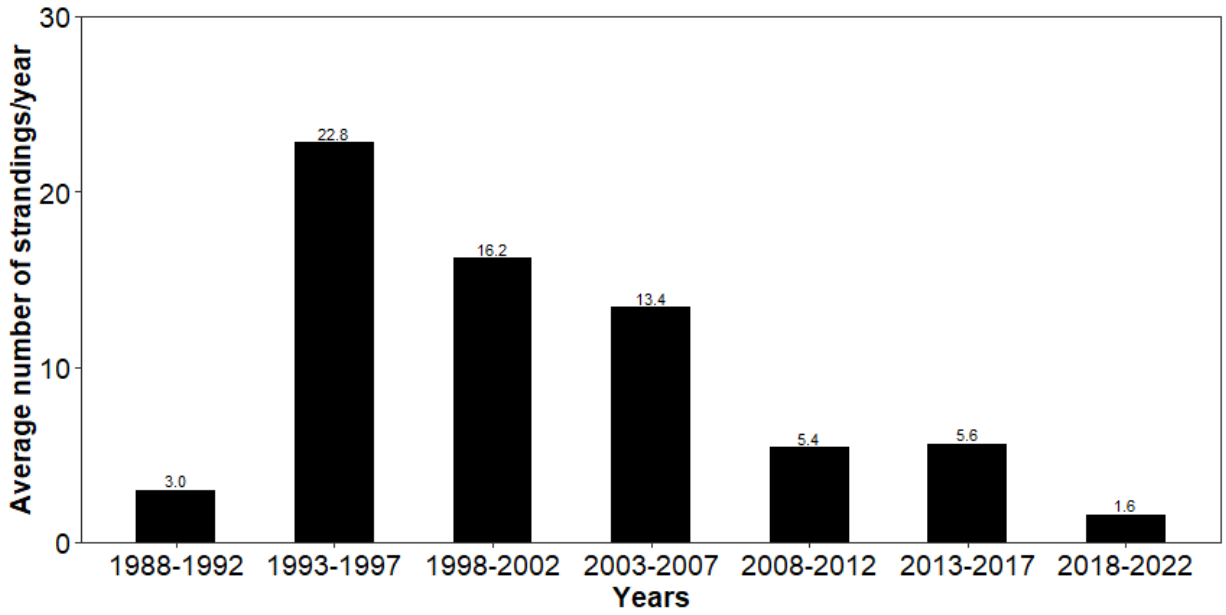


Figure 23. Average number of harbor porpoise strandings in Virginia from 1988 to 2022, summarized in five-year increments.

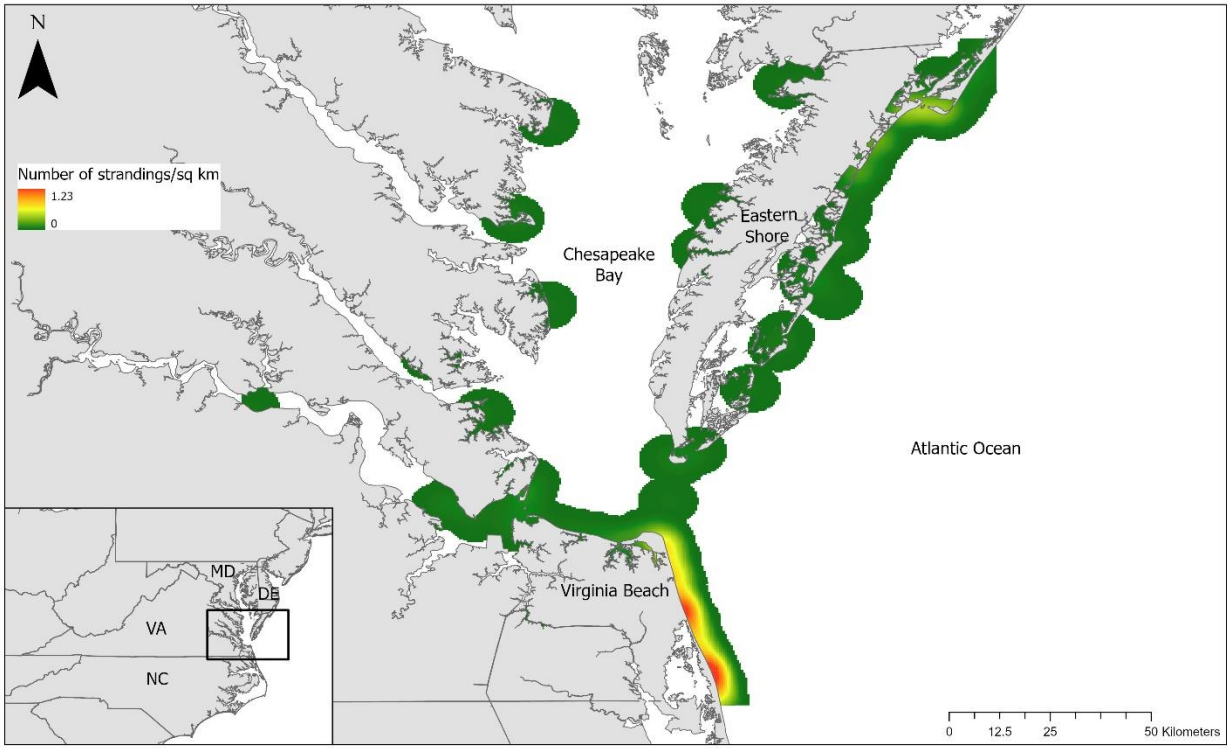


Figure 24. Density map of harbor porpoise strandings per square kilometer in Virginia from 1988 to 2022.

Harbor porpoise strandings were highly seasonal, with 61% occurring in the spring and 39% occurring in the winter (Figure 14). Strandings in the winter and spring were concentrated along the oceanfront of Virginia Beach. A few additional strandings were detected in the Chesapeake Bay in the spring (Figure 15). Ninety-eight percent (n = 332) of all harbor porpoise strandings were reported between February and May and peaked in April (43%) and March (31%; Figure 16). A total of 91 HI cases were documented, primarily consisting of fishery interactions.

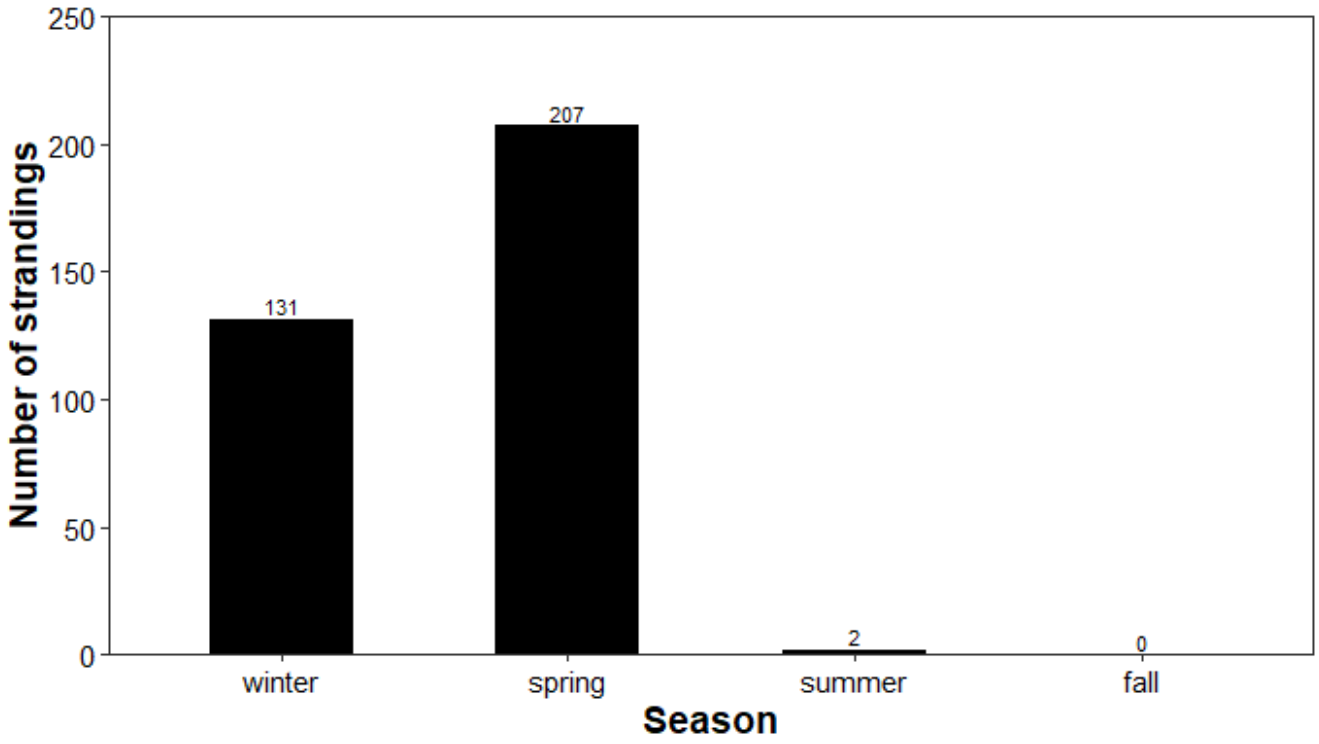


Figure 25. Number of harbor porpoise strandings per season in Virginia from 1988 to 2022.

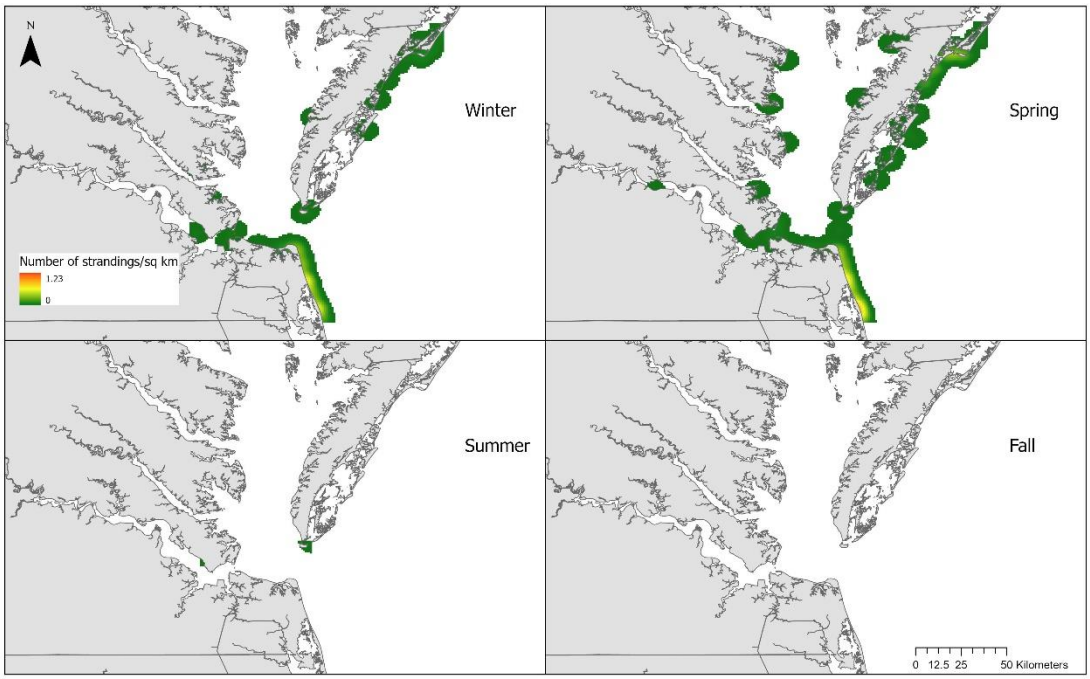


Figure 26. Density map of seasonal harbor porpoise strandings per square kilometer in Virginia from 1988 to 2022.

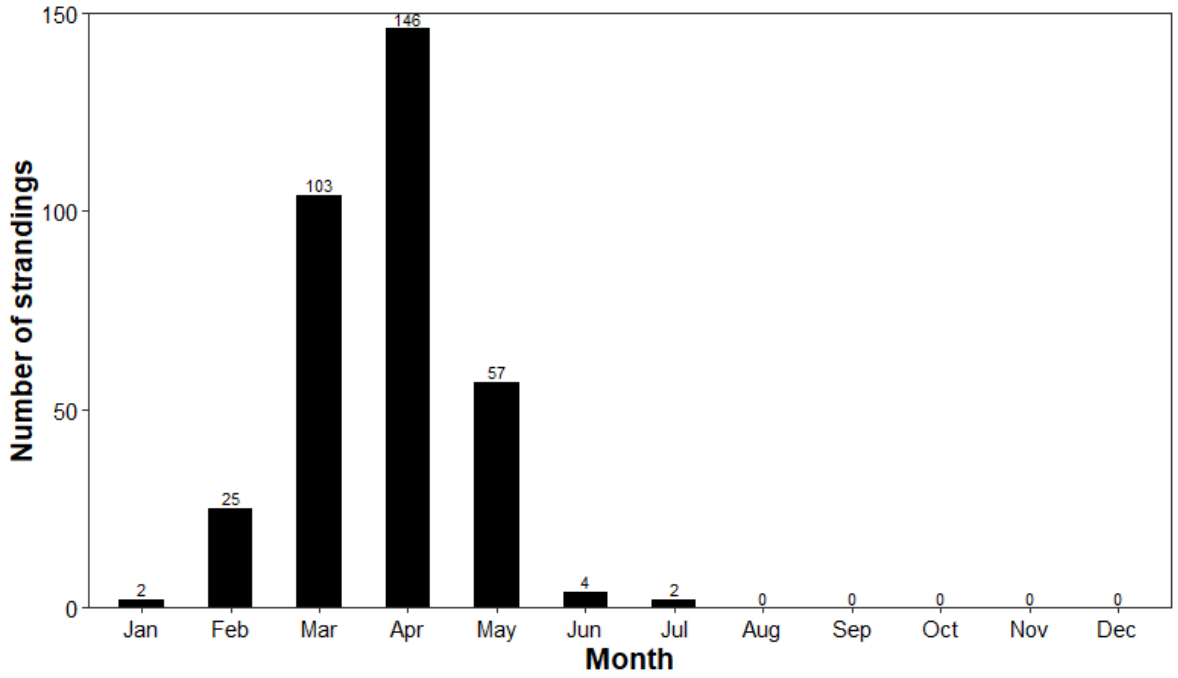


Figure 27. Number of harbor porpoise strandings per month in Virginia from 1988 to 2022.

Diet and Foraging in Virginia Waters

In a study conducted in 2013, the stomach contents of 37 harbor porpoises that stranded on the northern Outer Banks of North Carolina (n=3) and in Virginia (n=34) between 1997 and 2010 were examined. The study identified bay anchovy (*Anchoa mitchilli*) and spotted hake (*Urophycis regia*) as the most important prey. Atlantic herring (*Clupea harengus*), Atlantic menhaden, longfin squid, and shrimp (Penaeid family) were also common in the diet (Schoettle 2013).

Reproductive Activity in Virginia Waters

There have not been any reports of reproductive activity in Virginia waters.

Short-Beaked Common Dolphin (Delphinus delphis delphis)

Description

Short-beaked common dolphins (*Delphinus delphis delphis*) are relatively sleek in profile and have a fairly long and slender beak, a tall, pointed dorsal fin, and a white and cream colored "hourglass" pattern on its sides.

Status

Common dolphins (*Delphinus delphis*), as a whole, are categorized as a species of Least Concern on the IUCN Red List of Threatened Species (Braulik *et al.* 2021), and they are not listed as threatened or endangered under the state and federal ESA (DWR 2025). Further, they are not considered an SGCN in Virginia (DWR 2025). The western North Atlantic stock is not

considered a strategic stock under the MMPA. There are an estimated 172,947 short-beaked common dolphins off the Atlantic coast of North America (Hayes *et al.* 2020).

Occurrence, Distribution, and Abundance in Virginia Waters

Short-beaked common dolphins are an oceanic species that occur in temperate and subtropical waters of the Pacific and Atlantic oceans. In the mid-Atlantic region, they are primarily found in offshore and pelagic waters (Figure 17). The occurrence of common dolphins in Virginia waters is not well understood; however, inshore waters, including the Chesapeake Bay, are not considered normal habitat for this species.

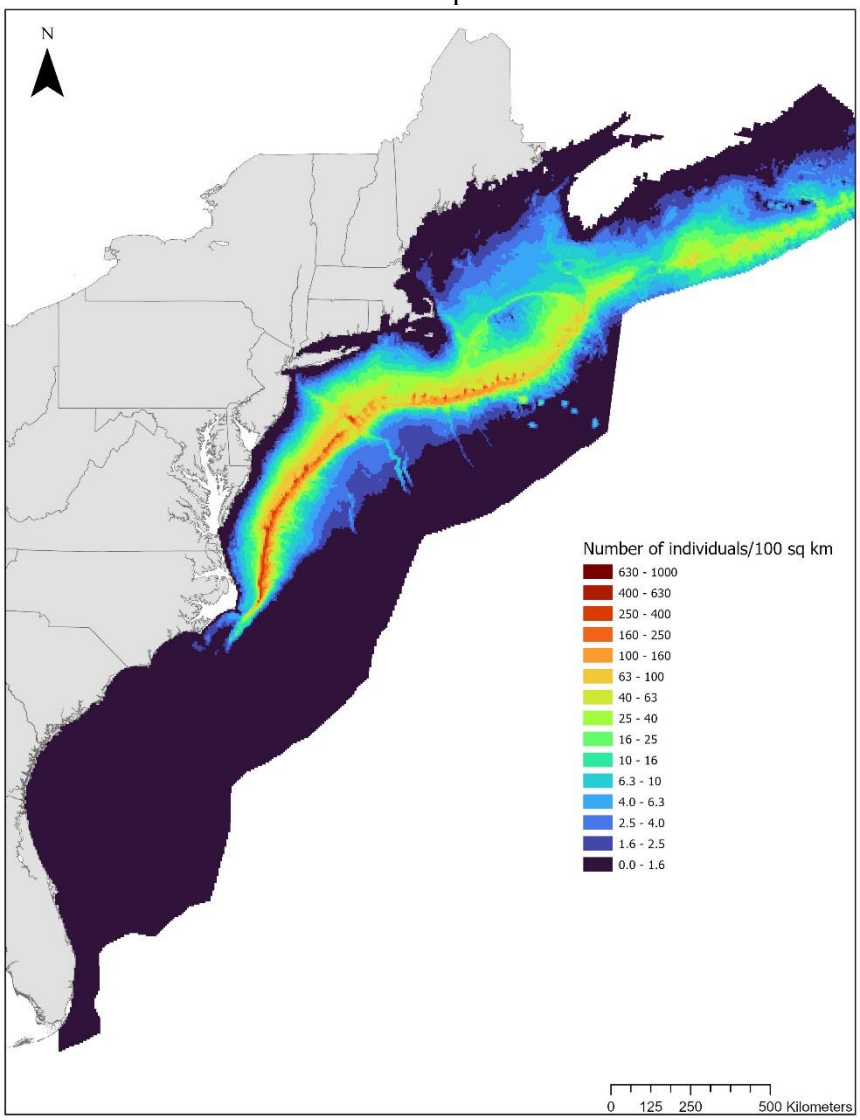


Figure 28. Modeled annual mean short-beaked common dolphin density along the US Atlantic coast (Roberts *et al.* 2023).

Intensive aerial sea turtle abundance surveys conducted from May to October in 2011 and 2012 revealed zero detections of short-beaked common dolphins in Virginia's inshore, nearshore, and offshore waters (Barco *et al.* 2015). However, during marine mammal and protected marine species aerial surveys conducted in Virginia waters between 2015 and 2019 that covered the entire continental shelf, short-beaked common dolphins were detected in groups consisting of

thousands of individuals year-round, with peak sightings occurring in the winter and spring (Mallette *et al.* 2017). The majority of the sightings occurred in offshore and pelagic waters (McAlarney *et al.* 2016; Mallette *et al.* 2017; McAlarney *et al.* 2017; McAlarney *et al.* 2018; Cotter 2019). Only one small group was detected landward of the 50 m isobath during a boat-based survey in the winter (Engelhaupt *et al.* 2016).

STRANDINGS

A total of 144 short-beaked common dolphins strandings were reported in Virginia from 1988 to 2022. Only one stranding was documented between 1988 and 1997, while the rest occurred after 1997 at an average rate of 5.7 strandings per year (range 0-20). When summarized in five-year increments, the average number of strandings peaked between 2008 and 2012 (Figure 18). This species is known to strand in large groups, and six mass stranding events have occurred in Virginia waters. Strandings have been concentrated on the barrier islands, particularly on Assateague and Fisherman Islands, and along the bayside portion of the Eastern Shore and on the Virginia Beach oceanfront (Figure 19).

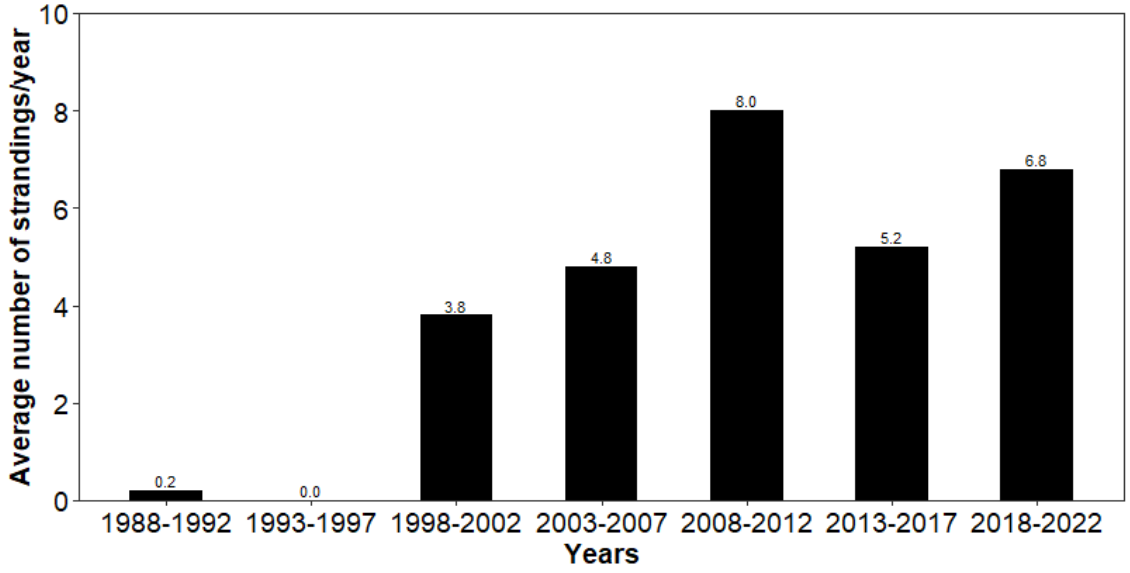


Figure 29. Average number of short-beaked common dolphin strandings in Virginia from 1988 to 2022, summarized in five-year increments.

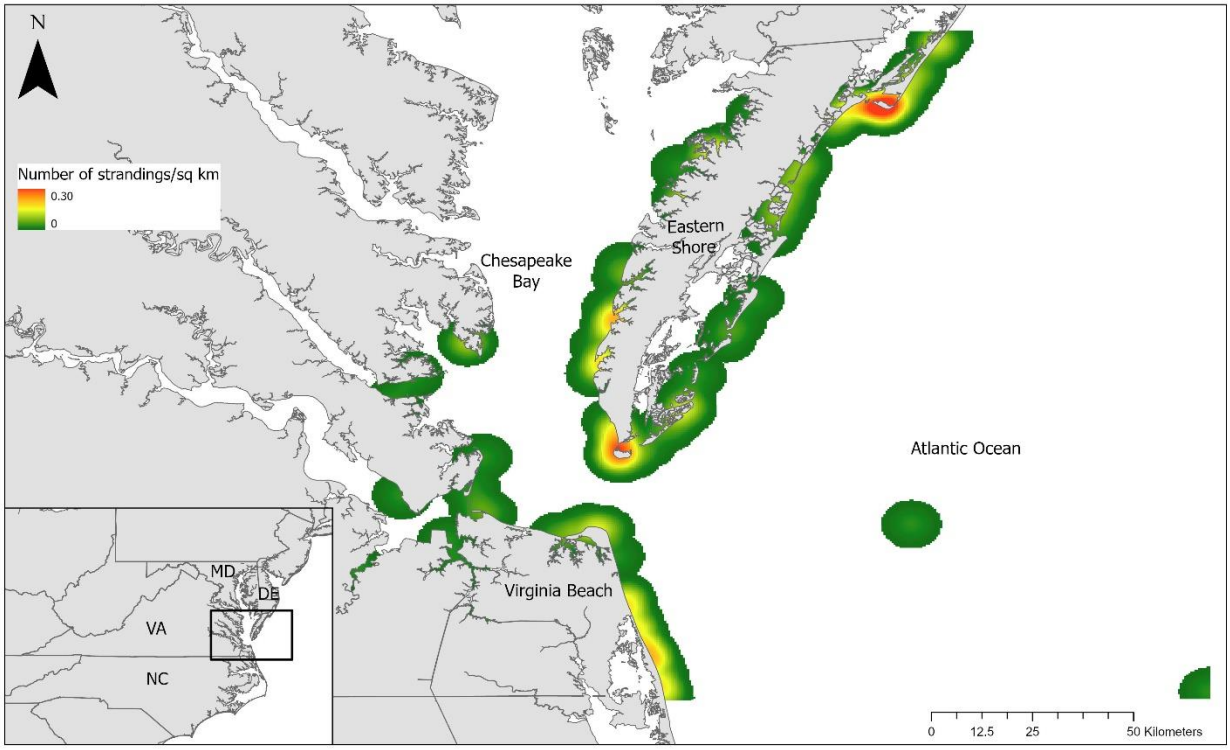


Figure 30. Density map of short-beaked common dolphin strandings per square kilometer in Virginia from 1988 to 2022. There were six mass stranding events documented in Virginia during this period of time, involving between two and 18 dolphins, and each individual's stranding location is depicted in the map. Offshore points represent carcasses discovered floating offshore.

Strandings were highest in the winter (53%, n=76), followed by the spring (33%, n=48; Figure 20). Strandings occurred year-round along oceanfront beaches and the mouth and southern portions of the Chesapeake Bay, with several occurrences further north in the Bay during winter and spring (Figure 21). Most strandings occurred in March (40%, n=57) and April (21%, n=30; (Figure 22). Interestingly, September is the only month in which no short-beaked common dolphin strandings were reported or observed alive during aerial or boat-based surveys (Engelhaupt *et al.* 2016; McAlarney *et al.* 2016; Mallette *et al.* 2017; McAlarney *et al.* 2017; McAlarney *et al.* 2018; Cotter 2019). Twelve short-beaked common dolphins have stranded with evidence of HI, including fishery interactions such as healed longline hook scars and marks consistent with monofilament net interaction (VAQS *unpublished data*, October 2023).

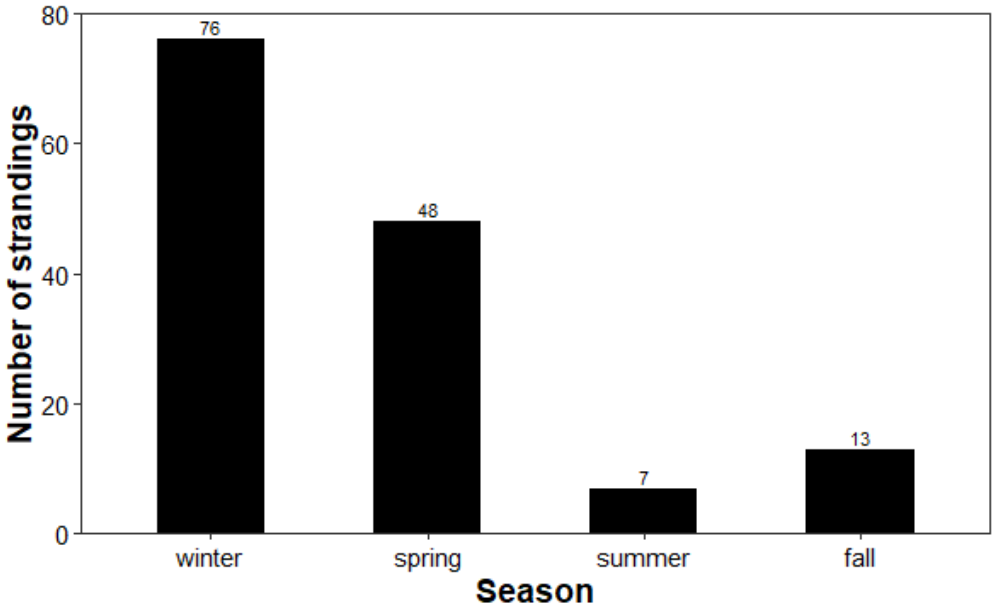


Figure 31. Number of short-beaked common dolphin strandings per season in Virginia from 1988 to 2022.

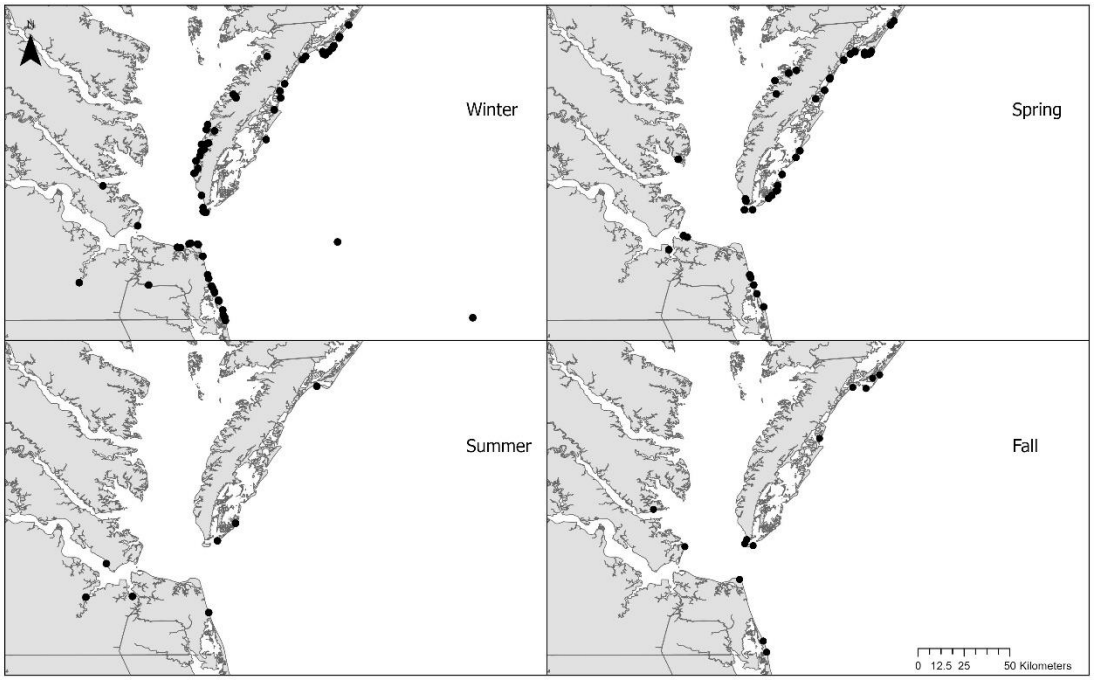


Figure 32. Map of seasonal short-beaked common dolphin stranding locations in Virginia from 1988 to 2022.

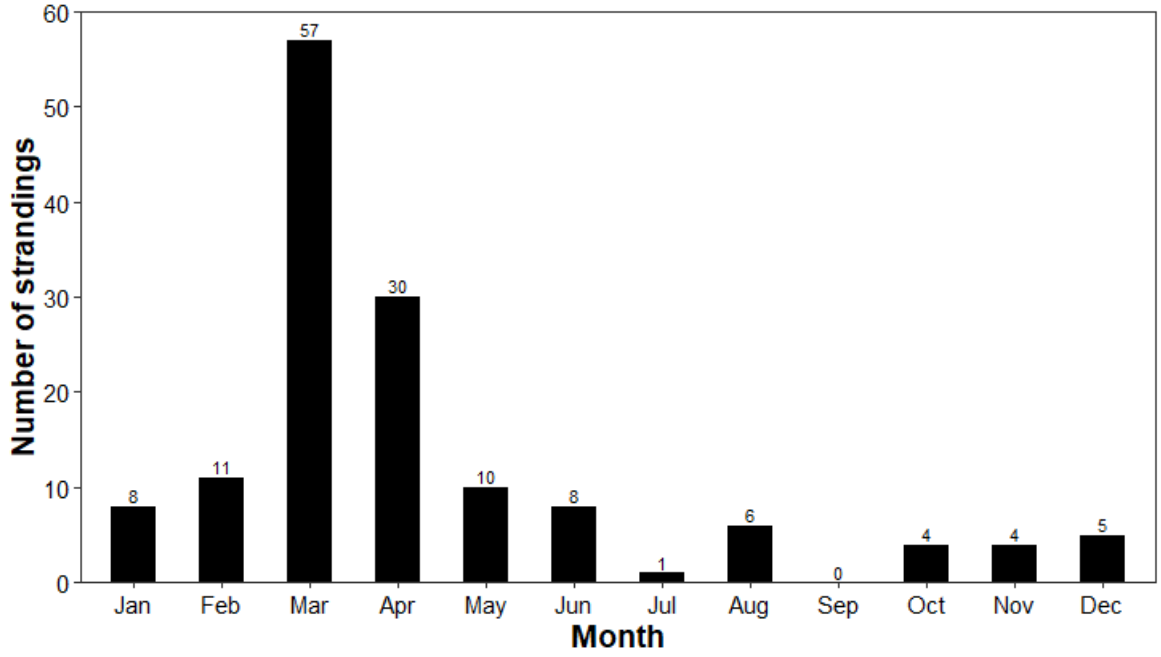


Figure 33. Number of short-beaked common dolphin strandings per month in Virginia from 1988 to 2022.

Diet and Foraging in Virginia Waters

Short-beaked common dolphins in the Northwest Atlantic consume fish and cephalopods, such as Atlantic mackerel (*Scomber scombrus*), hake, and longfin squid (Overholtz and Waring 1991).

Reproductive Activity in Virginia Waters

There is no known reproductive season in Virginia waters; however, strandings of pregnant and young-of-the-year dolphins have been reported in the Commonwealth in January and March. It is possible there is a calving season in Virginia waters, but this information has not been verified.

Other Delphinids

Other delphinids are present in Virginia waters based on stranding records, including Atlantic spotted dolphins (*Stenella frontalis*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), striped dolphins (*Stenella coeruleoalba*), short-finned pilot whales (*Globicephala macrorhynchus*), long-finned pilot whales (*Globicephala melas melas*), rough-toothed dolphins (*Steno bredanensis*), and Risso's dolphins (*Grampus griseus*). The IUCN Red List of Threatened Species considers each species of Least Concern (Braulik and Jefferson 2018; Kiszka and Braulik 2018; Minton *et al.* 2018a; Minton *et al.* 2018b; Braulik 2019a; Braulik 2019b; Kiszka *et al*. 2019). None of these species are state or federally listed, considered a strategic stock, or an SGCN (Hayes *et al.* 2019; Hayes *et al.* 2020; Hayes *et al.* 2022; DWR 2025). However, fishery-related mortality and serious injury exceeds 10% of the stock's PBR for short-finned pilot whales and Risso's dolphins (Hayes *et al.* 2019; Hayes *et al.* 2022), which has triggered the formation of a TRT for these species primarily addressing longline fishery bycatch.

Atlantic white-sided dolphins and rough-toothed dolphins have not been detected in Virginia waters during aerial and boat-based surveys, as Virginia represents the southernmost and

northernmost portions of their ranges, respectively (Hayes *et al*. 2019; Hayes *et al.* 2022). The remaining species are seen along the outer edge of the continental shelf during aerial and boat-based surveys but primarily occur in pelagic waters (McAlarney *et al.* 2016; Mallette *et al.* 2017; McAlarney *et al.* 2017; McAlarney *et al.* 2018; Cotter 2019; Engelhaupt *et al.* 2024). These species strand relatively infrequently in Virginia. From 1988 to 2022, stranding frequency for these delphinids ranged from four striped dolphins to 23 Risso's dolphin. Except for Atlantic spotted and Atlantic white-sided dolphins, all of these species have mass stranded in Virginia, in groups ranging from two to 14 individuals.

Other Toothed Whales (Physeteriids, Kogiids and Ziphiids)

Virginia's stranding records from 1988 to 2022 indicate that other toothed whales are present in Virginia waters including sperm whales (*Physeter macrocephalus*), pygmy sperm whales (*Kogia breviceps*), dwarf sperm whales (*Kogia sima*), and *Mesoplodon* sp. (Blainville's, Gervais', Sowerby's, and True's Beaked Whales). *Kogia* sp. and *Mesoplodon* sp. are listed as Least Concern on the IUCN Red List and are not state or federally listed, an SGCN, or a strategic stock (Hayes *et al.* 2020; Kiszka and Braulik 2020a; Kiszka and Braulik 2020b; Pitman and Brownell Jr. 2020a; Pitman and Brownell Jr. 2020b; Pitman and Brownell Jr. 2020c; Pitman et al. 2022; DWR 2025). Sperm whales, however, are listed as Vulnerable on the IUCN Red List, endangered under the state and federal ESA, and depleted under the MMPA (Taylor *et al.* 2019; DWR 2025). Therefore, they are considered a strategic stock due to their endangered status (Hayes *et al.* 2020) but are not considered an SGCN in Virginia (DWR 2025).

Collectively, these species are pelagic species only observed past the continental shelf break. Sperm whale sightings from aerial surveys were regular and occurred year-round, while *Kogia* sp. and beaked whales (*Mesoplodon* sp.) are cryptic, deep-diving species that yield infrequent detections during aerial surveys (McAlarney *et al.* 2016; McAlarney *et al.* 2017; McAlarney *et al.* 2018; Cotter 2019). Strandings of these species are relatively few and have consisted of two sperm whales, 43 *Kogia* sp. (14 dwarf sperm whale, 27 pygmy sperm whales, and two *Kogia* sp.), and 11 beaked whales (six Gervais' beaked whales, two Sowerby's beaked whales, two True's beaked whales, and one Blainville's beaked whale) between 1988 and 2022. Although not observed in Virginia's stranding record or highly detectable during aerial and boat-based surveys, the goose-beaked whale (*Ziphius cavirostris*) is regularly present in pelagic waters from Cape Hatteras, North Carolina, to the Norfolk Canyon off Virginia, based on tagging and acoustic surveys (McLellan *et al.* 2018; Shearer *et al*. 2019; Boisseau *et al.* 2023).

Mysticetes (Baleen whales)

North Atlantic Right Whale (Eubalaena glacialis)

Description

North Atlantic right whales (*Eubalaena glacialis*) are distinguished from other baleen whales by their black bodies, head callosities, lack of a dorsal fin, and a distinctive, bushy, V-shaped blow.

Status

North Atlantic right whales are considered Critically Endangered under the IUCN Red List of Threatened Species (Cooke 2020). Further, this species is listed as endangered under the state and federal ESA and is an SGCN in Virginia (DWR 2025). The exact number of North Atlantic right whales in the western Atlantic stock is not known; however, the most recent published population estimate (November 2020) was 338 individuals, with a minimum estimate of 332 individuals (Pace *et al.* 2017; Pace 2021). The North Atlantic Right Whale Consortium (NARWC) produces a NARWC annual report card and the 2023 population estimate for 2022 was 356 (+7/-10) individuals (Pettis and Hamilton 2024). The species has been declining since 2011, with a 24% decline observed between 2011 and 2020. Because of its endangered status and high rates of human-caused (*e.g.* vessel strikes and fishery entanglements) mortality and serious injury, the North Atlantic right whale population is considered a strategic stock with a PBR of 0.7 individuals and is managed under the Atlantic large whale TRT (Hayes *et al.* 2023).

There is an ongoing North Atlantic Right Whale UME that was declared by NOAA Fisheries in June 2017. The cause of this UME has been attributed to human activities, particularly vessel strikes and rope entanglements. As of November 2024, 148 right whales were part of this event that included 41 deaths, 37 serious injuries, and 70 individuals with sublethal injuries or illness (NOAA Fisheries 2024a).

Occurrence, Distribution, and Abundance in Virginia Waters

The North Atlantic right whale range extends from its winter calving grounds off the northeast Florida/southeast Georgia coast to its summer feeding grounds between New England and Newfoundland (Figure 23). Gowan and Ortega-Ortiz (2014) suggested that one of the primary drivers of winter right whale calving habitat in the southeastern US is sea surface temperature, suggesting that current and projected ocean temperature increases may push calving northward from the traditional calving grounds. Winter surveys have demonstrated neonate calf presence as far north as Cape Fear, North Carolina. Due to their migration through Virginia waters, the mouth of the Chesapeake Bay has a seasonal management area (SMA) from November 1 to April 30, mandating reduced ship speeds out to approximately 20 nm (73 FR 60173).

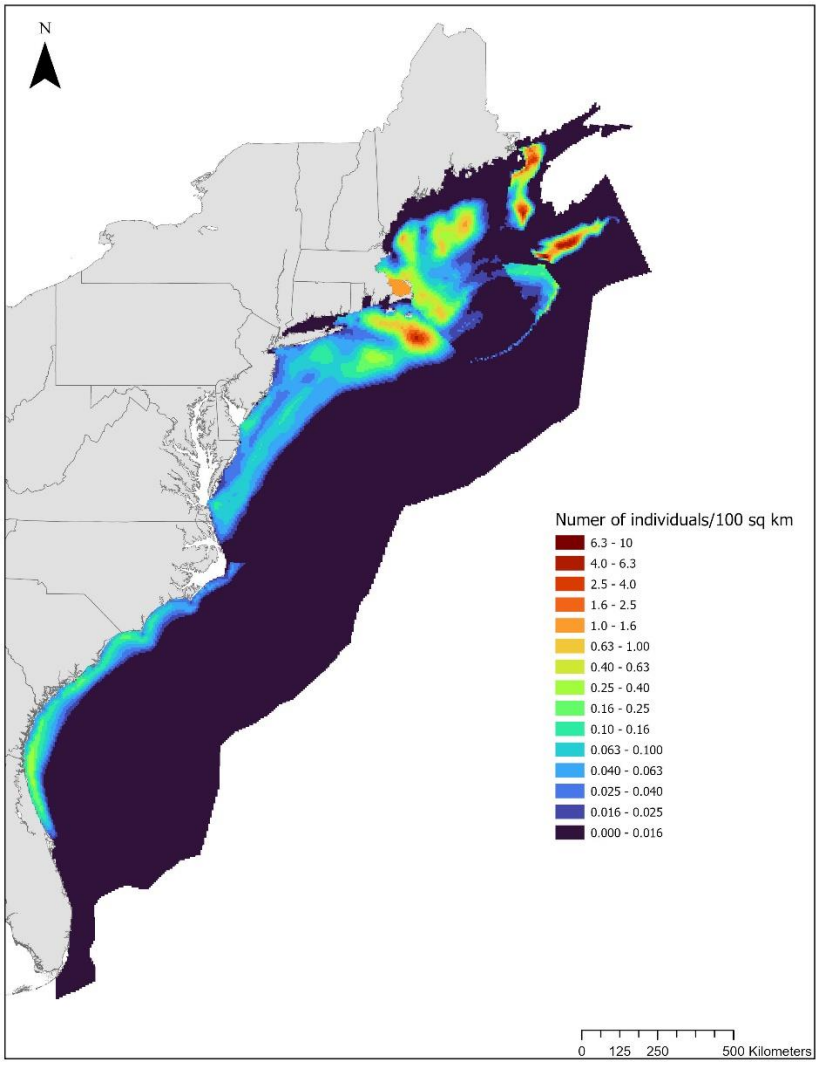


Figure 34. Modeled annual mean North Atlantic right whale density along the US Atlantic coast (Roberts *et al.* 2024).

Aerial survey data show a strong affinity for coastal waters and/or waters within the 100 m isobath; however, these same surveys, along with telemetry data, have shown right whales also occur in deep pelagic waters past the continental shelf break (Mate *et al.* 1997; McLellan *et al.* 2003; Baumgartner and Mate 2005). Virginia waters were previously only considered transit waters for North Atlantic right whales during their seasonal migrations (Figure 24). Right whale call detections from acoustic surveys utilizing PAM in Virginia waters peaked in the fall and late winter/early spring, coinciding with the timing of the southward and northward migration, respectively. The same acoustic surveys, however, detected right whales in Virginia waters year-round, suggesting these waters may be used for more than seasonal transits by some individuals (Salisbury *et al.* 2015). Aerial and boat-based survey sightings and drone observations collected since 2016 suggest that North Atlantic right whales may be regularly feeding off the Virginia coast, further supporting that this area serves as more than a migratory corridor during seasonal migrations (Mallette *et al.* 2017; Cotter 2019; Engelhaupt *et al*. 2023). Additionally, Aschettino *et al*. (2024) recently observed groups of right whales engaged in a surface active group (SAG) in Virginia waters. According to the New England Aquarium's right whale research blog, a SAG

occurs when two or more whales within a body length of each other interact at the surface. Typically, a SAG is comprised of one female and a number of males competing with each other in order to mate with her.

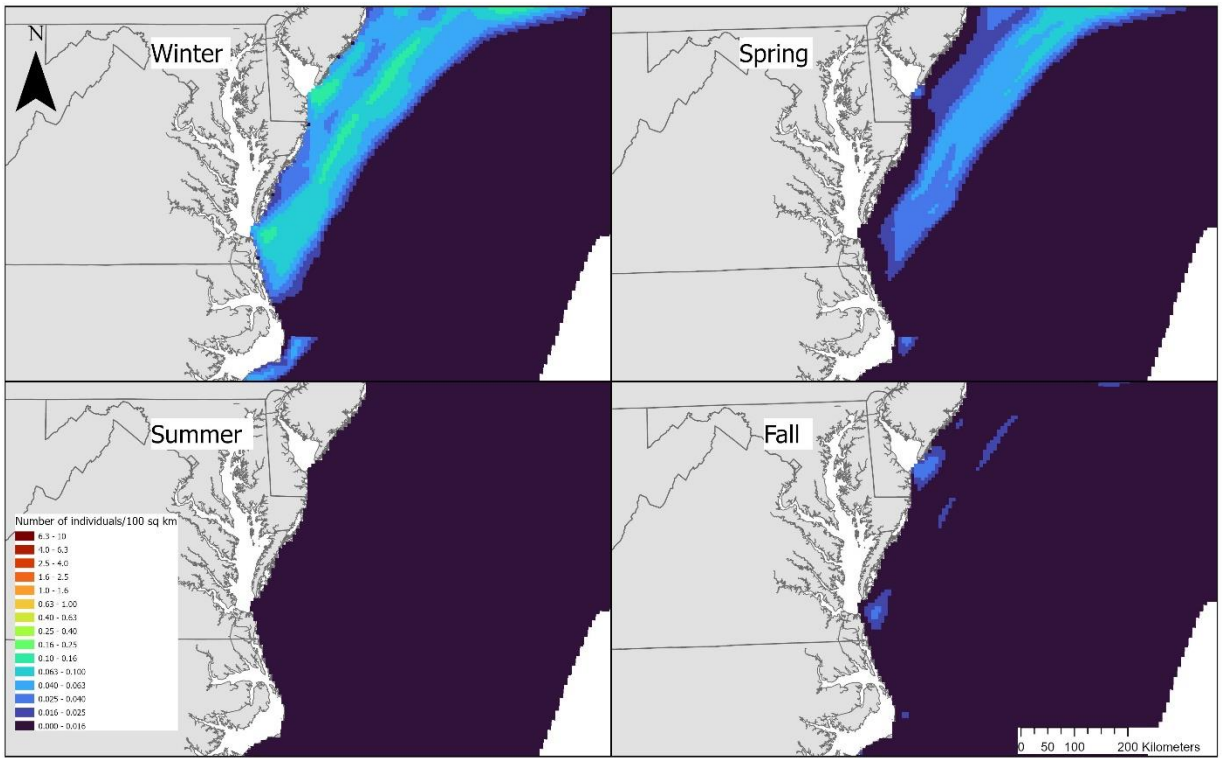


Figure 35. Modeled seasonal mean North Atlantic right whale density along the mid-Atlantic Bight (Roberts *et al.* 2024).

Aerial survey sightings of right whales in Virginia waters have been sporadic. Seven detections of up to four individuals were made between 2011 and 2016, and in 2016, two individual right whales were spotted in the winter over the mid-continental shelf (Mallette *et al.* 2017). Eight individual right whales were sighted in April 2018 within the 100 m isobath (Cotter 2019). Boat-based survey observations have increased as survey effort in mid-shelf waters has increased, with almost all sightings occurring in the winter. There were four sightings of seven individuals in the winter of 2021, three sightings of five individuals in the winter of 2022, and eight sightings of 34 individuals in the winter of 2023. There was one sighting of two individuals in November 2022. Almost all of these sightings occurred in mid-continental shelf waters, with the exception of one individual observed in the mouth of the Chesapeake Bay and another in the nearshore waters off of Virginia Beach in the winter of 2023. Location data obtained from three tagged calves also support the species' primary use of mid-continental shelf waters in Virginia, with one whale occupying waters closer to shore when it was east of the northern half of the Eastern Shore and another utilizing deep continental shelf waters during its northern migration (Aschettino *et al.* 2022; Aschettino *et al.* 2023; Aschettino *et al.* 2024). Although there are numerous unconfirmed reports of right whales inside Chesapeake Bay, their presence in the Bay is rare and may be accidental.

Strandings

Because of the critical conservation status of this species, all North Atlantic right whale strandings as of November 2024 were included. There have been seven total right whale strandings to date consisting of single whales stranded in Virginia in each of the following years: 2001, 2002, 2004, 2005, 2018, 2023, and 2024. Six of the right whale strandings in Virginia occurred on ocean-facing beaches or were found floating offshore, and one was first reported on a beach in the southern Bay mouth (Figure 25). Excluding one stranding in September, all strandings occurred in the winter. Three strandings occurred in March, two in February, and one in January. Six of the seven whales stranded with evidence of HI, consisting of vessel strikes and fishery interactions. In addition, a pregnant female whale that stranded in northeastern North Carolina with vessel strike injuries was likely struck by a large vessel in Virginia waters in November 2004 (S. Barco, *personal communication*, October 3, 2023).

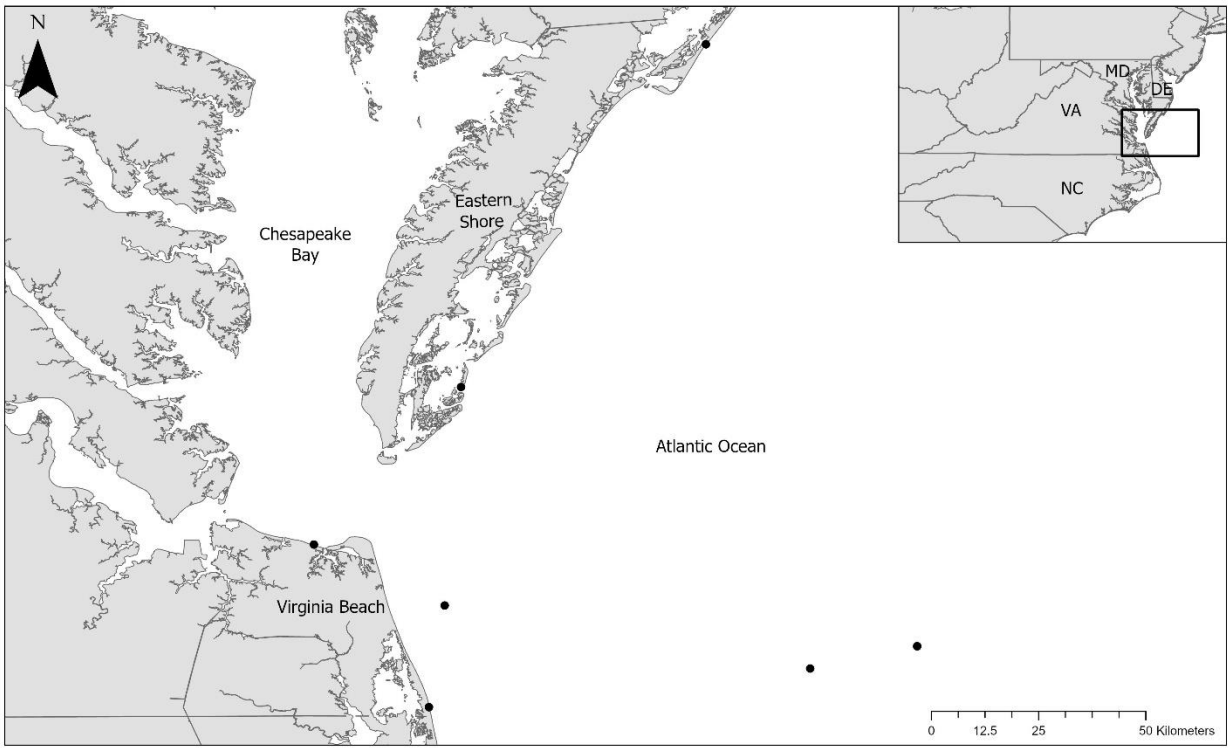


Figure 36. Map of North Atlantic right whale stranding locations in Virginia from 1988 to November 2024.

Diet and Foraging in Virginia Waters

Right whale diet consists almost exclusively of copepods in the genus *Calanus*, and right whales have been shown to require high density patches of copepods to optimize foraging efficiency (Baumgartner and Mate 2003; Baumgartner *et al.* 2007). Aerial and boat-based surveys and drone observations since 2016 have documented right whales foraging in Virginia waters (Mallette *et al.* 2017; Cotter 2019; Engelhaupt *et al*. 2023).

Reproductive Activity in Virginia Waters

The first reports of reproductive activity in Virginia occurred in January and February 2023 when multiple surface-active groups exhibited behaviors consistent with sexual activity were observed (Aschettino *et al.* 2024). In addition, pregnant right whales with near term fetuses

stranded in Virginia and northeastern North Carolina in February and November 2004, respectively (S. Barco, *personal communication*, November 15, 2024).

Humpback Whale (Megaptera novaeangliae)

Description

Humpback whales (*Megaptera novaeangliae*) are distinguished from other mysticetes by their extremely long pectoral flippers (up to one-third of the body length).

Status

Humpback whales are considered a species of Least Concern on the IUCN Red List of Threatened Species (Cooke 2018a). In September 2016, NOAA Fisheries issued a final determination (81 FR 62260) that divided the humpback whale into 14 global distinct population segments (DPSs). This ruling also removed the species-level endangered status, and listed four DPSs as endangered, one as threatened, and the remaining nine as de-listed under the state and federal ESA. Humpback whales occurring in the Northwest Atlantic Ocean are part of the West Indies DPS, which is not considered threatened or endangered as part of this ruling. The humpback whale population is stable or growing according to recent abundance estimates. One stock that is part of the West Indies DPS and relevant to Virginia waters is the Gulf of Maine stock, which is estimated at 1,396 individuals with a PBR of 22 individuals. Currently, this stock is not a strategic stock (Hayes *et al.* 2020). Due to its previous endangered status, humpback whales were included in the Atlantic large whale TRT and are still managed under this TRT (72 FR 57104). It is also considered an SGCN in Virginia (DWR 2025).

The Atlantic Humpback Whale UME was declared along the US Atlantic coast in April 2017 by NOAA Fisheries. The UME began in January 2016 and was ongoing as of November 2024. This UME is suspected to be caused by vessel strikes. Of the 232 total humpback whales that stranded between January 2016 and November 2024, 33, or 14%, stranded in Virginia, including some with evidence of vessel strike injuries (NOAA Fisheries 2024b). With the ongoing UME, there is increasing evidence that human-caused mortality and injury may be exceeding PBR for the Gulf of Maine stock, prompting closer examination of its status (Hayes *et al.* 2020).

Occurrence, Distribution, and Abundance in Virginia Waters

Humpback whales are distributed along the entire US Atlantic coast, although they are more prominent in higher latitudes (Figure 26). Humpback whales make seasonal migrations from their summer feeding grounds to winter breeding grounds in the West Indies, transiting through Virginia waters during these migrations (Figure 27). The West Indies DPS consists of six subpopulations based on feeding grounds in the North Atlantic (Hayes e*t al.* 2020). Barco *et al.* (2002) identified stranded and live-sighted individuals through photo-identification in the mid-Atlantic as belonging to three of these subpopulations: Gulf of Maine, Gulf of St. Lawrence, and Newfoundland. Although recent photo-identification efforts have not matched individuals to specific subpopulations, resighting rates of known individuals in the photo-identification catalog suggest humpback whales exhibit site fidelity to Virginia waters (Aschettino *et al.* 2022). Barco *et al.* (2002) suggested that the mid-Atlantic waters may serve as supplemental winter feeding grounds for juvenile and occasionally mature animals.

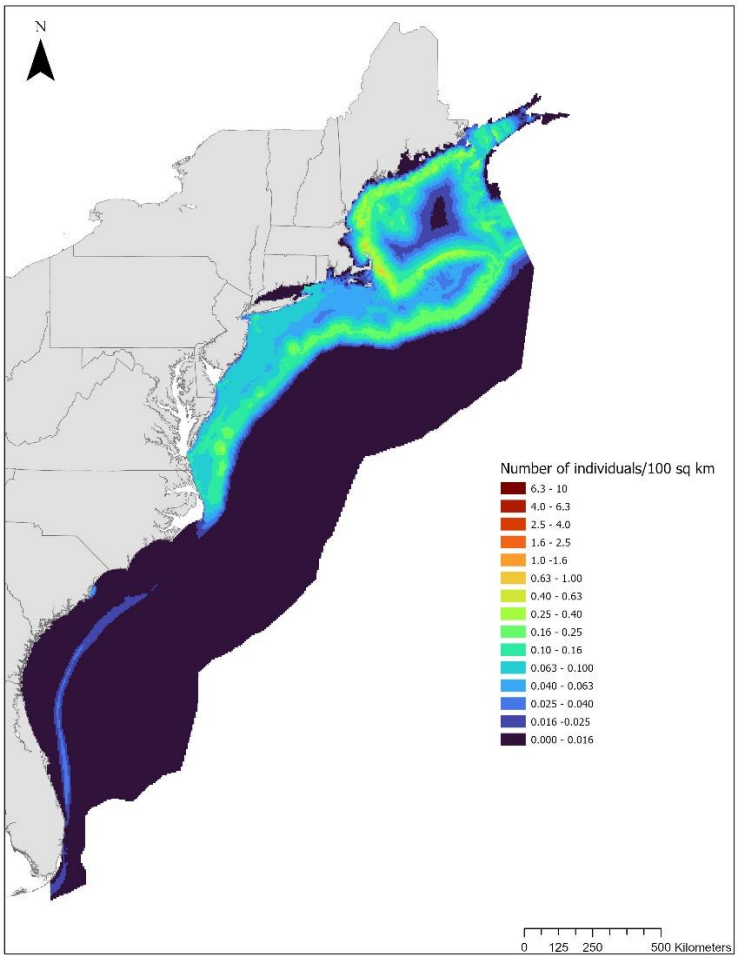


Figure 37. Modeled annual mean humpback whale density along the US Atlantic coast (Roberts *et al.* 2023).

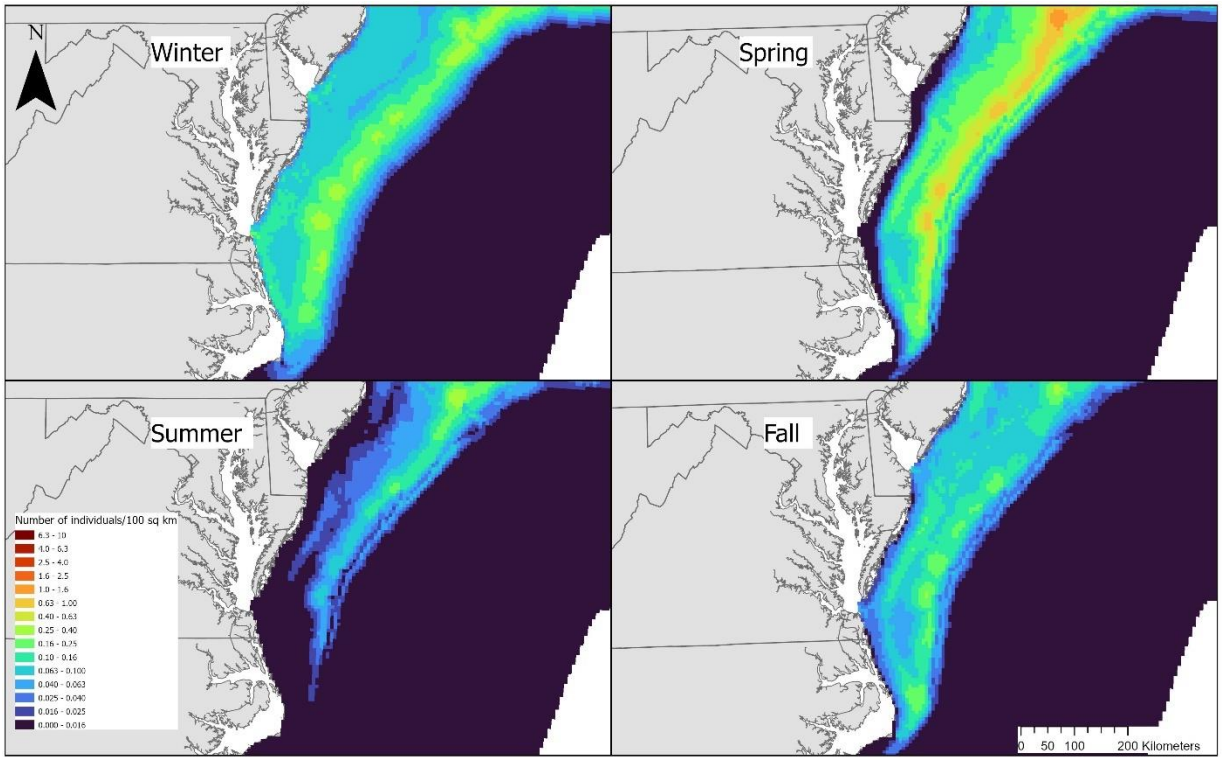


Figure 38. Modeled seasonal mean humpback whale density along the mid-Atlantic Bight (Roberts *et al.* 2023).

Live sighting records from vessel and aerial surveys indicate that humpback whales are seasonally present in Virginia waters from November to April, with the highest concentrations detected off of Cape Henry and the mouth of the Chesapeake Bay. Boat-based and aerial surveys, along with location data obtained from tagged individuals, show varied annual movements, occupying waters extending from the mouth of and occasionally inside the Chesapeake Bay to the offshore waters of the continental shelf break (Engelhaupt *et al.* 2016; McAlarney *et al.* 2016; McAlarney *et al.* 2017; McAlarney *et al.* 2018; Aschettino *et al.* 2018; Aschettino *et al.* 2019; Cotter 2019; Aschettino *et al.* 2020a; Aschettino *et al.* 2020b; Aschettino *et al.* 2022; Aschettino *et al.* 2023). Aschettino *et al.* (2022) suggested that these wide-ranging movements may be due to varied oceanographic conditions causing shifting prey distributions. Most of the detected animals were estimated to be between 8 and 12 m in length, indicating that a large portion of humpback whales that occur in Virginia waters are juveniles.

Strandings

Humpback whales make up the highest proportion of large whale strandings in Virginia. A total of 65 strandings were reported between 1988 and 2022, and strandings were significantly correlated with year (R^2=0.16, F(33)=7.31, $p<0.05$). The increase in strandings coincided with the onset of the UME in 2016 (Figure 28). Strandings primarily occurred on ocean-facing beaches around Virginia Beach and the northern barrier islands, and near or in the mouth of the Chesapeake Bay, particularly around Cape Henry (Figure 29). Most stranded whales (63%) were in the size class that is characteristic of newly independent juvenile animals (Wiley *et al.* 1995; Clapham *et al.* 1999). Only five individuals were larger than 11 m, including a 12.5 m male and 15.4 m female.

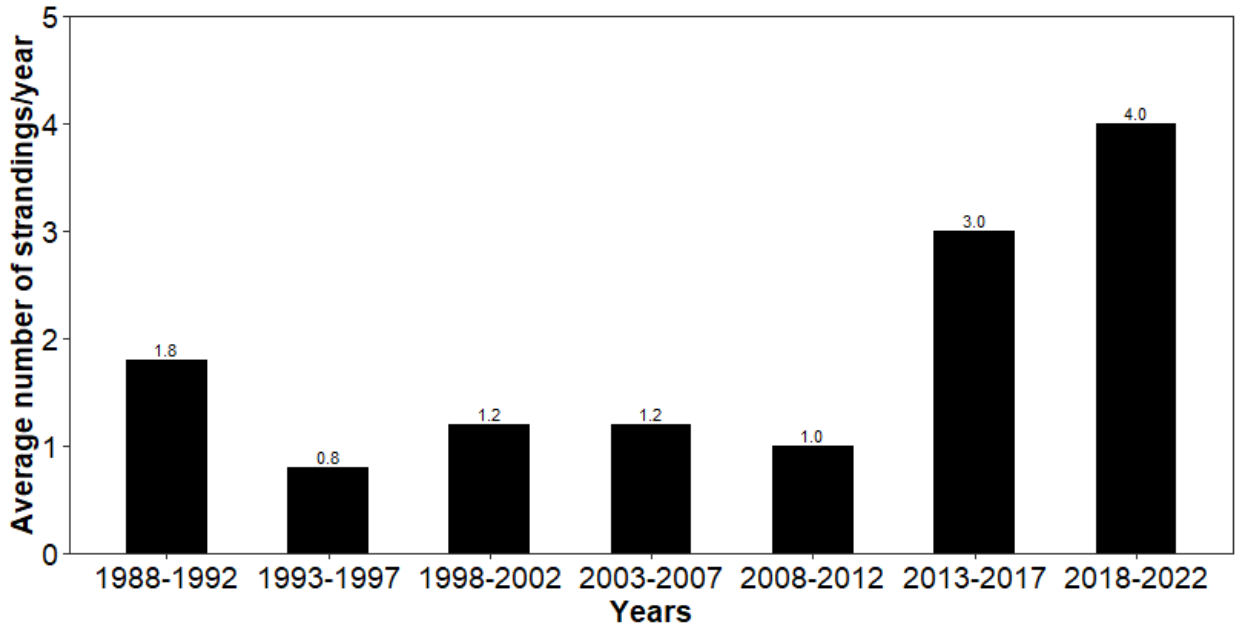


Figure 39. Average number of humpback whale strandings in Virginia from 1988 to 2022, summarized in five-year increments.

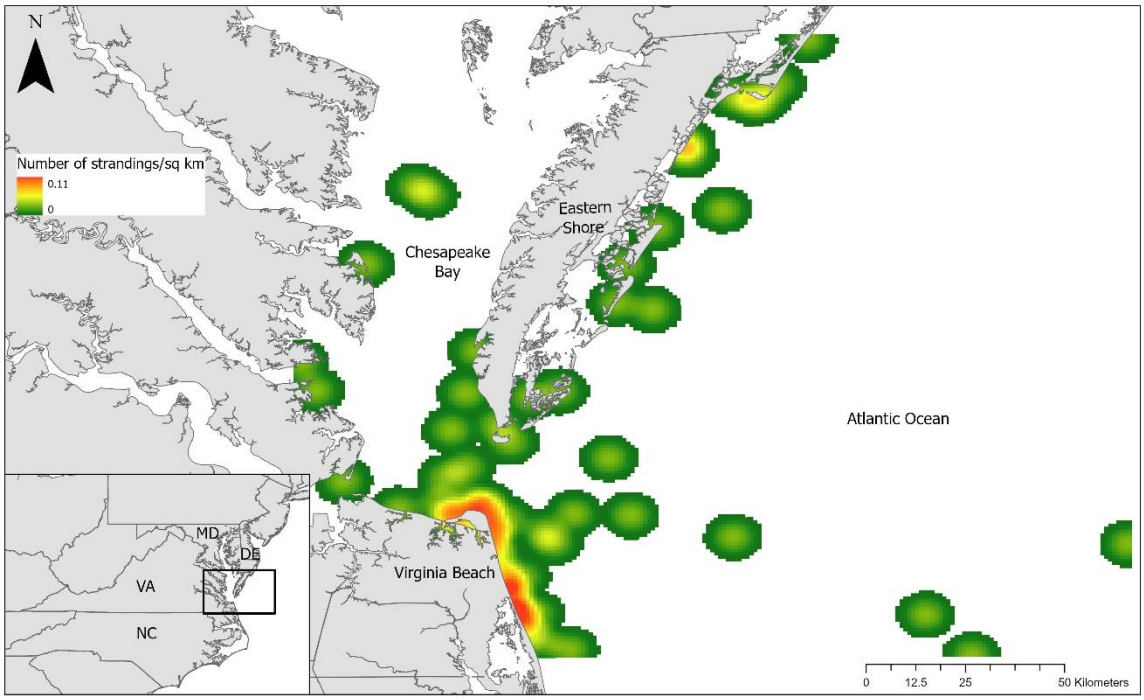


Figure 40. Density map of humpback whale strandings per square kilometer in Virginia from 1988 to 2022. Offshore points represent carcasses discovered floating offshore.

Over half of all strandings occurred in the winter and spring (66%; Figure 30) and in relatively similar locations across seasons (Figure 31). Humpback whale strandings occurred throughout the annual cycle with a slight monthly uptick in February (Figure 32). A total of 35 HI cases

were documented between 1988 and 2022, which were nearly evenly split between fishery interactions and vessel strikes.

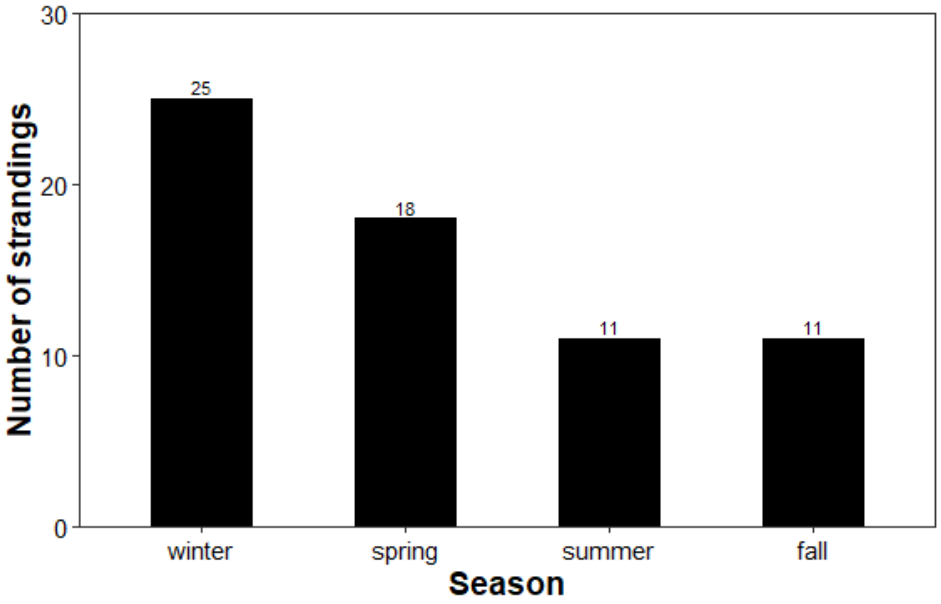


Figure 41. Number of humpback whale strandings per season in Virginia from 1988 to 2022.

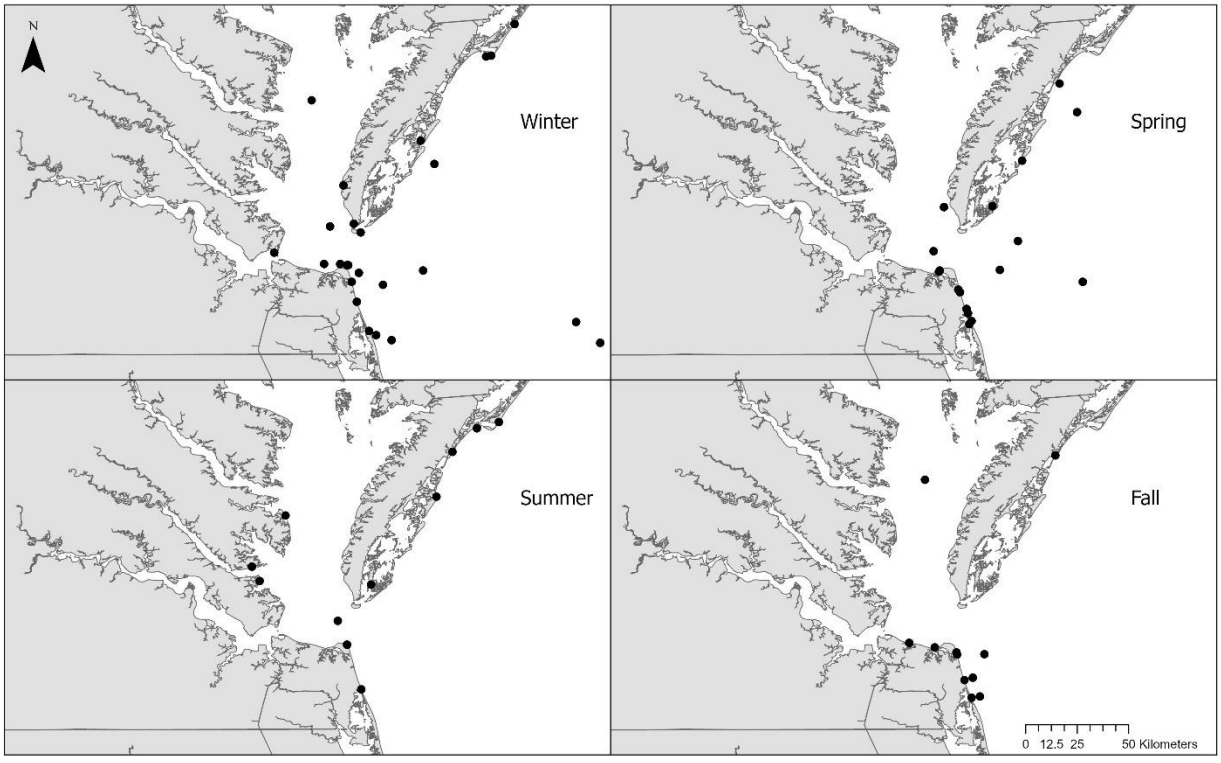


Figure 42. Map of seasonal humpback whale stranding locations in Virginia from 1988 to 2022.

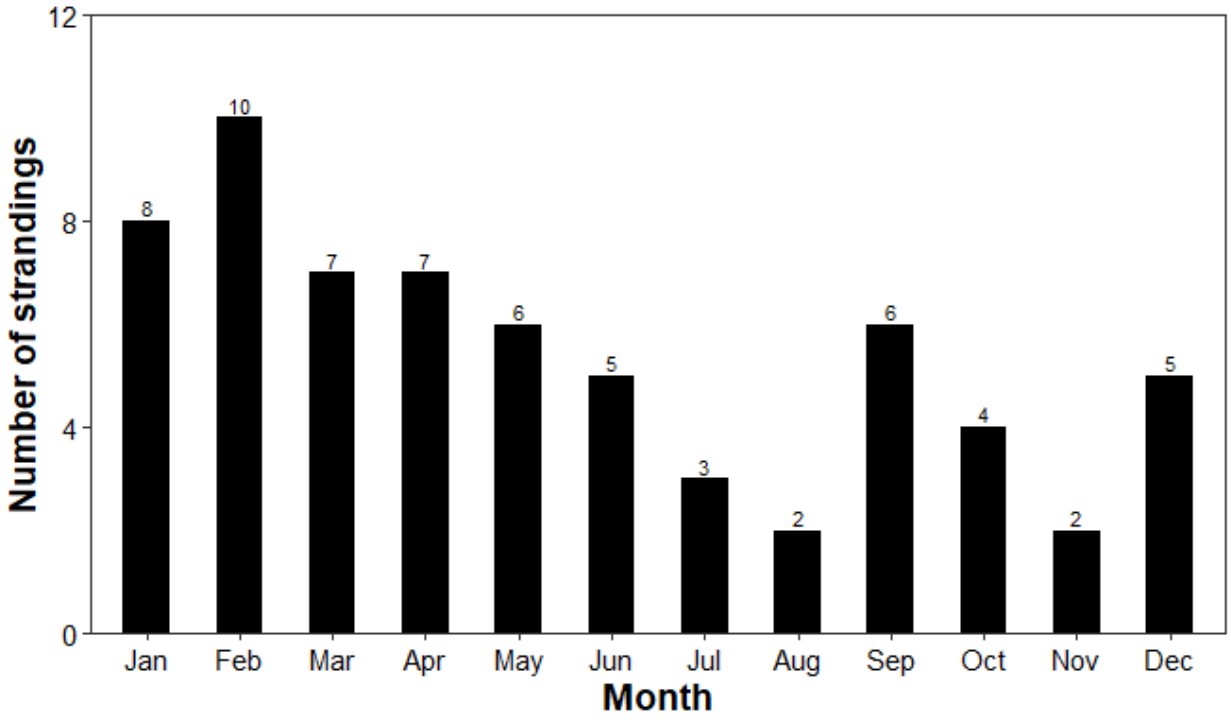


Figure 43. Number of humpback whale strandings per month in Virginia from 1988 to 2022.

Diet and *Foraging in Virginia Waters*

The primary prey for humpback whales in Virginia waters is thought to be Atlantic menhaden. Whales have been observed foraging on schools of menhaden during boat-based surveys, and necropsies of individuals stranded in Virginia have revealed large numbers of menhaden in the stomachs (VAQS *unpublished data*, October 2023). During vessel and aerial surveys, they have been observed engaging in lunge-feeding and, more rarely, bubble-net foraging behaviors (Mallette *et al*. 2018; Cotter 2019), suggesting that Virginia may be an important non-summer feeding area for this species.

Reproductive Activity in Virginia Waters

There is currently no indication that reproductive activity occurs in Virginia waters. Additionally, there have been no confirmed reports of live mother/calf pairs or stranded pregnant females in the Commonwealth (VAQS *unpublished data*, October 2023).

Minke Whale (Balaenoptera acutorostrata)

Description

Minke whales (*Balaenoptera acutorostrata*) are the smallest baleen whale in North American waters and are identified by a distinct white band on their pectoral flippers.

Status

Minke whales are categorized as a species of Least Concern on the IUCN Red List of Threatened Species (Cooke 2018b) and are not listed as endangered or threatened under the state and federal

ESA (DWR 2025). They are also not considered an SGCN in Virginia (DWR 2025). Four populations in the Atlantic are recognized: Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). Due to limited information, minke whales in US Atlantic waters are considered part of the Canadian East Coast stock, which ranges from the Davis Strait between Canada and Greenland to the Gulf of Mexico. This stock is currently estimated at 21,968 individuals and is currently not considered a strategic stock (Hayes *et al.* 2022).

An Atlantic Minke Whale UME was declared along the US Atlantic coast in January 2017 by NOAA Fisheries due to elevated mortalities along the Atlantic coast from Maine to South Carolina. While the exact cause of this UME is unknown, it is thought to be due to human interactions or infectious diseases. Of the 188 whales included in this event as of November 2024, 13 have stranded in Virginia (NOAA Fisheries 2024c).

Occurrence, Distribution, and Abundance in Virginia Waters

Minke whales are a widespread species that occupy temperate, tropical, and high-latitude waters, and are common in the US Economic Exclusive Zone (EEZ) (Hayes *et al.* 2022; Figure 33). Similar to other baleen whales, minke whales make seasonal migrations to and from high latitude summer feeding grounds and low latitude winter breeding grounds. In the winter, minke whales move as far south as the southeastern US and Bermuda. Based on acoustic data, most detections offshore on the continental shelf were recorded between spring and fall, while most detections in pelagic waters beyond the shelf break were recorded between September and April, indicating that the southbound migration occurs in pelagic waters while the northbound migration occurs in offshore waters (Clark and Gagnon 2002; Risch *et al.* 2013; Risch *et al.* 2014).

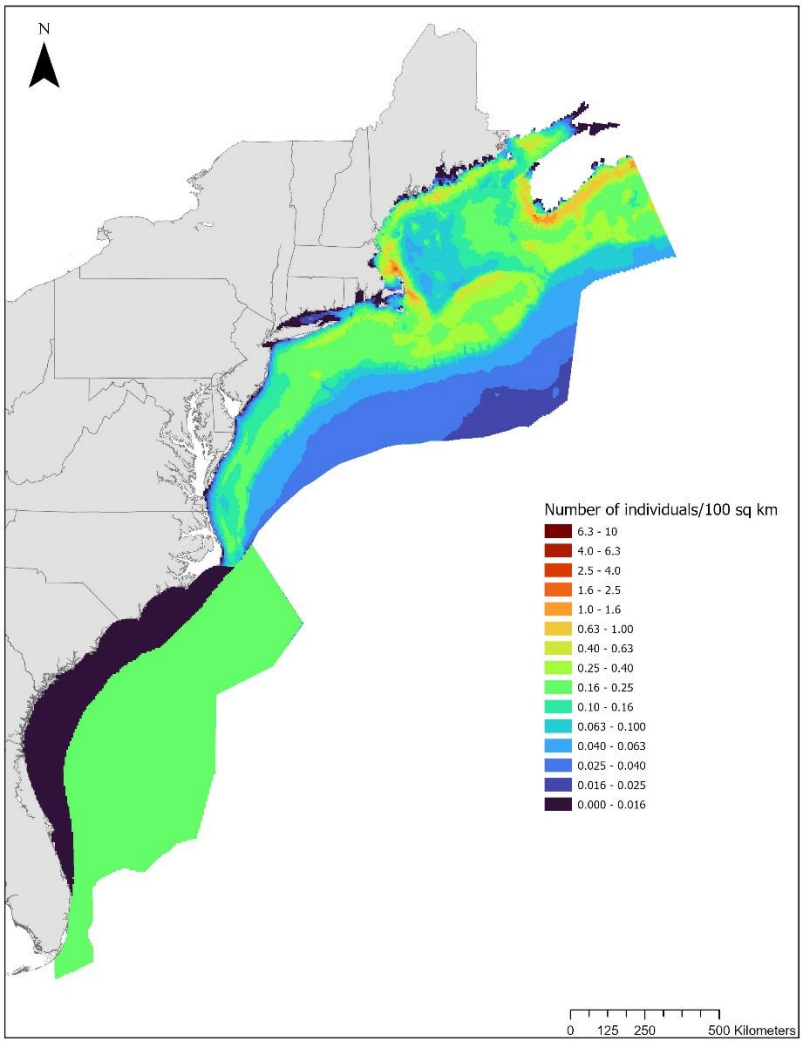


Figure 44. Modeled annual mean minke whale density along the US Atlantic coast (Roberts *et al.* 2023).

Sightings of minke whales from boat-based and aerial surveys primarily consist of single individuals, with some observations consisting of two individuals. Sightings have occurred year-round mainly over the continental shelf in offshore waters. There have also been sightings nearshore at the mouth of the Chesapeake Bay and in pelagic waters (McAlarney *et al.* 2016; McAlarney *et al.* 2017; Aschettino *et al.* 2018; Aschettino *et al.* 2019; Cotter 2019; Aschettino *et al.* 2020a; Aschettino *et al.* 2020b; Aschettino *et al.* 2023). To date, only one individual was possibly observed feeding in Virginia waters (Cotter 2019).

Strandings

A total of 22 minke whales stranded in Virginia between 1988 and 2022 ranging from zero to four strandings annually. However, strandings have increased within the last 10 years, coinciding with the onset of the 2017 UME (Figure 34). Strandings were equal across seasons and months and did not have a predominant peak. No strandings occurred in the month of July. Nine minke whales stranded with evidence of HI, mostly consisting of fishery interaction cases with at least one vessel strike and one case of debris ingestion (VAQS *unpublished data*, October 2023).

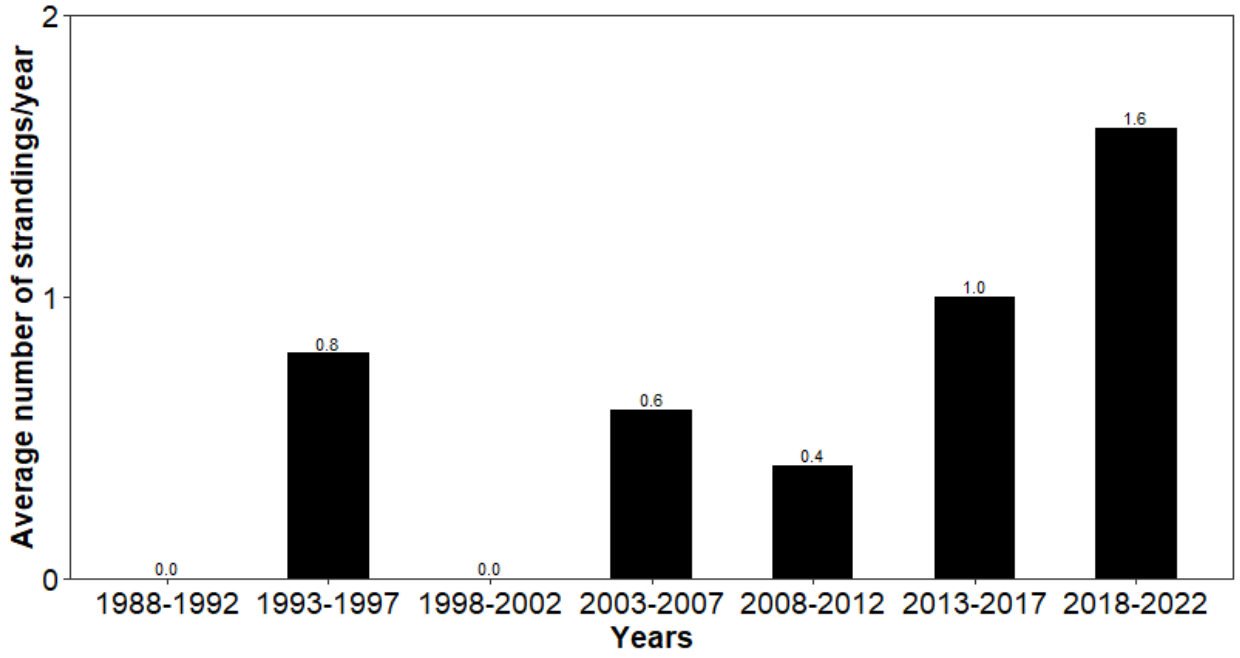


Figure 45. Average number of minke whale strandings in Virginia from 1988 to 2022, summarized in five-year increments.

Diet and Foraging in Virginia Waters

Minke whales feed on copepods, zooplankton (such as northern (*Meganyctiphanes norvegica*) and arctic (*Thysanoessa raschii*) krill), and forage fish (such as sand lance (*Ammodytes americanus*), capelin (*Mallotus villosus*), and herring) (Gavrilchuk *et al.* 2014). While minke whales primarily feed in their northern summer grounds, they may opportunistically feed in Virginia waters based on one aerial survey sighting of a minke whale possibly engaged in foraging behavior (Cotter 2019).

Reproductive Activity in Virginia Waters

There are no reports of reproductive activity in Virginia. Virginia waters are considered transit waters to an unknown southern migratory endpoint further south where they overwinter and breed (Risch *et al.* 2014). A neonatal minke whale stranded alive in northeastern North Carolina in January 2005 during an extreme weather event. The individual retained visible fetal lines and was estimated to be less than two months old. The whale was euthanized and subsequently necropsied but cause of death could not be determined. This stranding coincided with a short-finned pilot whale mass stranding event that involved over 50 individuals, and weather was suspected to be a contributing factor to both incidents (VAQS *unpublished data*, October 2023).

Fin Whale (Balaenoptera physalus)

Description

Fin whales (*Balaenoptera physalus*) are the second largest whale species found in the world, with blue whales being the largest.

Status

The IUCN Red List categorizes fin whales as Vulnerable (Cooke 2018c). Fin whales are listed as state and federally endangered and are an SGCN in Virginia (DWR 2025). Fin whales along the Atlantic coast from Florida to the southeastern coast of Newfoundland are recognized as the western North Atlantic stock. There is debate over stock boundaries in the Atlantic Ocean and whether the North Atlantic is a single stock or comprises multiple stocks or subpopulations. The stock is currently estimated at 6,802 individuals. This stock is considered a strategic stock because of its endangered status (Hayes *et al.* 2022). Moreover, total fishery-related mortality and serious injury exceeds 10% of the stock's PBR and is managed under the Atlantic large whale TRT (72 FR 57104). Current population trends are unknown (Hayes *et al.* 2022).

Occurrence, Distribution, and Abundance in Virginia Waters

Fin whales are globally distributed and relatively common in the US EEZ from Cape Hatteras northward (Figure 35). They have been detected as far south as the southeastern US, primarily in pelagic waters in their southernmost range (Davis *et al.* 2020), and major feeding areas include the waters off of New England and the Gulf of St. Lawrence. Unlike other baleen whales, fin whales are not believed to make annual latitudinal seasonal migrations, but their distribution varies seasonally (Hayes *et al.* 2022). Edwards *et al.* (2015) found more fin whales were present at higher latitudes, primarily northern US waters into Canada, in warmer months and at lower latitudes in cooler months. However, not all whales followed this distributional pattern.

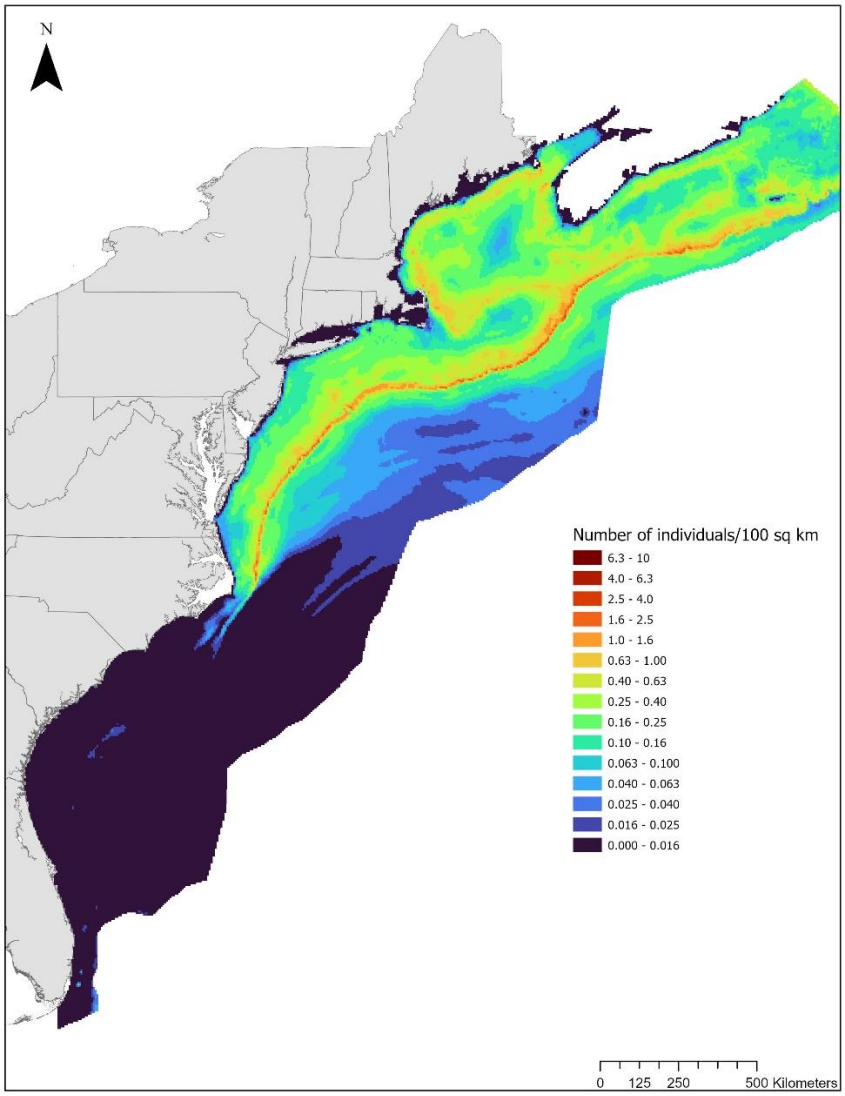


Figure 46. Modeled annual mean fin whale density along the US Atlantic coast (Roberts *et al.* 2023).

Acoustic surveys detected fin whales in Virginia waters year-round. Detections were greatest between August and April and lowest between May and July. Vocalizations were detected over the entire continental shelf (Davis *et al.* 2020), but it should be noted that fin whale vocalizations can be detected nearly 100 km from the source (Stimpert *et al.* 2015) and identifying the location of the sound source was not conducted in the Davis *et al.* (2020) study. Boat-based and aerial surveys commonly sighted fin whales off Virginia in all seasons. The majority of sightings occurred offshore, but some sightings occurred nearshore and in pelagic waters (McAlarney *et al.* 2016; Mallette *et al.* 2017; McAlarney *et al.* 2017; Aschettino *et al.* 2018; McAlarney *et al.* 2018; Cotter 2019; Aschettino *et al.* 2020a; Aschettino *et al.* 2022; Aschettino *et al.* 2023; Aschettino *et al.* 2024). Location data obtained from two fin whales tagged in 2021 showed they remained exclusively in offshore waters with periodic east to west and west to east fluctuations in their movement patterns (Aschettino *et al.* 2022).

Strandings

There were a total of 12 fin whale strandings in Virginia from 1988 to 2022. Half of the strandings occurred on ocean-facing beaches, and the other half occurred in Chesapeake Bay. The majority of strandings occurred in the winter (February and March), with one stranding each in April, September, and December. Five whales stranded with evidence of HI, primarily consisting of vessel collisions.

Diet and Foraging in Virginia Waters

Fin whales primarily consume euphausiids (krill), but also consume copepods, cephalopods, and fish (Flinn *et al.* 2002). Fin whales have been observed feeding in Virginia waters during aerial surveys (Cotter 2019).

Reproductive Activity in Virginia Waters

No reproductive activity has been reported in Virginia waters. Mating and calving grounds are unknown. Hain *et al.* (1992) suggested that calving occurs along mid-Atlantic latitudes from October to January based on neonatal stranding data, but this has not been confirmed.

Sei Whale (Balaenoptera borealis)

Description

Sei whales (*Balaenoptera borealis*) have a tall, hooked dorsal fin, and are often identified by their columnar, bushy blow pattern.

Status

Sei whales are categorized as endangered in the IUCN Red List and under the state and federal ESA (Cooke 2018d; DWR 2025). However, they are not considered an SGCN in Virginia (DWR 2025). The Nova Scotia stock is the only stock of sei whales that is currently recognized in the Atlantic Ocean; however, there are two distinct feeding grounds in the Gulf of Maine and Labrador Sea that may support different stocks. The Nova Scotia stock is currently estimated between 3,098 and 6,292 individuals. Because sei whales are endangered, this stock is considered a strategic stock. Population trends are unknown (Hayes *et al.* 2022).

Occurrence, Distribution, and Abundance in Virginia Waters

The Nova Scotia stock primarily occupies the deeper waters of the continental shelf from the Gulf of Maine to Newfoundland (Figure 36). Spring and summer are the primary seasons sei whales are seen in US waters, ranging from off New England to the Gulf of Maine. The southern limit of their range is unknown, but they have been detected via acoustic surveys in pelagic waters off the southeastern US coast exclusively in the winter. They are thought to make seasonal migrations from New England up to their summer feeding grounds in Canadian waters (Davis *et al.* 2020; Hayes *et al.* 2022).

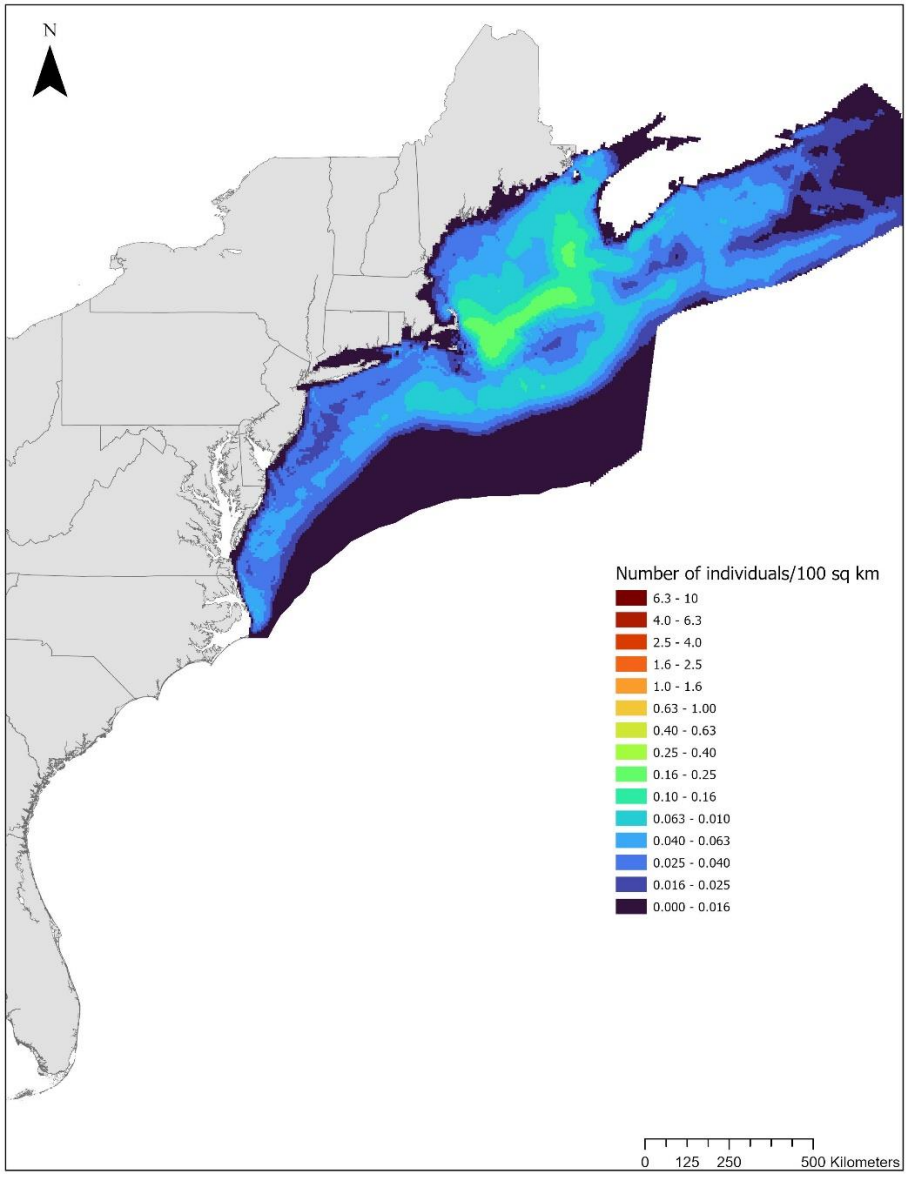


Figure 47. Modeled annual mean sei whale density along the US Atlantic coast (Roberts *et al.* 2023).

In the mid-Atlantic region, sei whale vocalizations were detected year-round across the continental shelf but detections were greater in the winter at the shelf break (Davis *et al.* 2020). One sighting of two sei whales in pelagic waters occurred during a boat-based survey in January 2017 (Engelhaupt *et al.* 2018). In addition, four sei whales were spotted in deep continental shelf and pelagic waters during an aerial survey conducted in April 2018 (Cotter 2019). Although feeding was not observed, the sightings coincided with a time of high copepod density, possibly indicating that sei whales were drawn to the area by prey.

Strandings

There have been four sei whale strandings in Virginia waters between 1988 and 2022. Three of the strandings occurred within Chesapeake Bay, while the fourth occurred on the Virginia Beach oceanfront. One stranding occurred in each of the following months: February, March, May and

August. There were three sei whale strandings with evidence of HI, all of which were vessel collisions.

Diet and Foraging in Virginia Waters

Sei whales in the North Atlantic primarily eat euphausiids and copepods (Flinn *et al.* 2002). Due to the low number of observations in Virginia, it is unknown if sei whales feed in the region.

Reproductive Activity in Virginia Waters

There are no reports of reproductive activity in Virginia waters.

PINNIPEDS (TRUE SEALS)

HARBOR SEAL (PHOCA VITULINA)

Description

Harbor seals (*Phoca vitulina*) are relatively small seals that have a gray to brown coat on the back with pale rings and oval spots (Jefferson *et al.* 2007).

Status

Harbor seals are considered a species of Least Concern on the IUCN Red List (Lowry 2016) and are not listed as state or federally threatened or endangered (DWR 2025; Hayes *et al.* 2022). They are also not considered an SGCN in Virginia (DWR 2025). Harbor seals in Virginia are considered part of the western North Atlantic population, which, based on mitochondrial DNA analyses, appears to be vastly different from the eastern North Atlantic population (Stanley *et al.* 1996). This stock is currently estimated at 61,336 individuals. This stock is not considered depleted or a strategic stock (Hayes *et al.* 2022).

The Northeast Pinniped UME was declared along the US Northeast coast in July 2019 by NOAA Fisheries and included harbor and gray (*Halichoerus grypus atlantica*) seals. The extent of the UME ranged from Maine to Virginia. The preliminary cause for this UME was phocine distemper virus. Although harbor seals primarily occur in the northeastern US (Maine, New Hampshire, and Massachusetts), 10 out of the 3,152 seals involved in this event stranded in Virginia with evidence of phocine distemper virus. This UME was active until March 2020 but is still pending closure (NOAA Fisheries 2023b).

Occurrence, Distribution, and Abundance in Virginia Waters

Harbor seals are a coastal pinniped species present throughout the northeast and mid-Atlantic regions. They are present year-round on their breeding grounds in Canada and Maine. Harbor seal presence in Virginia waters is seasonal, with observations of seals at known haul-out sites usually beginning in the fall and extending into the spring (Hayes *et al.* 2022; Ampela *et al.* 2023; Guins *et al.* 2023; Jones and Rees 2023).

In the decades since the first records of juveniles in poor condition appeared in the Virginia stranding database, harbor seal presence in Virginia has become a regular occurrence and seasonal haul-out sites have become firmly established. Survey data from 2015 to 2023 indicate the number of seals present in Virginia during the non-breeding season is relatively stable, with

some annual fluctuations. A mean abundance estimate of 198 individuals was calculated for Virginia using boat-based survey data collected from 2015 to 2023 (Jones and Rees 2023). Survey and tagging data from 2018 to 2021 show certain locations that have consistent seasonal usage as haul-out sites, such as the Chesapeake Bay Bridge Tunnel (CBBT) Islands, Smith Island, and, most recently, Fisherman Island. Individuals have been re-sighted on the same haul-out locations across successive years, suggesting a certain degree of site-fidelity (Ampela *et al.* 2023; Jones and Rees 2023). While it was previously thought only juveniles and subadults moved south of the New York/New Jersey Bight, all age classes of harbor seals have been documented in Virginia waters (Ampela *et al.* 2023).

Boat-based surveys, camera traps, and location data obtained from tagged individuals have led to a better understanding of harbor seal habitat utilization in Virginia. Harbor seals are consistently present from November to April, with the highest abundances documented between January and March. They have been seen as early as October and seem to leave the area between March and May (Ampela *et al.* 2023; Guins *et al.* 2023; Jones and Rees 2023). Tagging data identified core habitat near the tagging location behind Smith Island and farther north on the Eastern Shore near Hog and Parramore Islands, while the oceanfront areas of Virginia Beach were rarely utilized (Ampela *et al.* 2023). These same surveys and location data have also revealed habitat preferences. Certain seals exclusively used haul-out sites at the CBBT Islands or known sites on the Eastern Shore, while others utilized both areas (Jones and Rees 2023). Additionally, some tagged seals exclusively used Chesapeake Bay or inshore waters when not hauled-out (Ampela *et al.* 2023).

Strandings

A total of 106 harbor seal strandings were reported in Virginia between 1988 and 2022. These strandings comprised 51% of all pinniped strandings (n = 206) in in the Commonwealth. Harbor seals have consistently stranded in Virginia since 1991 for an average of 3.0 strandings per year, but as larger, healthier individuals have established haul-outs in the region, the number of strandings has declined (Figure 37). Strandings were concentrated near the southern end of Assateague Island, around Fisherman Island, and along the oceanfront beaches of Virginia Beach (Figure 38). Strandings of known size were primarily juveniles (Reeves *et al.* 1992; Geraci and Lounsbury 2005).

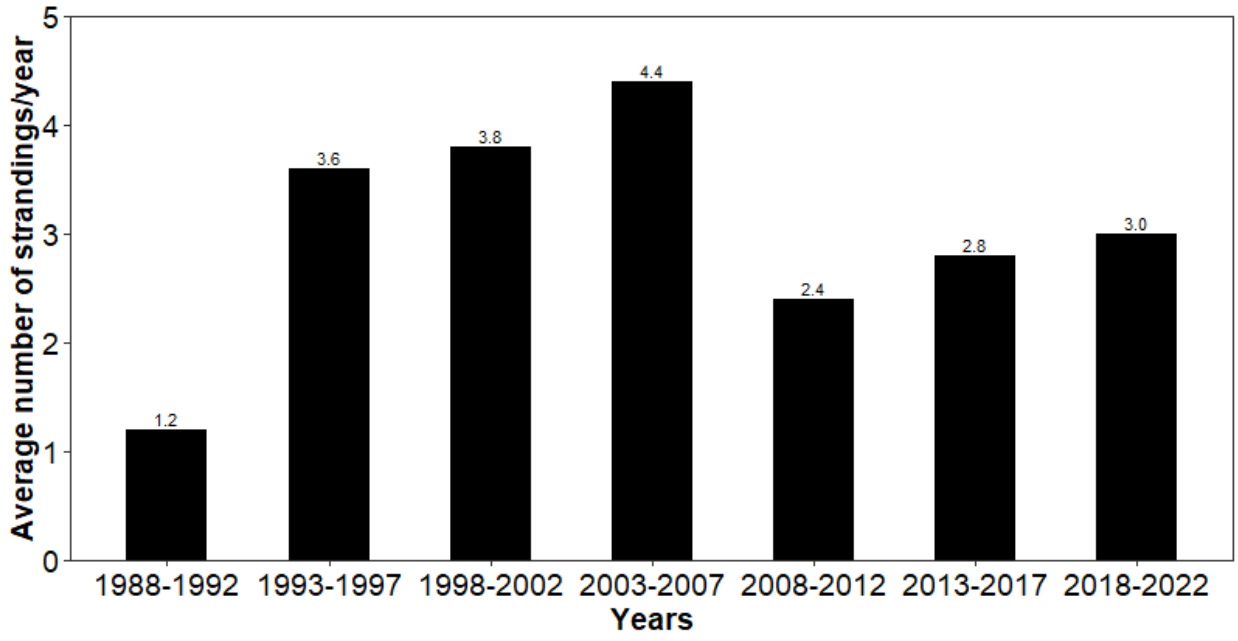


Figure 48. Average number of harbor seal strandings in Virginia from 1988 to 2022, summarized in five-year increments.

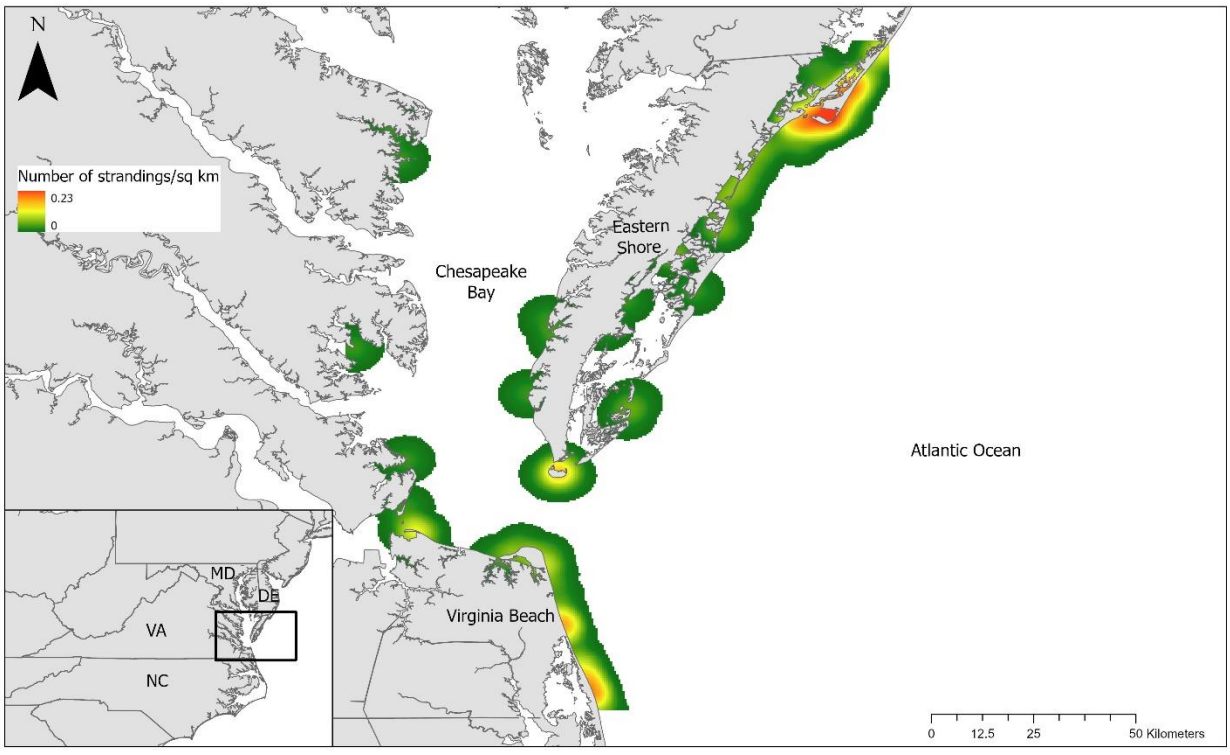


Figure 49. Density map of harbor seal strandings per square kilometer in Virginia from 1988 to 2022.

Similar to sightings, stranding records show distinct seasonal patterns with winter (53%, n=56) and spring (38%, n=40) having the highest number of strandings (Figure 39). While there were only a few strandings in the summer and fall, these primarily occurred on ocean-facing beaches, compared to strandings in the winter and spring which occurred along nearshore and ocean-

facing shorelines (Figure 40). The months of April (25%, n=26) and January (22%, n=23) had the highest number of strandings (Figure 41). No strandings were reported between August and October. Thirteen harbor seals have stranded with evidence of HI, many with evidence of fishery interactions, including multiple cases of recreational hook and line gear and shotgun pellets, neither of which have been commonly seen in other marine mammals that stranded in Virginia.

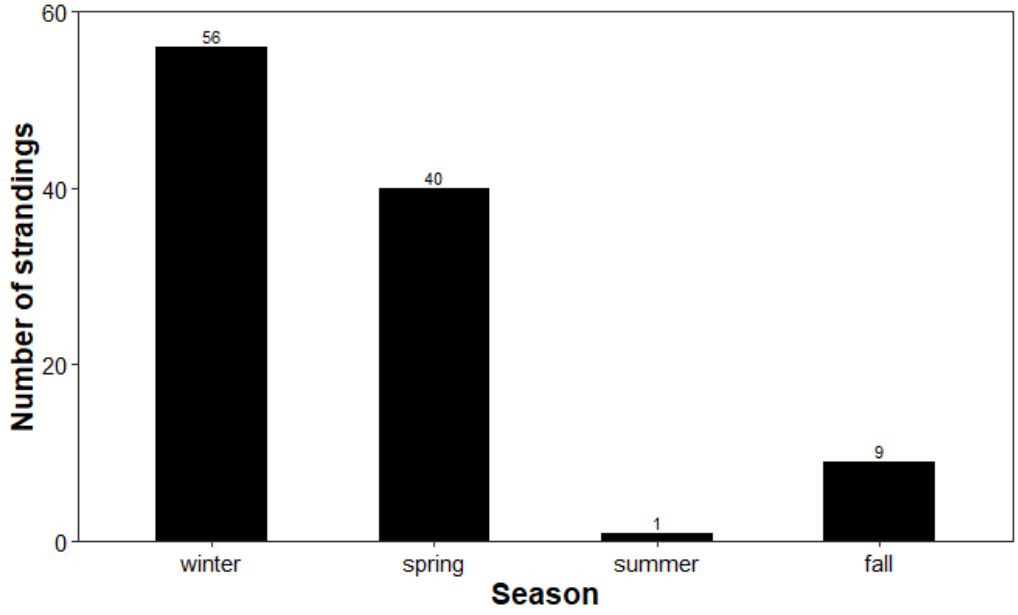


Figure 50. Number of harbor seal strandings per season in Virginia from 1988 to 2022.

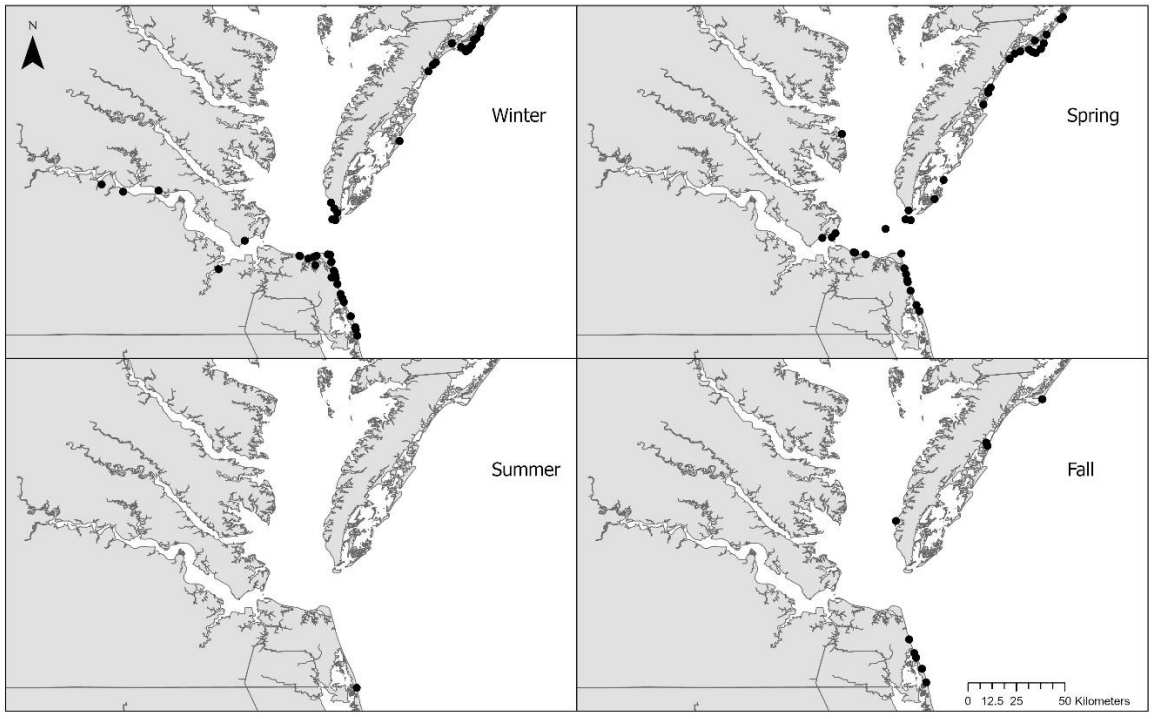


Figure 51. Map of seasonal harbor seal stranding locations in Virginia from 1988 to 2022.

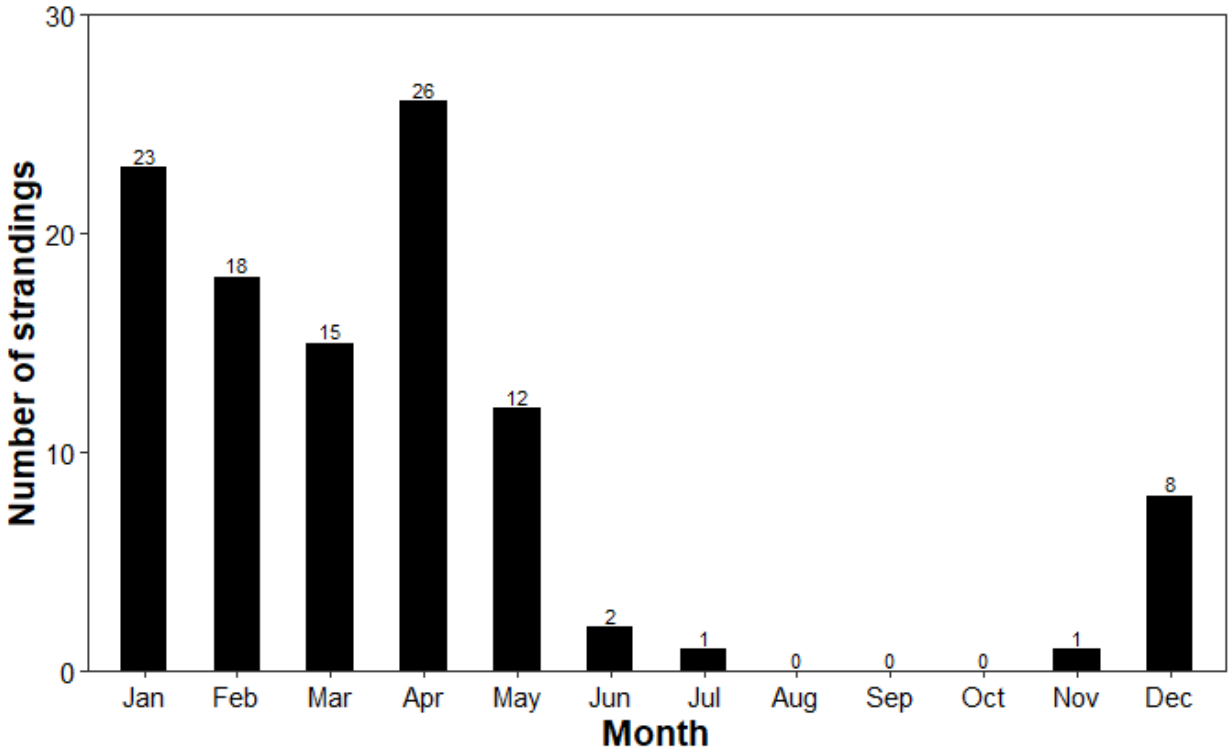


Figure 52. Number of harbor seal strandings per month in Virginia from 1988 to 2022.

Diet and Foraging in Virginia Waters

Harbor seal diet in Virginia waters is known only from stomach contents of stranded individuals. Ingested prey species included hake, Atlantic herring, Atlantic cod (*Gadus morhua*), pollock (*Pollachius virens*), short-finned squid (*Illex illecebrosus*), sand lance, and winter (*Pseudopleuronectes americanus*) and windowpane (*Scophthalmus aquosus*) flounder (Bowen and Harrison 1996; Toth *et al.* 2018).

Reproductive Activity in Virginia Waters

Reproductive activity has not been observed in Virginia waters.

Other Phocids

Based on stranding records, other phocids that are present in Virginia waters include gray seals, harp seals (*Pagophilus groenlandica*), and hooded seals (*Cystophora cristata*). The IUCN Red List categorizes gray and harp seals as Least Concern, while hooded seals are considered Vulnerable (Kovacs 2015; Bowen 2016; Kovacs 2016). None of these seal species are state or federally listed, a strategic stock, or an SGCN (DWR 2025; Hayes *et al.* 2020; Hayes *et al.* 2021; Hayes *et al.* 2022). Harp and hooded seals are ice seal species, and the only records of these seals in Virginia are of stranded individuals that are sick or injured and well outside of their normal range. Gray seal presence in Virginia waters is sporadic and occurs in the winter and early spring. Though their presence in Virginia waters may be becoming more regular, gray seal sightings from boat-based surveys and camera traps are typically of only a few individuals found at harbor seal haul-out sites (Guins *et al.* 2023; Jones and Rees 2023). These animals are

considered to be outside of their normal range and likely to be weanlings or marginalized seals. Strandings range from being rare for hooded seals to occurring almost annually for gray and harp seals.

SIRENIANS (MANATEES)

FLORIDA MANATEE (TRICHECHUS MANATUS LATIROSTRIS)

DESCRIPTION

Florida manatees (*Trichechus manatus latirostris*), a subspecies of the West Indian manatee (*Trichechus manatus*), are large herbivorous marine mammals with a spoon-shaped tail that occupy marine, brackish, and freshwater systems.

STATUS

Unlike other marine mammals in Virginia waters, Florida manatees are federally managed by USFWS. The West Indian manatee is considered vulnerable by the IUCN because of the low number of mature individuals and expected rate of decline from habitat loss and anthropogenic factors (Deutsch *et al.* 2008). Florida manatees were considered endangered under the state and federal ESA until 2017 when they were reclassified as threatened (USFWS 2023). They are also an SGCN in Virginia (DWR 2025). Although managed together as one stock, four management units are currently recognized: the Atlantic Coast and the upper St. Johns River units, both of which are on the Atlantic Coast side; and the Northwest Florida and Southwest Florida units, which are both on the Gulf Coast. Florida manatees were estimated at 8,810 individuals based on aerial surveys from 2015 to 2016 (Hostetler *et al.* 2018). Because of their threatened status, Florida manatees are considered depleted and a strategic stock (USFWS 2023).

The Atlantic Florida Manatee UME was declared along the east coast of Florida in March 2021 by the Florida Fish and Wildlife Conservation Commission and the USFWS. The event began in December 2020 and is ongoing. The UME is associated with phytoplankton blooms and seagrass loss in the Indian River Lagoon as evidenced by the high number of malnourished manatees. This UME is primarily impacting the Atlantic Coast management unit, which has the slowest population growth rate of the four management units. This unit was considered stable or growing prior to the UME, but the recent high mortality will likely impact overall population trends (Hostetler *et al.* 2018; USFWS 2023).

OCCURRENCE, DISTRIBUTION, AND ABUNDANCE IN VIRGINIA WATERS

Florida manatee presence in Virginia waters is seasonal. Manatees are thermally intolerant of water temperatures below 16 °C, and their movements are generally driven by water temperatures. In the winter, Florida manatees are restricted to the inland and coastal waters of peninsular Florida, where they utilize warm water sites such as natural springs and power plant discharges. During other seasons, manatees disperse and have been seen as far north as Massachusetts. Individuals within each management unit return to the same warm-winter sites annually. Movements occur between units that are on the same Florida coast, but movements between the Atlantic Coast and Gulf Coast management units are rare. Manatees that venture

into Virginia waters are likely from the management units on the Atlantic Coast of Florida (USFWS 2023).

Information on Florida manatee occurrences in Virginia waters come primarily from sighting data from 1991 to 2012. Manatees have been sighted in Virginia waters since 1991, and sightings were highest during the four-year period from 2009 to 2012. Sightings were most common during the months of June to October when water temperatures were above 20°C. Sightings have occurred as early as May and as late as November. Sightings were concentrated around Virginia Beach, primarily in rivers and creeks, but manatees have been reported in the James River near Richmond and in the Maryland portion of Chesapeake Bay (VAQS *unpublished data*, October 2023; Cummings *et al.* 2014). These data suggest Florida manatees are annual visitors to Virginia waters, and their presence may be increasing (Cummings *et al.* 2014).

STRANDINGS

Seven Florida manatee strandings have been documented in Virginia waters from 1998 to 2022. Five of the seven strandings were live animals considered to be well outside of their range and but appeared to leave the state based on the fact that sightings ceased and that no carcasses were ever recovered. The other two strandings were carcasses and the only documented HI cases, one had healed vessel strike scars and the other had blunt trauma consistent with being trapped in a lock structure near where the carcass was recovered. Strandings primarily occurred in rivers and creeks within the city limits of Virginia Beach and Norfolk. With the exception of one stranding in January, strandings have exclusively occurred from June to November.

DIET AND FORAGING IN VIRGINIA WATERS

Florida manatees are herbivorous and feed on a variety of vegetation. While their diet is unknown when in Virginia waters, dominant subaquatic vegetation species in the area include eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima;* Orth *et al.* 2015), which manatees consume in other locations (Allen *et al.* 2022). Manatees have also been observed foraging on terrestrial vegetation accessible from the banks of waterways, which has been observed in other habitats devoid of subaquatic vegetation (S. Barco, *personal communication*, October 3, 2023).

Reproductive Activity in Virginia Waters

Reproductive activity has not been observed in Virginia waters.

LIMITING FACTORS, CAUSES OF MORTALITY, AND OTHER THREATS TO MARINE MAMMALS IN VIRGINIA

A host of factors both related to human activities and of natural origin affect marine mammal populations and their habitats. Any federal action that is proposed which may affect protected marine species results in a consultation and review process between the agency proposing the action and agency overseeing federal protections. For marine mammals, NOAA Fisheries or USFWS is consulted through either the ESA section 7 or MMPA incidental take consultation process. Incidental takes for commercial fisheries are consulted separately under the Marine Mammal Authorization Program (MMAP). Additionally, a review process is required for any federal funding, permit, or work by a federal agency through the National Environmental Policy Act (NEPA) under the Environmental Protection Agency. The extent to which private entities

must comply with these policies depends on the location, action, and funding source (*i.e.* a private dredge company funded by the US Army Corps of Engineers [USACOE] must comply, commercial fishers using gear that may take marine mammals as bycatch must comply; commercial fishers in state waters using gear not deemed to take sea turtles or marine mammals do not need to comply). Therefore, many actions that may harm or 'take' marine mammals undergo a review process to assess the magnitude of the impact and how it should be mitigated and monitored.

Limiting Factors

While offshore species may be present year-round, occurrence of marine mammals in Virginia coastal waters is typically limited by either season (*e.g.* temperatures) or prey availability. For instance, North Atlantic right whales are considered transient visitors that inhabit Virginia waters during their latitudinal migrations between the summer feeding grounds and winter calving grounds. Their migration is seasonal, and occurrence in nearshore waters is strongly correlated with sea surface temperatures. In the northern feeding grounds, right whale occurrence is linked to dense patches of zooplankton, especially late stage calanoid copepods (Baumgartner *et al.* 2007). Similarly, winter presence of humpback whales in Virginia waters appears to be linked to ambient temperature and prey density (*e.g.* menhaden).

Causes of Mortality and Serious Injury

Mortality and serious injury in marine mammals are due to a wide variety of causes. With the exception of discrete, large scale mortality events due to disease (*e.g.* morbillivirus UME), biotoxin exposure (*e.g.* brevetoxicosis and domoic acidosis), or mass stranding events involving two or more animals stranding at the same time and place, excluding mother-calf pairs, there is a general paucity of information regarding natural causes of mortality and their effects on marine mammal stocks. For many marine mammal populations, a significant source of known mortality and serious injury is related to human activity; however, the level of such mortality has been challenging to document. Additionally, compounding sublethal effects of human activity (e.g. vessel noise, low level contaminants, harassment, climactic temperature rise) are difficult to assess and often do not receive the attention they deserve but are prevalent and exigent nonetheless.

Anthropogenic Mortality and Morbidity

Mortalities and impairment leading to mortalities are frequently the result of human activities, whether incidental or intentional. Such interactions, whether lethal or sublethal, are termed "Human Interactions". Intentional marine mammal takes, such as cetacean drive fisheries and seal hunts for human consumption, are only legal in the US where indigenous people are permitted a certain number of subsistence takes (*e.g.* Alaska). In Virginia waters, there are no permitted subsistence hunts at the time of this writing (2025). Incidental takes resulting from activities not specifically targeting marine mammals (*e.g.* bycatch) are assumed to represent a greater threat to marine mammals in Virginia waters than intentional takes. Incidental takes typically fall into one of three categories, namely those caused by interaction with a fishery (*e.g.* entanglement in nets or pot gear, hooking in longline fishery, etc.), interaction with a vessel (*e.g.* vessel collision, propeller wounding, dredge interaction, etc.) and pollution (*e.g.* ingestion of marine debris, entanglement in ghost fishing gear, noise and contaminants, etc.).

Disturbance and Harassment

Disturbance and harassment are common and persistent interactions between marine mammals and humans. While the impacts of disturbance and harassment are usually temporary and sublethal, impacts can compound with other sublethal impacts. Disturbance can be caused by a number of anthropogenic activities (*e.g.* noise pollution, fisheries activities, wildlife viewing, etc.). Vessel traffic, including vessel noise and other anthropogenic noise (*e.g.* geophysical surveys, sonar, pile driving, etc.), and other human interference can cause significant disturbance through various animal reactions, including avoidance of or displacement from an area, cessation of vocalization and other social behaviors, and alterations in foraging behavior (Nowacek *et al.* 2001; Papale *et al.* 2011; Sciacca *et al*. 2017. Such disturbance can ultimately impact an animal energetically, such as increased energetic costs avoiding an area or decreased energetic costs as food consumption decreases (Noren *et al.* 2017). Seals at haul-out sites on the CBBT and Eastern Shore of Virginia (ESVA) increased their time returning to the haul-out sites after flushing due to vessel presence over the 3-year study period from an average of 9 hours during the first study year to 14 hours during the last study at the CBBT haul-out site and from 4 to 13 hours at the ESVA haul-out site (Guins *et al.* 2023). Frequent disturbance can interfere with seal resting behavior, which can reduce overall fitness in a manner similar to vessel and noise disturbance discussed above.

Under the MMPA, harassment includes feeding, attempting to feed, approaching, interacting, touching/petting, and swimming with marine mammals. These actions may cause marine mammals to change their natural behaviors, such as seeking out humans for food, become less cautious around humans and/or boats, or result in individuals getting separated from each other, especially mother/calf and mother/pup pairs. Examples of harassment in Virginia waters include approaching or interacting with seals that are hauled out on land, feeding or watering manatees in marinas, and chasing dolphins or whales with vessels. Bottlenose dolphins conditioned to humans (*i.e.* begging, depredating, etc.) in Sarasota Bay, Florida, passed down this learned behavior to other dolphins and were more likely to become injured (*e.g.* vessel strike, entanglement, hook ingestion; Christiansen *et al.* 2016). Impacts of disturbance and harassment may also occur simultaneously, as observed in spinner dolphins (*Stenella longirostris*) off the coast of Egypt where their resting behavior was disrupted by the presence of swimmers and vessels (Fumagalli *et al.* 2018). In response, dolphins may have to alter their natural resting behavior, such as choosing a less optimal resting location or adopting irregular sleeping patterns, ultimately impacting other activities necessary for survival.

Other activities, such as dredging, marine construction, scientific research, and fishing, are regulated and require permits when activities may include harassment. In Virginia, harassment of dolphins, whales, manatees, and seals has been observed and reported to the stranding network (VAQS *unpublished data*, October 2023). Professional ecotourism operations usually voluntarily follow marine mammal wildlife watching guidelines, but anecdotal observation from whale watch and research vessels suggest that the general public does not regularly follow these guidelines when near marine mammals onshore or from vessels. Many members of the general public are unaware that marine mammal federal protections include disturbance and harassment. In cases where an animal or small group of animals remains in an area for an extended time period, outreach to local residents or casual observers usually mitigates the harassment, but the public does not always respond positively to guidance offered by stranding responders as they have no law enforcement authority.

Fishery Interactions

Fishery interactions with marine mammals are relatively common in numerous species. The scope of mortality and serious injury due to fisheries interactions are not known, due in part to the lack of adequate fisheries observer coverage and the challenging nature of forensic evaluation of stranded animals. In acute mortality cases, the cause of death in fisheries interactions is often related to underwater entrapment (*e.g.* suffocation/drowning; Moore *et al.* 2013). If initially survived, fishery interactions can lead to chronic conditions with increased morbidity, such as infection, physical (*e.g.* skeletal) deformation, energetic impairment due to impaired foraging, and a general failure to thrive (Moore *et al.* 2013). Commercial fisheries are classified into one of three categories based on the level of incidental mortality and serious injury observed: Category 1 (frequent interactions); Category 2 (occasional interactions); and Category 3 (remote likelihood of/no known interactions; NOAA Fisheries 2023d).

From stranding data, fishery interactions are the most common type of HI observed in Virginia waters. The mid-Atlantic gillnet fishery is the Commonwealth's only Category 1 fishery, while the Chesapeake Bay inshore gillnet, Atlantic blue crab trap/pot, mid-Atlantic menhaden purse seine, mid-Atlantic haul/beach seine, and the Virginia pound net fishery are all Category 2 fisheries (NOAA Fisheries 2023d). Virginia stranding and entanglement data include fishery interactions with pound nets, gillnets, crab trap/pot lines, and various unidentified rope/line gear, the latter being consistent with, but not indicative of, a fishery interaction. Numerous mortalities of cetaceans in pound nets and gillnets have been documented through stranding response (VAQS *unpublished data*, October 2023). Additionally, reports and sightings of live and dead bottlenose dolphins entangled in crab pot gear are not uncommon (VAQS *unpublished data*, October 2023). Other times, gear may no longer be attached; however, animals have ligature marks and abrasions consistent with different gear types, such as twisted twine (*e.g.* pound net); monofilament net (*e.g.* gill net); or braided pot warp (*e.g.* pot buoy line). Deceased bottlenose dolphins with ligature marks and abrasions are recovered by VAQS annually. Marine mammal species such as bottlenose dolphins, humpback whales, and seals may also interact with or ingest recreational, or commercial hook and/or line gear (VAQS *unpublished data*, October 2023). Hooks can become embedded externally and line can become wrapped around the body, appendages, mouth, teeth, or baleen. While fishery interactions with bottlenose dolphins are the most common, they have also been documented with harbor porpoises, short-beaked common dolphins, humpback whales, minke whales, fin whales, North Atlantic right whales, harbor seals, and gray seals in Virginia waters (VAQS *unpublished data*, October 2023).

Marine mammals in federal waters may interact with the Atlantic Ocean large pelagics longline fishery, a Category 1 fishery, or the mid-Atlantic mid-water trawl and mid-Atlantic bottom trawl fisheries, both of which are Category 2 fisheries. Stranded species in Virginia with evidence of fisheries interactions include Atlantic white-sided dolphins, dwarf sperm whales, long-finned pilot whales, and Risso's dolphins (VAQS *unpublished data*, October 2023). Since these interactions occur in offshore waters with species that infrequently strand, it is difficult to assess the frequency of these interactions from stranding data alone. One method to assess offshore fishery interactions is through federal fisheries observer programs. Data from federal observers are used to estimate bycatch rates and serious injury and mortality for marine mammal stocks by fishery management area (*e.g.* not on a state-by-state basis). For example, 77 serious injuries and one mortality were observed in the western North Atlantic stock of short-finned pilot whales from 2015 to 2019 in waters from Maine to Florida for an estimate of 136 serious injuries and mortalities annually (Hayes *et al.* 2022).

Fishery interactions with marine mammals in Virginia waters are currently documented through the Northeast Fisheries Observer Program (NEFOP) and managed through TRTs. NOAA Fisheries is authorized to place trained observers on Category 1 or 2 fishing vessels and on certain Category 3 vessels. The mid-Atlantic gillnet, Atlantic Ocean large pelagics longline, mid-Atlantic mid-water trawl, and mid-Atlantic bottom water trawl all have annual federal observer coverage, although the percentage of coverage varies. For state-managed fisheries, limited federal observer coverage has occurred in the mid-Atlantic menhaden purse seine, while no federal observer coverage has occurred in the Chesapeake Bay inshore gillnet, mid-Atlantic haul/beach seine, Virginia pound net, and Atlantic blue crab trap/pot. TRTs for large whales (*i.e.* humpback, fin, and North Atlantic right whales), bottlenose dolphins, and harbor porpoises manage gear requirements for gillnets, pound nets, and trap/pots through gear markings, weak links or rope (*i.e.* an attachment or portion of the rope that breaks at a lower strength than the rest of the rope), mesh size regulations, and seasonal closures among other factors (72 FR 57104; 71 FR 24776; 63 FR 66464). In offshore waters, a TRT for the Atlantic Ocean pelagics longline fishery mandates mainline lengths and careful handling and release of bycaught cetaceans, mainly short- and long-finned pilot whales and Risso's dolphins (74 FR 23349).

Fishery interactions with marine mammals in state-managed fisheries from the state-run observer program differ from interactions observed in stranding data. The MRC observer program was developed in 2016 primarily to monitor Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) bycatch. During the 632 observed trips conducted by the MRC Protected Species Observer Program from 2016 to August 2024, the program recorded zero marine mammal takes. The state-managed fisheries that were observed included: anchored gillnet (501 trips); drift gillnet (52 trips); staked gillnet (20 trips); beam trawl (47 trips); haul seine (3 trips); pound net (2 trips); and electrofishing (7 trips; MRC *unpublished data*, November 2024). Of these, the MRC estimates that 253 trips were conducted in typical marine mammal habitat on gillnet gear that may interact with marine mammals, including gillnet, pound net, and haul seine. Gillnet trips targeted striped bass, Spanish mackerel (*Scomberomorus maculatus*) and spiny dogfish (*Squalus acanthias*). Haul seine and pound net gear are non-specific gear types that target all species moving close to shore.

Vessel Strikes

The commonality of vessel interactions varies considerably by species. Odontocete species sustain watercraft injuries far less frequently than mysticetes. Conversely, vessel interactions are regularly documented in large whale species that inhabit coastal waters, such as North Atlantic right whales, fin whales, and humpback whales (Jensen and Silber 2003; Douglas *et al.* 2008), with up to one third of strandings of these species in some regions involving vessel interactions (Laist *et al.* 2001). Vessel interactions can range from sublethal injuries with little effect, to chronic, insidious injuries, to catastrophic interactions with immediate fatality (Moore *et al.* 2013). Vessel collisions can result in blunt force trauma (*e.g.* hematomas, contusions, bone fractures) with or without forced submergence; sharp force trauma (*e.g.* incising propeller or skeg/rudder wounds) and, occasionally, exsanguination, depending on the wound depth and location; or chop wounds involving both incising and crushing injuries (Rommel *et al*. 2007; Moore *et al*. 2013). In North Atlantic right whales, severity of propeller injury appears to be correlated with injury location (Sharp *et al.* 2019), and this is likely true for all species. A wide range of vessel/propellor sizes have been implicated in serious injury and mortality of baleen whales.

The coastal waters of Virginia have high levels of vessel traffic since being home to the Norfolk Naval Station, the largest naval installation in the world, and the Port of Virginia in Portsmouth, Virginia, the sixth busiest port in the US (USACOE 2017). In addition, Virginia also hosts a healthy commercial fishing industry with over 700 commercial fishing vessels documented in Virginia in the US Coast Guard Merchant vessel registry as of November 2024. Of these, the majority (n = 611, 83%), were less than 50 feet in length, 103 fishing vessels (14%) were listed as 50-99 feet, and 23 fishing vessels were 100 feet or greater. The number of registered commercial fishing vessels in coastal and bayfront Virginia counties was relatively stable from 2016 to 2024 (DWR *unpublished data*, November 2024). In addition to commercial vessels, Virginia has high numbers of recreational vessel registrations in coastal and bayfront counties, with more than 33,000 vessels greater than 20 feet in length registered in 2024 as of November (DWR *unpublished data*, November 2024). The number of recreational vessels in these counties show an increasing trend since 2016, in all length categories, with 99% of vessels (32,973) between 20 and 49 feet in length. Vessel traffic ranges from personal watercraft to commercial container ships and military aircraft carriers. Vessels using Automated Identification System (AIS, required for commercial vessels 65 feet or greater in length) utilize much of the Chesapeake Bay and surrounding coastal waterways (Figure 42).

In species that inhabit inshore and nearshore waters, injuries consistent with vessel strikes have been documented in stranded bottlenose dolphins, fin whales, minke whales, humpback whales, sei whales, North Atlantic right whales, and Florida manatees (VAQS *unpublished data*, October 2023). North Atlantic right whales appear to be more susceptible to vessel strikes than other marine mammals, with 43% of North Atlantic right whale strandings in Virginia having evidence of vessel strikes (VAQS *unpublished data*, October 2023). Further, vessel strikes were responsible for 42% of North Atlantic right whale deaths reported along the US Atlantic coast from 2003 to 2018 (Sharp *et al.* 2019). Although vessel strikes have been documented less frequently in other large whale species in Virginia waters from stranding records, these species still are at risk. Tagging data from humpback whales in Virginia found spatial overlap between whale movements and shipping channels leading to and within the Chesapeake Bay. Fin and minke whales were also observed in the shipping channels, though less frequently (Aschettino *et al.* 2020a).

Although there is less spatial overlap between marine mammals and vessels in offshore and pelagic waters, marine mammals are still at risk of vessel interactions. Deeper waters of the continental shelf to waters past the shelf break are US Navy operating and training areas. A study conducted on the detectability of various cetaceans by US Navy lookout teams found all analyzed groups had a high probability of remaining undetected (≥80%). Baleen whales were the easiest to detect followed by sperm whales and small cetaceans, which were the most difficult to detect (Oedekoven and Thomas 2022). Naval ships are just one example of the type of vessel utilizing offshore waters. Other vessel types include commercial ships and fishing vessels of all sizes. The exact impact of vessel strikes in offshore waters is difficult to assess due to the low likelihood of such an event being witnessed and subsequently reported. While stranding records can document the occurrences of vessel interactions, it cannot discern where the strike occurred.

Existing federal actions to mitigate vessel strikes in Virginia waters include the North Atlantic right whale SMA. The SMA encompasses waters within a 20 nm radius half circle from the mouth of the Chesapeake Bay where vessels 65 ft or greater in length cannot exceed 10 knots

from November 1 to April 30 (73 FR 60173). Although the SMA targets the protection of right whales, other large whales utilize this area as well and benefit from the SMA.

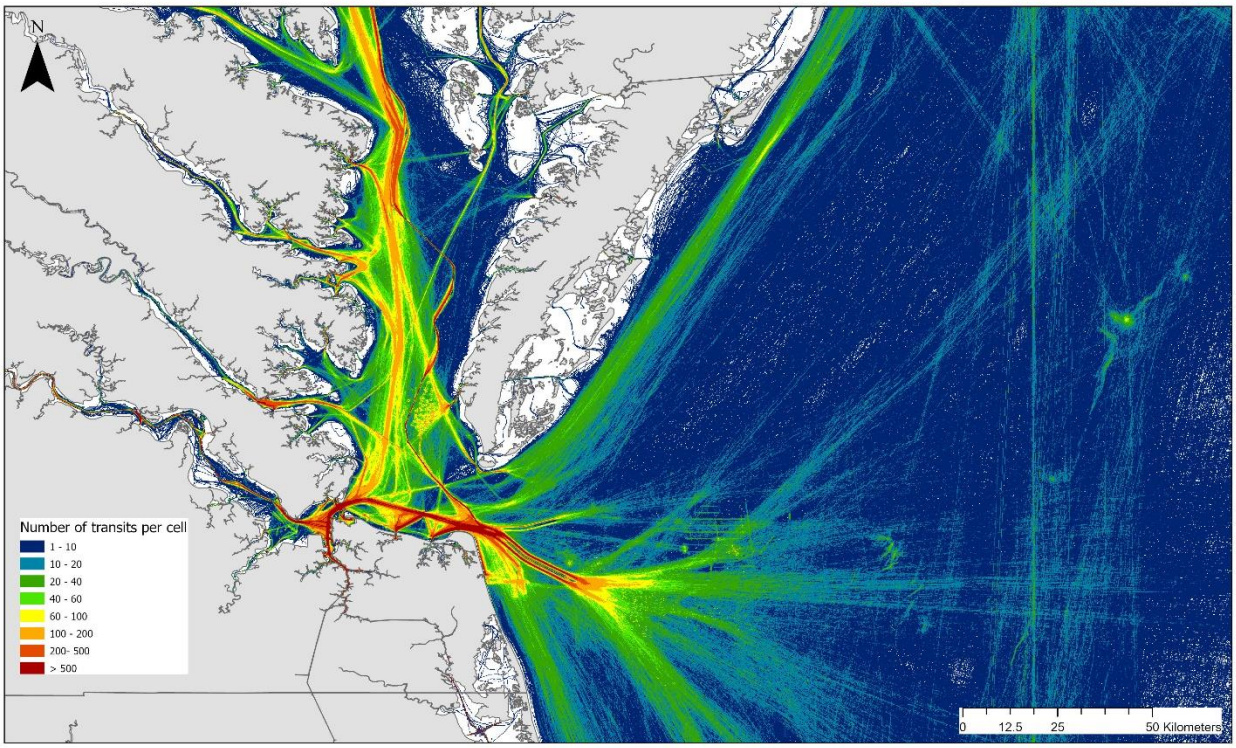


Figure 53. Density map of vessel traffic using AIS for 2022 along the Virginia coastline (Fontenault 2023).

Pollution

Marine mammals are affected by pollution in many overt and subtle ways. Pollution comes in many obvious forms, such as trash or marine debris (*e.g.* Great Pacific trash gyre) and "ghost" fishing gear, or more insidious forms including noise (*e.g.* noise generated by mid-frequency active sonar, seismic surveys, and motorized vessels). The direct effects of debris and noise pollution are documented in individual animals; however, the population level effects are difficult to estimate. In addition to trash and ghost gear, microplastic debris is becoming a concern for its impact on many species.

Debris

Debris impacts marine mammals in Virginia waters in the form of micro- and macro-plastics and other debris of various sizes and composition. Microplastics are small plastic particles that are < 5 mm, such as microbeads, pellets, or fragments from larger plastic pieces, while macro-plastics includes all plastic particles > 5 mm (NOAA Marine Debris Program 2021). Debris in the marine environment primarily comes from land-based sources, such as litter transported by way of storm drains or runoff, but also comes from water-based sources, such as derelict fishing gear and trash intentionally or unintentionally discarded from vessels (Register *et al.* 2021). The Virginia stranding record has documented the ingestion of and entanglement in marine debris among bottlenose dolphins, minke whales, sei whales, harbor seals, and harp seals and included items such as plastic bags, a partial DVD case, and fishing line and hooks (VAQS *unpublished data*, October 2023). Effects of debris ingestion can range from mild to severe, sometimes resulting in

death. Additionally, microplastics which are present in the Chesapeake Bay (Yonkos *et al.* 2014; Murphy *et al.* 2019) can impact marine mammals both chemically and physically when ingested. Although the long-term impacts are unknown, microplastic ingestion has also been documented in many species across the Atlantic Ocean, including bottlenose dolphins (Lusher *et al.* 2018; Battaglia *et al.* 2020), harbor porpoises (Lusher *et al.* 2018), fin whales (Garcia-Garin *et al.* 2021), and harbor and gray seals (Hudak and Sette 2019). Entanglement in debris can occur in larger, discarded items, such as a parachute which entangled a bottlenose dolphin, or discarded or derelict fishing line and/or hooks that have been found wrapped around bottlenose dolphins and harbor seals (VAQS *unpublished data*, October 2023). Larger pieces of fishing gear, such as pots and nets, also pose a risk of entanglement and entrapment. Sometimes, it is unclear whether the gear was derelict at the time of interaction or became so because of the marine mammal. Derelict fishing gear surveys in the Chesapeake Bay found blue crab pots were the most common type of gear, comprising 94% of recovered gear, and 40% of the pots appeared to be functional and abandoned as opposed to being lost or unretrievable (Bilkovic *et al.* 2014).

Debris also poses a threat to marine mammals in pelagic Virginia waters. Although it is more difficult to assess the impacts in pelagic waters, both micro and macro-plastics have been documented in the Norfolk Canyon (Jones *et al.* 2022). A pygmy sperm whale and Risso's dolphin have stranded in Virginia with macro-plastics in their stomachs, though when and where the debris were ingested is unknown (VAQS *unpublished data*, October 2023). Microplastic ingestion has also occurred in offshore species, such as True's beaked whales, short-beaked common dolphins, and striped dolphins (Lusher *et al.* 2015; Lusher *et al.* 2018).

Marine debris in Virginia waters is increasing, with plastics comprising 83% of all items collected from 2014 to 2018 (Register *et al.* 2019); however, this threat is not exclusive to Virginia waters and will require considerable collaboration to address. The Virginia Marine Debris Reduction Plan and the Mid-Atlantic Marine Debris Action Plan contain many viable actions that can be taken to address marine debris. Both plans share the same goals: to understand, prevent, and mitigate consumer debris and single-use plastics, derelict fishing gear, microplastics and microfibers, and abandoned vessels through efforts such as clean-ups, outreach, and monitoring (NOAA Marine Debris Program 2021; Register *et al.* 2021). From these efforts, the MRC established the Abandoned or Derelict Vessel Program to provide grant funding for the removal of abandoned or derelict vessels (MRC 2025).

Noise

Noise pollution has received increasing attention since the 1990s. Sources and types of noise pollution can vary considerably from commercial (*e.g.* shipping noise, energy exploration/operations, etc.) to construction and military (*e.g.* pile-driving, dredging, mid-frequency active sonar, demolitions/explosions, etc.). Effects of noise pollution are highly variable, ranging from temporary harassment level impacts to acoustic injury to mortality (Fernández *et al.* 2005; Weilgart 2007). Harassment level impacts include avoiding critical feeding or breeding areas, and obscuring or masking vocalizations and sounds, which ultimately reduces the signal range and quality of information. Acoustic injury includes hearing loss or shifts in hearing thresholds that can either be temporary or permanent, depending on whether noise exposure is repeated, prolonged, or especially loud (Weilgart 2007). Mortality can result from decompression-like syndrome (*e.g.* the bends), as tissues become super-saturated with nitrogen gas from surfacing too quickly, observed more frequently in deep-diving species such as beaked whales (Fernández *et al.* 2005; Weilgart 2007).

Anthropogenic noise from various sources is omnipresent in all Virginia waters. One of the most significant emerging sources of noise is the development of wind energy areas (WEA). In fact, the Regional Wildlife Science Collaborative (RWSC) has identified noise as the industry's greatest impact to marine mammals in its Integrated Science Plan for Offshore Wind, Wildlife and Habitat in US Atlantic waters (RWSC 2024). Noise associated with offshore wind comes from vessels used to construct and service wind farms, construction activities, especially pile driving, and from functioning turbines (Kraus *et al*. 2019). Development of the first offshore wind facility in Virginia, the Coastal Virginia Offshore Wind (CVOW) development by Dominion Energy, began in May 2024 and is expected to continue through 2026, with pile driving expected to end sometime in the summer or fall of 2026 (Figure 43). Dominion Energy also purchased a lease in Northeastern North Carolina (formerly Kitty Hawk Wind) and leased an area to the east of the current CVOW site (CVOW East). Mitigation measures addressing noise production from pile driving include restrictions on timing of activities to avoid right whales, use of bubble curtains to acoustically dampen sound, and independent observer surveys before and during pile driving activities that are required by federal permitting agencies and are described in the CVOW Construction Mitigation and Monitoring Plan (Tetra Tech 2024).

To analyze baleen whale use of the Virginia WEA, moored PAM units were deployed approximately 30 km to 120 km offshore. Fin, humpback, minke, and North Atlantic right whales were all detected within the WEA. While fin whale calls were detected in relatively high numbers year-round, other large whale presence was seasonal based on their migratory movement. Odontocete calls were also detected and mostly occurred closer to shore and in the summer months. These results suggest numerous cetacean species utilize the waters surrounding the WEA at different times of the year (Klinck *et al.* 2018). Other sources of noise include dredging operations, most recently navigational channel expansion that began in December 2019 in the Port of Virginia shipping channels to both deepen and widen the channels and is expected to take ten or more years to complete (USACOE 2018).

Vessel and construction noise also pose a threat in offshore waters by way of high-traffic shipping activity and offshore wind energy development (Figure 43). Military noise from mid-frequency active sonar is also of concern, specifically with deep-diving species. In areas with mid-frequency active sonar, fewer beaked whales were present during periods of sonar activity. Their response was also impacted by the loudness of the sonar, with less whales present at louder sounds (Van Parijs *et al.* 2023). Short-finned pilot whales have also been documented moving away from sources of sonar (Southall *et al.* 2018).

Noise is difficult to manage due to both the complicated and difficult-to-predict nature of its propagation through the water column and the unpredictable animal behavioral responses to noise levels not considered physically injurious. Two current studies to understand the impacts of noise on marine life and provide possible mitigation measures are NOAA's Ocean Noise Strategy Roadmap and the RWSC Science Plan. NOAA's Ocean Noise Strategy Roadmap includes monitoring and better understanding the physical impacts of ocean noise on various marine species and future actions, such as protected areas and "green ships" that are quieter (Gedamke *et al.* 2016). The RWSC Science Plan focuses on understanding the impacts of offshore wind development off the US Atlantic and provides recommendations to understand habitat-use of various marine species for successful ocean planning and minimization of environmental disturbance (RWSC 2024).

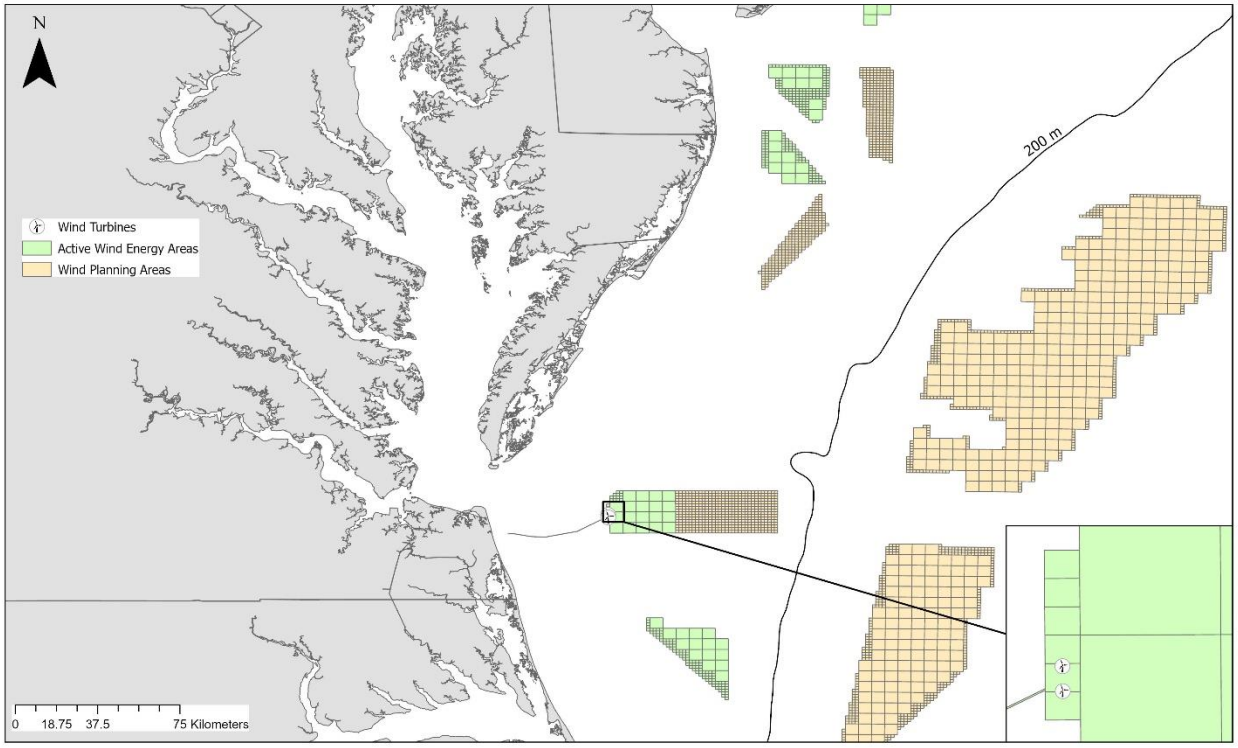


Figure 54. Map of active wind energy areas and future wind planning areas, with cable and turbine (inset) locations, along the mid-Atlantic Bight, with the 200-m isobath (BOEM 2023). Dominion Energy has acquired leases for the two areas on the Virginia continental shelf and recently acquired the lease for the northern North Carolina area. Offshore areas (tan) are considered planning areas and, as of early 2025, lease areas and timelines were not finalized.

Contaminants

Contamination occurs when a substance is present where it normally does not occur or at a concentration above background levels (Chapman 2007). Further, contamination can be classified as point, originating from a single source, or non-point, originating from multiple sources. Point source contamination is discussed in this section, while non-point source contamination is discussed in the habitat degradation section.

Point source contamination is especially problematic for marine mammals when it is an acute or short-term event that directly impacts animals and can potentially be lethal. Examples of these types of events include spills of fossil fuels or sewage. Although no large-scale spills have occurred in coastal or offshore Virginia waters, exposure to fossil fuels can impact marine mammals by irritating skin, fur, eyes, and mucus membranes, damaging internal tissues, and causing die-offs (Geraci and Lounsbury 2005). Although fossil fuels are not currently extracted from the marine environment in or offshore of Virginia, fuel associated with military and shipping vessels creates a risk of moderate-sized spills that could impact marine mammals. Response to these types of events requires coordinated planning and training that specifically addresses how marine mammals will be monitored, assessed, and who will capture and care for them should intervention be required.

Natural

Threats to marine mammals can also stem from natural sources. Infectious diseases (*e.g.* morbillivirus), harmful algal blooms (*e.g.* domoic acid, saxitoxins, brevetoxins), resource/prey

shifts, and other variables can lead to nutritional stress, immunosuppression, reduced fecundity, and/or direct mortality. Additionally, it is believed that some natural phenomena, such as domoic acid toxicity caused by a neurotoxin found in plankton diatoms, can lead to chronic impairment that may affect brain development and make marine mammals more susceptible to other threats, both natural and manmade (Ramsdell and Zabka 2008; Pulido 2008; Montie *et al.* 2012; Buckmaster *et al.* 2014; Ramsdell and Gulland 2014). Although epigenetic effects of natural biotoxin and infectious agent exposure in marine mammals are not understood, it is assumed that such mechanisms bear some similarities to other mammals by potentially compromising long-term survival and fitness.

Disease

Infectious diseases are poorly understood in most marine mammal species but can be categorized by the type of infectious agent involved (*e.g.* fungal, viral, bacterial, protozoal, etc.). The manifestation of such diseases can be either acute or chronic, resulting in one of three subsequent outcomes: survival, morbidity, or mortality. Little is known about infectious diseases in marine mammals inhabiting inshore and offshore waters of Virginia. What is known primarily involves emerging or resurging diseases, such as morbillivirus, brucellosis, and influenza. Morbillivirus, a relative of canine distemper virus, can affect cetaceans and phocids and has been implicated as the cause of large-scale mortalities of bottlenose dolphins in Virginia. Morbillivirus was diagnosed as the causative agent of a massive cetacean mortality event affecting much of the US Atlantic coast (New York to Florida) and spanning from July 1, 2013, to March 1, 2015. The morbillivirus UME resulted in 1,614 documented bottlenose dolphin mortalities, of which Virginia experienced the highest number (416; NOAA Fisheries 2023a). Prior to this mortality event, an extensive morbillivirus associated event occurred in 1987 to 1988, resulting in 740 coastwide bottlenose dolphin mortalities, prompting the speculation that morbillivirus has a cyclical resurgence based on herd immunity patterns. Phocine distemper virus was most recently implicated as the causative agent of a large-scale die-off of harbor and gray seals from July 1, 2018, to March 13, 2020, from Maine to Virginia (NOAA Fisheries 2023b).

Brucellosis, a bacterial infection caused by *Brucella* spp., has been detected in 53 species of marine mammals worldwide. Two strains primarily infect marine mammals: *Brucella ceti* and *Brucella pinnipedialis*. Both can cause inflammation of the brain, meningitis, pneumonia, arthritis, and abortions (Hernández-Mora *et al.* 2013). The epidemiology of brucellosis is poorly understood, but in South Carolina, there were more cases among bottlenose dolphins during the spring calving season, suggesting there may be a temporal pattern in bottlenose dolphins (McFee *et al.* 2020). Influenza A and B viruses have been detected in various marine mammal species, primarily phocids. It is thought to be spread to marine mammals via contact with birds and can result in pneumonia or some other respiratory condition (Fereidouni *et al.* 2016). Influenza has been responsible for multiple large-scale die-offs of seals. The most recent example occurred in June 2022, which affected harbor and gray seals in northern US Atlantic waters (NOAA Fisheries 2023c).

Injury (Infanticide, *Predation*, Incidental Foraging)

Non-anthropogenic sources of lethal and non-lethal injuries among marine mammals include conspecifics, other marine mammal species, predators, and the incidental ingestion of large prey items or harmful prey parts such as stingray and fish spines. Several cases of infanticide, presumably caused by adult bottlenose dolphin males, has been documented in Virginia waters

(Dunn *et al.* 2002), and cases of interspecific aggression have been suspected among bottlenose dolphins attacking juvenile harbor porpoises (VAQS *unpublished data*, October 2023). Predation also occurs occasionally, primarily by sharks targeting smaller or compromised marine mammals. There are also incidents of external and/or internal injury or infection caused by stingray spines, injury or suffocation from ingested fish spines in the esophagus, and epiglottal blockage or dislocation from large prey or awkward ingestion (Walsh *et al.* 1988; McFee and Lipscomb 2009; Stolen *et al.* 2013). Epiglottal blockage or dislocation ultimately resulting in asphyxiation has been suspected as the cause of death in stranded bottlenose dolphins and harbor porpoises in Virginia ingesting summer flounder (*Paralichthys dentatus*), striped bass (*Morone saxatilis*), hogchoker (*Trinectes maculatus*), and blackcheek tonguefish (*Symphurus plagiusa*) (VAQS *unpublished data*, October 2023).

Harmful Algal Blooms (HABs)

Harmful algal blooms (HABs) occur when alga bloom in large numbers, producing biotoxins and depleting the water of oxygen as the alga decompose. HABs are driven by excess nutrients, primarily nitrogen and phosphorus, entering the water. The diatom *Pseudo-nitzschia* spp. and various bloom-forming dinoflagellates that produce biotoxins such as karlotoxins, saxotoxins, hepatotoxins, and domoic acid are found in the Chesapeake Bay (Rattner *et al.* 2022). Biotoxins pose a serious threat to marine mammals because they can be inhaled at the surface when they aerosolize (Mase *et al.* 2000) or can be ingested through prey items (*e.g.* fish or seagrass; Flewelling *et al.* 2005). Exposure to biotoxins can cause neurological dysfunction, locomotor impairment, ataxia, seizures, and even death (Goldstein *et al.* 2008; Fire *et al.* 2021). Large-scale mortality events off the Gulf Coast of Florida have been attributed to red tide blooms which produces brevetoxin (Mase *et al.* 2000; Flewelling *et al.* 2005) and exposure to domoic acid has resulted in mass die-offs off the California coast (Goldstein *et al.* 2008). Biotoxins have been detected in a variety of species, including brevetoxin in Florida manatees and bottlenose dolphins (Mase *et al.* 2000; Flewelling *et al.* 2005), and saxitoxin and domoic acid in short-beaked common dolphins, humpback whales, and harbor seals (Fire *et al.* 2021). Offshore species, such as Risso's dolphins and dwarf and pygmy sperm whales (*Kogia* sp.), have also tested positive for biotoxins even though most blooms occur in inshore waters (Fire *et al.* 2021). HABs in the Chesapeake Bay are increasing over time due to increasing water temperatures and eutrophication (Li *et al.* 2015), prompting intensive water quality surveillance and research on how HABs are affecting marine organisms, not just marine mammals, in Virginia waters.

Cetacean Mass Stranding(s)

A mass stranding is defined as an event where two or more cetacean strandings occur at the same time and place, excluding mother-calf pairs. Some species are known to mass strand, including pilot whales, sperm whales, and several pelagic dolphin species. The causes of mass strandings are difficult to discern, but some include disease, social cohesion, complex bottom topography, weather, oceanographic conditions, and anthropogenic causes (*e.g.* sonar; Geraci and Lounsbury 2005). Mass stranding events in Virginia waters have included common dolphins, dwarf sperm whales, Risso's dolphins, short-finned pilot whales, pygmy killer whales, striped dolphins, and rough-toothed dolphins (VAQS *unpublished data*, October 2023). Some, but not all, of these events were correlated with strong weather events (VAQS *unpublished data*, October 2023).

Other Threats

Changing Environmental Conditions

The study of changing environmental conditions effects on marine mammals is in its infancy. Marine mammal populations are being affected by changing environmental conditions as evidenced by shifts in distribution, spatial and temporal changes in migration, and habitat loss. Although not conclusively linked to climate change, recent years have shown significant changes in the distribution of several marine mammal species. North Atlantic right whales have shifted their distribution northward with increased sightings in the Gulf of St. Lawrence, possibly due to shifting prey distribution (Pettis and Hamilton 2016; Davis *et al.* 2017). Additionally, calving grounds saw record low numbers of mother-calf pairs in 2016 and 2017. At the same time, body condition scores and indices of health among adult right whales have been worsening, leading scientists to speculate about prey shifts, disease, and the loss of population-level knowledge of alternate feeding grounds as the possible causes. Similarly, states such as Virginia and North Carolina have progressively experienced increased phocid (true seal) sightings in winter and early spring months. Individual seals have been observed returning to some locations, indicating a degree of seasonal residency and site fidelity not historically seen in those latitudes (Ampela *et al.* 2023; Jones and Rees 2023). In addition to redistributions, other species have shifted the timing and duration of their migrations. Both fin whales and humpback whales arrived at and departed from their summer feeding grounds in the Gulf of St. Lawrence earlier than previously recorded over the course of a 26-year study period (1984–2010), most likely driven by the earlier timing of the phytoplankton bloom (Ramp *et al.* 2015). Other indirect effects could come in the form of sea level rise, increased water temperatures, Gulf Stream current changes, and rainfall changes that can drastically affect coastal watersheds and promote algal growth. Increasing nutrient runoff and freshwater effluent, decreases in salinity, and increasing water temperatures and carbon dioxide can be major contributors to the onset and persistence of harmful algal blooms.

Water temperatures in the Chesapeake Bay watershed are increasing over time (Rice and Jastram 2015). For species already changing their distribution and timing of migration (*e.g.* humpback and fin whales), this may impact when and where these species are seen in Virginia waters. Cold-water species, such as harbor porpoises and short-beaked common dolphins, are predicted to move northward to remain in cooler waters (van Weelden *et al.* 2021). Subsequently, these species may occur less frequently in Virginia waters, which may already be reflected in the reduced stranding rates of Atlantic white-sided dolphins, harbor porpoises, and hooded seals (Thorne *et al.* 2022; VAQS *unpublished data*, October 2023). Conversely, bottlenose dolphin strandings have been increasing over time in the mid-Atlantic Bight (Thorne *et al.* 2022), coinciding with increased bottlenose dolphin strandings over time in Virginia (VAQS *unpublished data*, October 2023).

The effects of changing environmental conditions will take extensive collaboration to address since it is not exclusive to this region and many marine mammal species occur only seasonally in Virginia waters. Lettrich *et al.* (2023) analyzed the exposure and sensitivity of each marine mammal stock to determine which stocks are most vulnerable to outcomes resulting from changing climate conditions. Most stocks in the western North Atlantic Ocean ranked high to very high for exposure to environmental change and are considered to have low to moderate sensitivity to tolerate environmental change. Further, phocids ranked lower for exposure in comparison to other taxonomic groups and endangered species had higher exposure and lower

sensitivity. While these findings highlight stocks of concern, each stock will respond differently in terms of its abundance, distribution, and phenology (Lettrich *et al.* 2023), making this threat extremely challenging to address. In 2023, the federal Ocean Policy Committee enacted the Ocean Climate Action Plan to address ocean climate change. The Ocean Climate Action Plan has three key goals: create a carbon-neutral future; accelerate nature-based solutions to protect and support natural coastal and ocean systems; and enhance community resilience to ocean change (Ocean Policy Committee 2023). It identifies a number of cross-sector action items needed to achieve these goals, predicated on collaboration between governmental and non-governmental entities, communities, and commercial and industrial entities.

As marine mammal distribution changes spatially and temporally in response to climate change, the possibility of greater exposure to other identified threats in Virginia waters may become more likely. For example, shifts in the distribution of some animals may cause greater overlap with fishing gear, marine construction activities, military training exercises, and other human activities, or result in increased exposure to pathogens and parasites. Documenting shifts in marine mammal distribution and abundance and tracking stranding trends and causes of mortality will be key to understanding the implications of climate change in Virginia.

Habitat Degradation

Habitat degradation occurs from non-point source contamination and encroachment, among other factors. Non-point source contamination includes background levels of chemicals, heavy metals, and other substances in the marine environment that can ultimately harm marine mammals as they bioaccumulate, causing immune, reproductive, and hormone dysfunction (Krahn *et al.* 2009; Hunter-Foster *et al.* 2022). Some populations (*e.g.* Southern Resident killer whales of Pacific Northwest US) have demonstrated record levels of persistent organic pollutants among mammals (Krahn *et al.* 2009). Cook Inlet beluga whales have copper levels in their livers that are higher than levels reported to cause kidney damage in bottlenose dolphins (URS Corporation 2010; Norman 2012).

In Chesapeake Bay, contaminants such as polychlorinated biphenyls (PCBs), pesticides (*e.g.* chlordane, dichlorodiphenyltrichloroethane [DDT]), and metals (*e.g*. mercury, lead), have been detected (DEQ 2022). In 2010, 72% of the Chesapeake Bay was impaired by toxic contaminants. This percentage has increased over time and was estimated at 78% in 2020 (Chesapeake Progress 2023). Of growing concern, per- and polyfluoroalkyl substances (PFAs) have also been detected in Chesapeake Bay, with the highest concentration of three Virginia test sites in the James River (Hunter-Foster *et al.* 2022). Although contaminant testing has not been regularly conducted on Virginia marine mammals, contaminants, including PCBs and DDT, were detected in a bottlenose dolphin that stranded in Virginia (Yordy *et al.* 2010). Contaminants are also capable of being transported to offshore oceanic waters, as demonstrated in the Northeast Atlantic (Lara-Martín *et al.* 2020).

While contaminants can be difficult to mitigate due to their ability to disperse large distances, accumulate in all levels of the food chain, and become sequestered in benthic substrate, there are some existing efforts to mitigate contaminant levels. The Chesapeake Bay Watershed Agreement was created for all states within the watershed to conduct water quality monitoring and improvement, gaining a better understanding of sources and mitigation strategies for toxic

contaminants (*i.e.* PCBs and mercury), and reducing contaminant levels below thresholds that harm humans and the aquatic system (Chesapeake Executive Council 2022).

Habitat encroachment occurs when infrastructure and development extend into natural habitats. As a result, natural habitat is lost and/or altered and water quality worsens, allowing nutrients and sediment to increase in the marine environment (Virginia Coastal Program 2018). Examples of encroachment include offshore wind facilities within marine mammal migration corridors, coastal development on or near seal haul-out sites, marine construction projects in important foraging areas, and navigational channel dredging that can temporarily displace marine mammals. Reduced water quality can lead to a loss of vegetation, which serves as food and cover for lower trophic level prey species and manatees. Encroachment ultimately leads to increased overlap between humans and marine mammals and may even cause marine mammals to occupy smaller areas, which may increase the potential for disease transmission and intra- and inter-specific aggression. It is also possible that aquaculture could encroach on marine mammal habitat. Currently, marine aquaculture occurs in Virginia's coastal bays and in the Chesapeake Bay estuary and is largely confined to shellfish production. Impacts from inshore shellfish aquaculture seem to be relatively benign. Greater concerns may arise from large scale finfish or other oceanic aquaculture development should this become a reality in Virginia's nearshore waters.

11. Marine Mammal Conservation Strategy

Numerous marine mammal species are present in the mid-Atlantic waters of the United States (US) at some point during the year. As such, policies and protections provided by any one state in the region should be part of larger, regional collaborative conservation efforts. The Virginia Department of Wildlife Resources (DWR) Board periodically adopts federal Endangered Species Act (ESA) status and population unit designations for all federally listed species, including listed marine mammals, via regulatory action. The Virginia Aquarium Stranding Response Program (VAQS) has been the sole Virginia marine mammal stranding response organization in Virginia since the mid-1990s and operates the scientifically based Virginia Marine Mammal Stranding Network (VMMSN or "Network"). The Virginia Marine Resources Commission (MRC) has a Joint Enforcement Agreement (JEA) with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries, also known as NMFS) for Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) enforcement, which includes assisting VAQS with stranding events. In addition, Virginia's on-going ocean planning efforts and the regional partnership with the Mid-Atlantic Regional Council on the Ocean (MARCO) provide a foundation for addressing many of the risks facing marine mammals in the state, such as fishery interactions, vessel strikes, noise pollution, habitat degradation, energy development, marine debris, and other sources of pollution.

In order to begin development of this Plan, a two-day workshop was held that included a variety of stakeholders. The purpose of the workshop was to discuss conservation efforts, challenges, and topics associated with marine mammals and to formulate suggestions for actions to be considered for inclusion in the Plan. The group received background information and discussed challenges faced by marine mammals in Virginia. Topics discussed included harassment, vessel

strikes, commercial and recreational fishery interactions, marine debris, noise, climate change, and other forms of pollution. Stakeholders represented state and federal entities, environmental non-governmental organizations, ecotourism operators, and representatives from maritime industries in the region. While the planning team reached out to several tribal partners and commercial fishers, those stakeholder groups did not attend the workshop, although a CZM funded fisheries liaison attended remotely. Stakeholders who were invited to the workshop were also invited to review the final draft Conservation Strategy of this Plan.

This Conservation Outline lists goals and strategies, followed by a narrative (which adds detail to the listed strategies), a list of actions that address the strategies, the designated lead entity for each action (in bold lettering) and supporting organizations, and timelines, where appropriate. Timelines were classified into three categories: near-term (to be implemented within three years of Plan publication); longer-term (to be implemented between three and eight years of Plan publication); and on-going (regardless of implementation timeline). Finally, the Conservation Outline includes references to similar federal conservation and recovery recommendations from US marine mammal recovery plans, where appropriate.

CONSERVATION OUTLINE

THE OVERARCHING GOAL OF THIS PLAN IS TO ENHANCE THE SURVIVAL OF MARINE MAMMALS AND CONSERVE THEIR HABITATS IN VIRGINIA.

Conservation Goal 1: Maintain a permanent and effective Marine Mammal Stranding Network in Virginia.

Strategy 1.1. – Establish one or more consistent funding sources to sustain a permanent and effective Marine Mammal Stranding Network in Virginia.

Strategy 1.2. – Establish an Interagency Stranding Event Network (ISEN).

Actions listed in the North Atlantic right whale recovery plan that align with the Virginia plan (NOAA Fisheries 2005):

4. Monitor the status and trends of abundance and distribution of the western North Atlantic right whale.
    4.6 Respond to Strandings

Actions listed in the fin whale (NOAA Fisheries 2010), sei whale (NOAA Fisheries 2011), and sperm whale (NOAA Fisheries 2010) recovery plans that align with the Virginia plan (NOAA Fisheries 2010):

1.0 Maximize Efforts to Acquire Scientific Information from Dead, Stranded, and Entangled or Entrapped Whales.
    1.1 Respond effectively to strandings in U.S. waters.
    1.2 Establish reliable sources of funding for rescue, necropsy, and tissue collection and analysis efforts.

Actions in the Florida manatee recovery plan that align with the Virginia plan (USFWS 2001):
Objective 1: Minimize causes of manatee disturbance, harassment, injury, and mortality
1.10 Rescue and rehabilitate distressed manatees and release back into the wild
Objective 2: Determine and monitor the status of manatee populations
2.4 Evaluate and monitor causes of mortality and injury

Conservation Goal 2: Identify, assess, and mitigate risks to marine mammal populations and habitats in Virginia through cost-effective monitoring, research, and best practices.

Strategy 2.1. – Collect, analyze, and compare commercial fishery effort, observed marine mammal takes, and stranding data for state managed fisheries known to or likely to interact with marine mammals.

Strategy 2.2. – Continue to assess trends in key marine mammal population demographics in Virginia over time and compare them to trends observed throughout the mid-Atlantic region.

Strategy 2.3. – Continue to monitor key marine mammal demographics, distribution, diet, and health status (*e.g.* contaminant levels, nutritional status, parasite loads) in Virginia.

Strategy 2.4. – Assess, protect, and/or enhance marine mammal in-water and haul-out habitats through engagement with state and regional initiatives and partnerships.

Strategy 2.5. – Incorporate the foraging and habitat needs and distribution patterns of marine mammals in the development of or revisions to relevant fishery management plans, fishery and aquaculture regulations, and best practices as a move toward ecosystem-based management of marine resources.

Strategy 2.6. – Develop standardized reporting and response procedures for marine mammal harassment cases and marine debris and fishing gear interactions, including witnessed gear interactions, in Virginia waters.

Strategy 2.7. – Develop working groups with representatives from various industries, such as state-managed commercial fisheries, shipping in state waters, and other maritime industries operating in the state of Virginia, to identify, assess, and mitigate relevant marine mammal conflicts.

Actions listed in the North Atlantic right whale recovery plan that align with the Virginia plan (NOAA Fisheries 2005):
1. Significantly reduce sources of human-caused death, injury and disturbance.
1.1 Reduce ship collisions with right whales.
1.2 Reduce injury and mortality caused by fisheries and fishing equipment.
1.4 Enforcement of fishing and shipping regulations.
3. Identify, characterize, protect and monitor important right whale habitats.
3.1 Characterize and Monitor Right Whale Habitat
3.3 Reduce Human Impact to Habitat

4. Monitor the status and trends of abundance and distribution of the western North Atlantic right whale.

4.4 Monitor right whale occurrence and habitat use pattern in known high-use areas.

5. Coordinate Federal, State, international and private efforts to implement the Recovery Plan.

5.2 Enforce right whale protection laws

5.4 Coordinate with States involved in right whale activities to maximize protection measures.

Actions in the sei whale recovery plan that align with the Virginia plan (NOAA Fisheries 2011):

4.0 Continue to Collect Data on "Unknown" Threats to Sei Whales.

4.1 Opportunistically collect data on the impacts of climate change on sei whales.

4.2 Opportunistically collect data on injury and mortality caused by fisheries and fishing equipment.

4.3 Opportunistically collect data on mortality and serious injury from vessel collisions.

4.4 Opportunistically collect data on the effects of anthropogenic noise on the distribution, behavior, and productivity of sei whales.

Actions listed in the fin whale (NOAA Fisheries 2010), sei whale (NOAA Fisheries 2011), and sperm whale (NOAA Fisheries 2010) recovery plans that align with the Virginia plan (NOAA Fisheries 2010):

1.0 Coordinate State, Federal, and International Actions to Implement Recovery Actions and Maintain International Regulation of Whaling for Fin Whales.

2.0 Identify, Characterize, Protect, and Monitor Habitat Important to Whale Populations in U.S. Waters and Elsewhere.

2.1 Characterize whale habitat

2.2 Monitor important habitat features and sei whale use patterns to assess potentially detrimental shifts in these features that might reflect disturbance or degradation of habitat.

2.3 Promote actions to protect important habitat in U.S. waters.

2.4 Conduct research and perform analyses to understand the impacts of climate change on fin whales and seek strategies to reduce these impacts. (Fin and sperm whale plans only)

3.0 Develop and Apply Methods to Estimate Population Size and Monitor Trends in Abundance.

3.2 Conduct surveys to estimate abundance and monitor trends in whale populations worldwide.

4.0 Investigate Causes of and Reduce the Frequency and Severity of Human-caused Injury and Mortality.

4.1 Investigate and reduce injury and mortality caused by fisheries and fishing equipment and reduce depredation.

4.2 Investigate and reduce mortality and serious injury from vessel collisions.

4.3 Investigate and, if medium or high ranked threat, reduce injury and mortality caused by anthropogenic noises. (Sei whale plan only)

4.4 Investigate the impacts of climate change on sei whales and seek strategies to reduce any impacts found to be detrimental to sei whales and their habitat. (Sei whale plan only)

4.5 Conduct studies of environmental pollution that may affect sperm whale populations and their prey. (Sperm whale plan only)

4.6 Identify areas where concentrations of fin whales coincide with significant levels of maritime traffic, fishing, or pollution (including marine debris). (Fin whale plan only)

5.0 Determine and Minimize Any Detrimental Effects of Anthropogenic Noise in the Oceans. (Fin and sperm whale plans only)

5.2 Take steps to minimize anthropogenic noises that are found to be potentially detrimental to whales. (Fin and sperm whale plans only)

Actions in the Florida manatee recovery plan that align with the Virginia plan (USFWS 2001):

Objective 1: Minimize causes of manatee disturbance, harassment, injury, and mortality

1.3 Minimize collisions between manatees and watercraft

1.7 Minimize manatee injuries and deaths caused by fisheries and entanglement

1.11 Implement strategies to eliminate or minimize harassment due to other human activities

Objective 2: Determine and monitor the status of manatee populations

2.3 Determine life history parameters, population structure, distribution patterns, and population trends

Conservation Goal 3: Promote marine mammal conservation in Virginia through social marketing and information dissemination.

Strategy 3.1. – Promote marine mammal conservation in Virginia through effective social marketing techniques.

Strategy 3.2. – Develop marine mammal educational materials for a variety of audiences and messages.

Strategy 3.3. – Prepare and regularly update permitting guidance documents to assist with the review of proposed human activities that may negatively affect marine mammals in Virginia.

Actions listed in the North Atlantic right whale recovery plan that align with the Virginia plan (NOAA Fisheries 2005):

1.0 Significantly reduce sources of human-caused death, injury and disturbance.

1.3 Continue and Improve Education and Outreach Programs

Actions in the Florida manatee recovery plan that align with the Virginia plan (USFWS 2001):

Objective 1: Minimize causes of manatee disturbance, harassment, injury, and mortality

1.2 Continue state and federal review of permitted activities to minimize impacts to manatees and their habitat

Objective 4. Facilitate manatee recovery through public awareness and education

4.1 Identify target audiences and key locations for outreach

4.2 Develop, evaluate, and update public education and outreach programs and materials

4.3 Coordinate development of manatee awareness programs and materials in order to support recovery

4.5 Develop and implement a coordinated media outreach program

CONSERVATION NARRATIVE

The Conservation Narrative provides an implementation roadmap for the goals and strategies presented in the Conservation Outline (see previous section). More precisely, the Narrative identifies each strategy's need; specific actions and corresponding Entities; ideal timeline for completion; and additional resource requirements (*e.g.* funding, extra staff, federal coordination), as needed. Identified entities are not an exclusive list of expected participants but instead are meant to represent those with a critical role in initiating, funding, and/or leading the action, as well as those entities with mandated federal oversight associated with the listed action(s). Many of the strategies in this Plan rely on the willingness of Tribal nations, agencies, academia, and affected stakeholders to ameliorate actions that affect wildlife and ecosystems, while ensuring human activities are sustainable. This approach will require a shift in management that acknowledges the connection between human and marine ecosystem concerns and emphasizes the need to facilitate marine mammal conservation and habitat protection, while sustaining homeland security and human economic interests, safety, and recreation.

CONSERVATION GOAL 1: MAINTAIN A PERMANENT AND EFFECTIVE MARINE MAMMAL STRANDING NETWORK IN VIRGINIA.

The Virginia Marine Mammal Stranding Network (VMMSN) was founded in 1987 and from 1993 through 2024 was coordinated statewide solely by VAQS to monitor trends in marine mammal mortality and health. As of 2025, VAQS capacity is substantially reduced and future funding is unknown. Stranding Network management includes managing stranding reports throughout the state and associated data when a response is conducted. Marine mammal stranding and incidental take data from permitted activities such as marine construction, fishing activities, and military exercises provide the only available index of marine mammal mortality and morbidity available to resource management agencies. Data collected by the VMMSN are entered into a national marine mammal stranding database maintained by NOAA Fisheries. That agency has assisted state and federal conservation agencies with the implementation and evaluation of regulations and management strategies for marine mammals along the eastern seaboard. Data collected by the VMMSN are entered into a national marine mammal stranding database maintained by NOAA Fisheries. That agency has assisted state and federal conservation agencies with the implementation and evaluation of regulations and management strategies for marine mammals along the eastern seaboard.

Maintaining an effective Marine Mammal Stranding Network in Virginia allows for the collection of many types of information, ranging from basic demographic information (*i.e.* species, sex, age class) to the evaluation of human interaction to monitoring shifts in distribution patterns, which are all critical to the management and conservation of marine mammals. For example, the consistent reporting and examination of bottlenose dolphin pound net interactions in southeastern Virginia led to the establishment of regulations requiring gear modifications to reduce entanglement in 2009. Fishery interactions observed by the stranding network continue to be evaluated by protected species managers responsible for the Bottlenose Dolphin Take Reduction Plan. Other deep-diving, cryptic species, such as *Kogia* sp. and beaked whales, are mostly encountered through stranding events, which are often the only opportunity to study these species.

Stranding data also provide an opportunity to monitor changes in marine mammal occurrences, distribution and population demographics in state waters. Evaluation of Virginia data have revealed phenological shifts in occurrence and allowed researchers to compare demographic characteristics (*e.g.* size/age class proportions, gender ratios) with cause of stranding, particularly for HI cases and during unusual mortality events (Lynott 2012; Mallette *et al.* 2016; Leslie 2022; Volker 2020). Likewise, changes in distribution and population size may first be detected as trends observed in stranding data.

Lastly, the effectiveness of a single state stranding network is greatly enhanced when contact with other state stranding networks and the national marine mammal stranding network is maintained over the long term. This contact involves attending relevant meetings, workshops and conferences for the purpose of remaining current with stranding data collection techniques, data reporting and management protocols, communication between NOAA Fisheries and strandings biologists, and collaborative research and monitoring opportunities.

Strategy 1.1. – Establish one or more consistent funding sources to sustain a permanent and effective Marine Mammal Stranding Network in Virginia.

Despite its importance to marine mammal management in the Commonwealth, there has never been sustained, sufficient support for the VMMSN. Funding sources include competitive grants from CZM and the John H. Prescott Marine Mammal Rescue Assistance Grant Program, non-profit fundraising through the Virginia Aquarium & Marine Science Center Foundation (VAQF), and in-kind support from the City of Virginia Beach. Collectively, these funds support stranding data management, volunteer training, carcass recovery, large whale field response, live stranding response, and several short-term forensic, health, diet, and mortality studies. This approach, however, is untenable over the long term, especially as administrative, operating, staff costs, and other resource needs continue to increase. The VMMSN funding needs to be at least, in part, non-competitive, and funds should extend beyond basic administrative and operational costs to include expenditures associated with mitigating human/animal conflict (e.g. seals on public beaches, manatees at marinas, live animal entanglement/disentanglement), conducting detailed necropsies on fresh carcasses, and collecting biological samples from live and fresh dead animals to determine cause of death or morbidity.

The VAQS, the current administrator of the VMMSN, is part of the Virginia Aquarium & Marine Science Center's (VAMSC) Veterinary Science and Research Division. The VAMSC is a collaboration between the City of Virginia Beach and the VAQF, a non-profit 501(c)(3) organization. The VAQF is responsible for maintaining the VAQS, along with other VAMSC-sponsored conservation and scientific research efforts. Because the VMMSN is led and managed by a non-profit organization and is almost entirely reliant on grants and donations, it is vulnerable to economic vagaries that may result in inconsistent stranding response or, at worst, the termination of the Network.

Action 1.1.1. – Identify all existing and potential revenue streams to permanently fund the operation of the VMMSN (Entities: **DWR**, CZM, MRC, VAQS, United States Fish and Wildlife Service [USFWS], NOAA Fisheries).

Action 1.1.2. – Develop the justification for and explore the feasibility of establishing a state-supported (DWR supervised) position within the VMMSN to ensure the permanency and viability of the Network long-term (Entities: **DWR**, VAQS, CZM).

Action 1.1.3. – Assemble a temporary working group tasked with recommending and/or establishing one or more revenue streams that will permanently sustain operational funding and establishment of a permanent state position to sustain the VMMSN, and/or provide emergency funding in years when no Prescott Grant is awarded to the VAQS. Membership should include representatives from government agencies, non-profit organizations, and other partners with a vested interest in marine mammal conservation and/or stranding response (Entities: **DWR**, CZM, VAQS, MRC, NOAA Fisheries).

Action 1.1.4. – Develop a Cooperative Agreement among the DWR and the City of Virginia Beach, the VAMSC, and/or the VAQF which clearly defines VMMSN-related roles and responsibilities of the state-supported position and includes a contingency plan should the VAQS lose its capacity to manage the day-to-day operations of the VMMSN (Entities: **DWR**, City of Virginia Beach, VAQS, VAMSC, VAQF).

Action 1.1.5. – Seek the necessary support from the Governor and the Secretary of Natural and Historic Resources to safeguard the permanency of the VMMSN (Entities: **DWR**, MRC, CZM).

Action 1.1.6. – Maintain contact with other state marine mammal stranding networks and the national marine mammal stranding network by attending relevant meetings and conferences for the purpose of remaining current with stranding data collection techniques, reporting and management protocols, and collaborative research and monitoring opportunities (Entities: **DWR**, VAQS).

Strategy Timeline: Actions 1.1.1 through 1.1.5 will be near-term and Action 1.1.6 will be ongoing.

Strategy 1.2. – Establish an Interagency Stranding Event Network (ISEN).

Live and dead marine mammal stranding response, rescue, and disentanglement requires a significant amount of coordination with stranding response personnel and volunteers and other agencies and organizations. Strandings can occur in locations that are remote and difficult to reach, have restricted access, or are densely populated with high potential for public interference, all of which raise unique logistical difficulties. Live animal response requires trained personnel to safely handle the animals, provide crowd control, and maintain access to the scene, whether it's on land or via boat. Dead animal response also requires trained personnel, access to or retrieval of carcasses by land or boat, and in some instances carcass burial or disposal. Large whale strandings require significantly more resources and logistical planning due to the size of the animals and the need for experienced personnel to handle these cases. Although the VAQS has several informal agreements with agencies and organizations to assist with strandings, assistance is generally provided on a case-by-case basis. The overall effectiveness of the VMMSN can be improved by developing formal partnerships with all appropriate agencies and organizations across the state.

A pre-established institutional framework is especially needed for detecting and responding to unusual marine mammal stranding events that require resources and staff beyond capacity of the VAQS or any single state agency. These events may involve large numbers of sick, out-of-habitat (situations where marine mammals are found outside of their range or in unsuitable habitats, most common among manatees and seals), injured or dead marine mammals washing ashore on publicly- and privately-owned shorelines, in marinas, waterfront communities, military installations, or other heavily populated areas over a short or extended periods of time. Unusual stranding events also may involve only one or several marine mammals that become entrained or trapped within the footprint of a marine construction project, a power plant, or some other infrastructure or human-induced circumstance that necessitates monitoring, capture, or removal. Large whale stranding events and/or the disentanglement of large and small cetaceans, manatees, and seals are often logistically difficult as well. Unusual marine mammal stranding events can span several days, weeks or even months and quite often require multiple authorizations and special use permits. These kinds of events demand the cooperation, coordination and sharing of resources among federal, state, and local agencies, as well as nongovernmental stakeholders that are impacted by these occurrences.

For live animal scenarios, the VAQS responds to live entangled or stranded pinnipeds and small cetaceans, while the NOAA Fisheries' Large Whale Disentanglement Response Network responds to live entangled large whales (baleen whales and sperm whales). Response to live entangled, distressed or stranded manatees is overseen by USFWS, including transportation to a critical care or rehabilitation facility in Florida since Virginia currently does not have the capacity or authority to rehabilitate manatees. For manatees, any responses would likely be coordinated with the Manatee Rescue and Rehabilitation Partnership, a group of 24 organizations that work together to rescue, rehabilitate, and return manatees to the wild.

Action 1.2.1. – Identify and contact stakeholders that may be willing and have the capacity to participate in an ISEN, and determine the extent to which each stakeholder can: (1) contribute funds, staff, equipment, or other resources; (2) assist with stranded, entangled or out-of-habitat marine mammal searches, transport, or disposal during unusual stranding events; (3) provide expertise to help identify cause of stranding events or help direct response efforts (*e.g.* pathologists, veterinarians, fishery gear experts, marine construction companies); (4) identify and acquire the necessary authorizations and permits to access sensitive areas and dispose of carcasses; and (5) help develop stranding response training materials and workshops (Entities: **DWR**, CZM, VAQS, MRC, NOAA Fisheries, USFWS).

Action 1.2.2. – Convene regular meetings with stakeholders who have committed to being part of the ISEN to (1) develop and regularly update response plans, communication plans, and task and resource assignments; (2) establish and regularly update a post-event evaluation process; and (3) incorporate (and regularly update) marine mammal response protocols into existing contingency plans such as those developed for hazardous fuel/chemical spills (Entities: **DWR**, MRC, VAQS).

Action 1.2.3. – Develop a marine mammal stranding response Memorandum of Understanding between DWR and MRC to outline expectations for state assistance with unusual marine mammal stranding events (Entities: **DWR,** MRC).

Action 1.2.4. – Convene annual ISEN meetings to update plans, identify training and resource needs and assignment tasks for improved response (Entities: **DWR**, MRC, VAQS).

Action 1.2.5. – Continue to provide pinniped and live cetacean disentanglement training workshops for currently authorized individuals and recruit and train new staff that have access to and experience with operating boats in Virginia's coastal waters (Entities: **TBA**, VAQS, DWR, MRC, US Coast Guard).

Strategy Timeline: Actions 1.2.1 - 1.2.3 will be longer-term. Actions 1.2.4 and 1.2.5 will be ongoing.

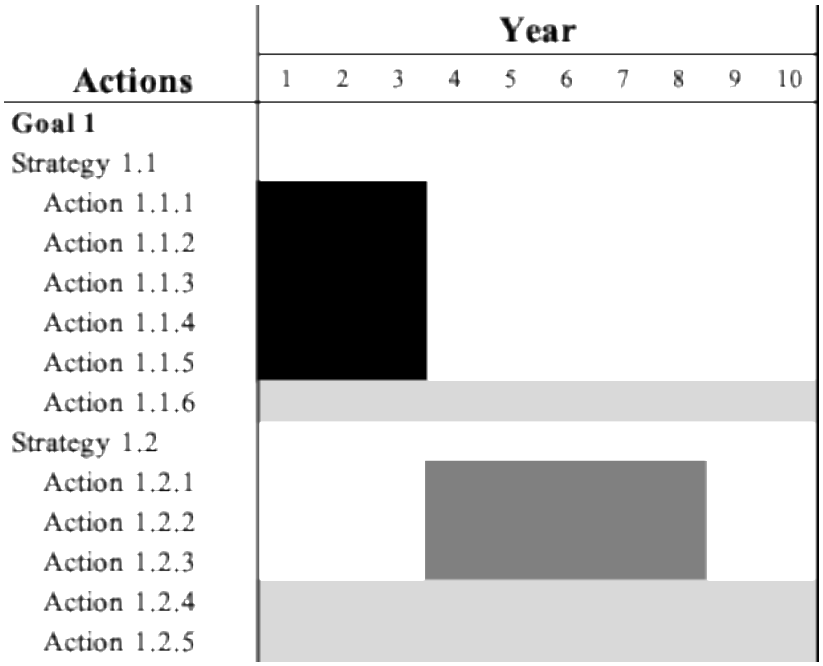


Figure 55. Implementation timelines of actions under Goal 1 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing.

Conservation Goal 2: Identify, assess, and mitigate risks to marine mammal populations and habitats in Virginia through cost-effective monitoring, research, and best practices.

A variety of marine mammal species utilize inshore and offshore Virginia waters. Although species vary in their seasonal occurrences, marine mammals are present year-round in the Commonwealth. Each species has different habitat needs and prey preferences while inhabiting state waters. Increased ocean temperatures due to climate change may be altering some species' distribution and/or abundance in Virginia. In addition, the potential for fishery interactions and vessel collisions, the presence of large-scale offshore wind energy development, emerging

climate change impacts, and possible exposure to various types of pollution makes the identification, assessment, and mitigation of these and other risks a real need in Virginia.

Identification of risks to marine mammal populations in Virginia primarily occurs through stranding response but also includes fishery observer data and the collection of tracking and survey data The most effective approaches for addressing this goal are to: (1) support or supplement marine mammal research and monitoring efforts; (2) collaborate with experts specializing in commercial and recreational fisheries, vessel interactions, climate change, harmful algal blooms, marine contaminants, and other risk categories to ensure marine mammal concerns and research needs are addressed in each of these disciplines; and (3) support the development and implementation of science-based best management practices for human activities taking place in marine mammal habitat.

Strategy 2.1. – Collect, analyze, and compare commercial fishery effort, observed marine mammal takes, and stranding data for state managed fisheries known to or likely to interact with marine mammals.

One of the most scientifically rigorous and effective ways to quantitatively understand fishery interactions with protected species is through a fishery observer program. Federally managed fisheries in Virginia that are likely to interact with protected species receive limited observer coverage by the Northeast Fisheries Observer Program (NEFOP) which is administered by NOAA Fisheries for the purpose of quantifying bycatch rates. Fisheries operating in state waters and/or managed solely by state agencies are usually not covered by the NEFOP. Developing and maintaining a state fishery observer program that collects rigorous data on harvested target species, non-target bycatch, and fishing effort will inform fishery management decisions and help with the development of gear modifications and other best practices designed to avoid or minimize fishery interactions with protected species. Participating in and following regulations of existing fishery management councils and groups will enhance state and collaborative efforts.

Action 2.1.1 – Maintain the proper federal agreements and permits to operate a state observer program for protected species, including marine mammals (Entity: **MRC**).

Action 2.1.2 – Provide guidance and training for observers to handle, release, and collect data and samples from marine mammal takes (Entities: **MRC**, DWR, VAQS).

Action 2.1.3 – Provide semi-annual (mid-year and end of calendar year) calculation of bycatch rates by fishery and compare with similar gear in federal waters or in other states. Share marine mammal take details, effort data, and bycatch rates with other agencies in the Commonwealth and other stakeholders (Entity: **MRC**).

Action 2.1.4 – Create a semi-annual review process of marine mammal takes reported by state observers to assess trends and needs for management actions. (Entities: **MRC**, DWR).

Strategy Timeline: Actions 2.1.1 and 2.1.2 are near-term. Actions 2.1.3 and 2.1.4 will be ongoing and implemented after Actions 2.1.1 and 2.1.2 are completed. Completion of Action 2.1.1 is dependent on staff availability, and, more importantly, NOAA Fisheries' Protected Resources review and approval. Action

2.1.2 should be completed before the next NOAA Fisheries approved training course becomes available.

Additional Resource Requirements: Actions 2.1.2 and 2.1.3 will require additional staff time for data analysis.

Strategy 2.2. – Continue to assess trends in key marine mammal population demographics in Virginia over time and compare them to trends observed throughout the mid-Atlantic region.

Stranding and survey data allow for the opportunity to monitor changes in marine mammal species occurrences and demographics in Virginia waters and make comparisons with regional data. Historic and current data from Virginia show changes in species abundance and stranding rates (*e.g.* increased harbor seal abundance, decreased harbor porpoise strandings) and seasonal occurrences over time (*e.g.* North Atlantic right whale presence year-round; Salisbury *et al.* 2015; Jones and Rees 2023; VAQS *unpublished data*, October 2023). Demographic trend analyses will provide important baseline levels to which future data can be compared to detect short-term and long-term changes. Lastly, incorporating relevant environmental co-variates and predictive modeling in the recurring marine mammal population trend analyses of existing data is a cost-effective way to detect and interpret state and regional demographic shifts over time and inform future management decisions. Stranding data is available from VAQS, while sighting data is primarily available from the US Navy Marine Species Monitoring Program, North Atlantic Right Whale Consortium, NOAA Fisheries, and other sources.

Action 2.2.1. – Identify key species of interest and appropriate partners, then secure funding for recurring marine mammal population trend analyses described in Actions 2.2.2 and 2.2.3 (Entities: **DWR**, VAQS, CZM, US Navy, NOAA Fisheries, USFWS).

Action 2.2.2. – Conduct a comprehensive marine mammal population trend analysis every 10 years using Virginia and mid-Atlantic stranding and sighting data and incorporating environmental co-variates and predictive modeling in the recurring analyses (Entities: **DWR**, VAQS, US Navy, Virginia Institute of Marine Science [VIMS], CZM, NOAA Fisheries, USFWS).

Action 2.2.3. – Foster collaborations with academic institutions and other entities with expertise in time series and/or climactic trend analysis/modeling to assist with Action 2.2.2 (Entities: **DWR**, VAQS, US Navy, VIMS, NOAA Fisheries, USFWS).

Strategy Timeline: Action 2.2.1 will be near-term. Actions 2.2.2 and 2.2.3 will be longer-term but should be implemented as soon as feasible after the completion of Action 2.2.1.

Strategy 2.3. – Continue to monitor key marine mammal species demographics, distribution, diet, and health status (*e.g.* contaminant levels, nutritional status, parasite loads) in Virginia.

Ongoing live animal research efforts in Virginia contribute to demographic and distribution information on species in Virginia and the larger mid-Atlantic region.

Current efforts are primarily led by the US Navy Marine Species Monitoring Program, with partners such as Henningson, Durham and Richardson, Inc. (aka HDR), The Nature Conservancy (TNC), and Duke University. Other efforts include surveys conducted by NOAA Fisheries, North Atlantic right whale management and data summarization and visualization by Regional Wildlife Science Collaborative (RWSC), and MARCO. The US Navy Marine Species Monitoring Program efforts have been expanded for large whales to include stable isotope analysis, which provides information on diet, and body condition assessment and behavioral data collection via drone, which contributes to health status and understanding the use of Virginia waters by baleen whale species.

Stranding investigations conducted by VAQS contribute to demographic and distribution data through the collection of Level A data that includes the species, sex, and animal length from stranding events. Health status is assessed via various body condition measurements during necropsy, such as blubber thickness and girth. Diet studies based on stomach contents have been performed from individuals stranded in Virginia for two species, bottlenose dolphins and harbor porpoises, with the most recent analyses being conducted in 2020 and 2013 respectively (Schoettle 2013; Volker 2020).

These ongoing efforts are important for establishing baselines and provide invaluable data for future species management. Combined with new techniques, such as the use of eDNA for diet and disease investigations and Unmanned Aerial Systems for distribution and body condition, these efforts can help detect shifts in health status, diet, and food availability over time.

Action 2.3.1. – Convene a temporary working group with subject matter experts to (1) determine the most appropriate methodologies for diet analyses and establishing accurate health status indices and identify species of interest; (2) determine sampling protocols and develop sample size requirements needed to generate diet data and health status indices for trend analyses, and (3) identify the lead entity for this project (Entity: **DWR**, VAQS).

Action 2.3.2. – Identify and secure funding for (1) hiring a project lead; (2) establishing accurate diet analyses and health status indices; (3) subsequent collection and monitoring of key diet and health status parameters; and (4) and conducting diet and health status trend analyses every five years (Entity: **DWR**).

Action 2.3.3. – Determine appropriate entities to develop accurate diet analyses and health status indices and initiate the collection and analysis of diet and health status data (including ingestion of plastics and microplastics) following the methodologies developed under Action 2.3.1 (Entity: **DWR**)

Action 2.3.4. – Conduct a diet and health status trend analysis every 10 years so that results are available for plan revisions (Entities: **TBD**, DWR, VAQS).

Strategy Timeline: Actions 2.3.1 through 2.3.4 will be longer-term with the goal that the results of analyses be available two years prior to Plan revision deadline (*e.g.* eight years from completion of this Plan).

Strategy 2.4. – Assess, protect, and/or enhance marine mammal in-water and haul-out habitats through engagement with state and regional initiatives and partnerships.

There are numerous state and regional initiatives and partnerships that conduct and coordinate relevant monitoring and research of marine wildlife and ecosystems. Some focus on mitigating specific activities, such as offshore wind energy development (*e.g.* RWSC) and marine debris (*e.g.* VIMS Trap, Removal, Assessment, and Prevention Program, or TRAP), while others consolidate available data to help inform conservation planning and management decisions (*e.g.* MARCO and RWSC). These types of initiatives often stem from or can result in the formation of effective partnerships that can yield cost-effective, broad scale conservation benefits that cannot be achieved by a single state, federal agency, or organization.

One unique aspect of seal behavior is hauling-out onto land, requiring additional assessment and protection of these specific habitats. Current identification and monitoring of haul-out sites is being performed by the US Navy Marine Species Monitoring Program and partners. As seal populations in Virginia are increasing, there is the potential for new haul-out sites or changes in high-use areas. There is also the potential for overlap between seals and humans at haul-out sites. Information sharing with state and regional initiatives will be key, as will recognizing and addressing potential human-wildlife conflict.

Action 2.4.1. – Identify, participate in, and contribute data to state and regional initiatives and partnerships that promote the assessment, protection, and/or enhancement of marine mammal in-water and haul-out habitats (Entities: **DWR**, VAQS, CZM, MRC).

Action 2.4.2. – Support and promote strategies and actions in the Virginia Marine Debris Reduction Plan overseen by Clean Virginia Waterways (CVW; Register *et al.* 2021) and the regional 2021 Mid-Atlantic Marine Debris Action Plan (NOAA Marine Debris Program 2021) that will help reduce marine mammal marine debris entanglement and ingestion and reduce marine debris in in-water and haul-out habitats (Entities: **CVW**, CZM, DWR).

Action 2.4.3. – Review and evaluate seal haul-out habitat protection and management strategies established by other states or federal agencies within the region for possible adoption in Virginia (Entities: **DWR**, VAQS, MRC, NOAA Fisheries).

Strategy Timeline: All actions will be ongoing.

Strategy 2.5. – Incorporate the foraging and habitat needs and distribution patterns of marine mammals in the development of or revisions to relevant fishery management plans, fishery and aquaculture regulations, and best practices as a move toward ecosystem-based management of marine resources.

Marine mammals consume a variety of forage fish within the mid-Atlantic region. Diet in Virginia waters has been studied in more abundant species by examining stomach contents of stranded animals. This work revealed that bottlenose dolphins primarily consume Atlantic croaker, spot, and Atlantic menhaden (Volker 2020) whereas harbor porpoises tend to target anchovy and hake (Schoettle 2013). For other species, diet is inferred based on regional studies. For example, North Atlantic right whales feed on copepods and, because they have been observed feeding during aerial surveys in Virginia

(Mallette *et al.* 2017; Cotter 2019), it is assumed that these whales are consuming copepods in state waters.

Since many of these identified prey species are commercially important (*i.e.* sciaenid fishes and Atlantic menhaden), they are managed intensively for the purpose of maintaining commercially sustainable populations. Equally important, however, is the need to ensure that these harvested populations are viable enough to support marine mammals and other marine wildlife that prey on these species. Although current shellfish aquaculture in Chesapeake Bay and its tributaries pose a low risk to marine mammals, large-scale, ocean-based aquaculture (*e.g.* sea pens for finfish), should they be approved off the coast of Virginia, may pose a much greater risk. Additional research will be needed as new aquaculture enterprises move into the region.

Action 2.5.1. – Assess and incorporate the foraging and habitat needs and distribution patterns of marine mammals in commercially important marine mammal prey species' management plans, harvest limits, regulations, and by-catch reduction measures (Entities: **MRC,** DWR).

Action 2.5.2. – Assess potential effects of emerging aquaculture and commercial fisheries on marine mammal habitats and/or prey abundance and availability and develop science-based best practices designed to avoid or reduce identified risk factors (Entities: **MRC**, DWR, VIMS, CZM, NOAA Fisheries)

Strategy Timeline: Action 2.5.1 will be near-term. Action 2.5.2 will be developed in the near-term and implemented whenever changes in aquaculture and fisheries are being proposed.

Additional Resource Requirements: The impact assessments and/or development of best practices described in each of the actions will require additional funding from sources such as Virginia Sea Grant, NOAA Fisheries and the National Fish and Wildlife Foundation (Entities: **DWR**, VIMS, MRC, CZM).

Strategy 2.6. – Develop standardized reporting and response procedures for marine mammal harassment cases and marine debris and fishing gear interactions, including witnessed gear interactions, in Virginia waters.

Marine mammal harassment cases and marine debris and recreational gear interactions present unique scenarios that may not necessarily require a response or an intervention but are important to understand for management. Marine mammal harassment has been well documented in Virginia. Examples include people approaching hauled-out seals, "watering" manatees with hoses, and operators of small vessels deliberately herding free swimming cetaceans. The stranding record has documented marine debris entanglement and ingestion that included recreational gear such as fishing line and plastic bags (Barco *et al.* 2010; VAQS *unpublished data*, October 2023). The VAQS is currently authorized to respond to live entangled pinnipeds and small cetaceans, although these entanglement scenarios occur relatively infrequently and require many resources and partners for successful monitoring, documentation, and, if warranted, intervention.

Multiple agencies in the state (*e.g.* MRC, Department of Environmental Quality [DEQ], VIMS, DWR) receive reports of these scenarios. For harassment cases specifically, not

every agency that receives reports has the authority to enforce violations of the MMPA and those agencies who do have authority may be reluctant to do so due to a lack of capacity or for other reasons. Further, many people are unsure whether these scenarios require reporting and to whom they should be reported. It is for these reasons that a centralized reporting mechanism should be developed, alongside a streamlined response protocol, and disseminated to the public that is designed to capture these data.

Action 2.6.1. – Develop a centralized reporting mechanism for the Commonwealth of Virginia for the public, researchers, ecotour operators, fishermen, and others to report marine mammal harassment and interactions with marine debris and recreational gear. This mechanism should also be advertised at beach accesses, boat ramps, marinas, fishing piers, and other similar locations to encourage reporting (Entities: **DWR**, MRC, VAQS).

Action 2.6.2. – Establish an interagency Standard Operating Procedure (SOP) for response to reported harassment events/scenarios (Entities: **MRC**, VAQS, DWR, NOAA Fisheries, USFWS).

Action 2.6.3. – Establish an interagency SOP for response to reported marine mammal marine debris and fishing gear interactions (Entities: **DWR**, MRC, CZM, VAQS, NOAA Fisheries, USFWS).

Strategy Timeline: All actions will be longer-term.

Additional Resource Requirements: Action 2.6.1 will require training, if existing hotlines are used, and/or additional funding to develop if web or phone app-based reporting is implemented (Entities: DWR, VIMS, MRC, CZM).

Strategy 2.7. – Develop working groups with representatives from various industries, such as state-managed commercial fisheries, shipping in state waters, and other maritime industries operating in the state of Virginia, to identify, assess, and mitigate relevant marine mammal conflicts.

While there are many identified risks to marine mammals in Virginia waters, some risks have limited conservation options or the understanding of emerging risks is incomplete. Near-term actions can include establishing working groups with representatives of various industries to identify potential areas of conflict, assess the level of risk to marine mammals and industry, and develop best management practices, monitoring programs, and other mitigatory measures that reduce risks. Working groups will improve communication among respective industries and agencies, and if data are available, assess risks from all perspectives, and facilitate successful conflict resolution. Where applicable, working groups will be modeled after existing regional and federal efforts.

Action 2.7.1 – Identify, assess, and support long-term monitoring data and collection efforts, such as stranding, observer, and shipping data and fishery effort, that are required to inform conflicts identified in Action 2.7.2 (Entities: **DWR**, MRC, VAQS).

Action 2.7.2. – Identify areas of potential or existing conflict where working groups may be an effective solution to understanding and mitigating a concern. Identify representatives from relevant state agencies, industry, Tribal nations, and non-

governmental organizations to form working groups and provide neutral party facilitation to develop goals and identify and achieve tasks (Entities: **DWR**, MRC, CZM, VIMS).

Action 2.7.3. – Develop a sustainable meeting schedule, convene meetings, and develop working group reports for participating entities (Entities: **DWR**, MRC, CZM, VIMS).

Action 2.7.4. – Summarize and distribute working group recommendations to appropriate entities and incorporate recommendations into future planning efforts (Entities: **DWR**, MRC, CZM, VIMS).

Strategy Timeline: Actions 2.7.1 and 2.7.2 will be longer-term. Actions 2.7.3 and 2.7.4 will be ongoing following the completion of Action 2.7.2 and vary by working group.

Additional Resources: Meeting space, travel, and professional facilitation may require additional resources, which will need to be identified and appropriated before work can be conducted.

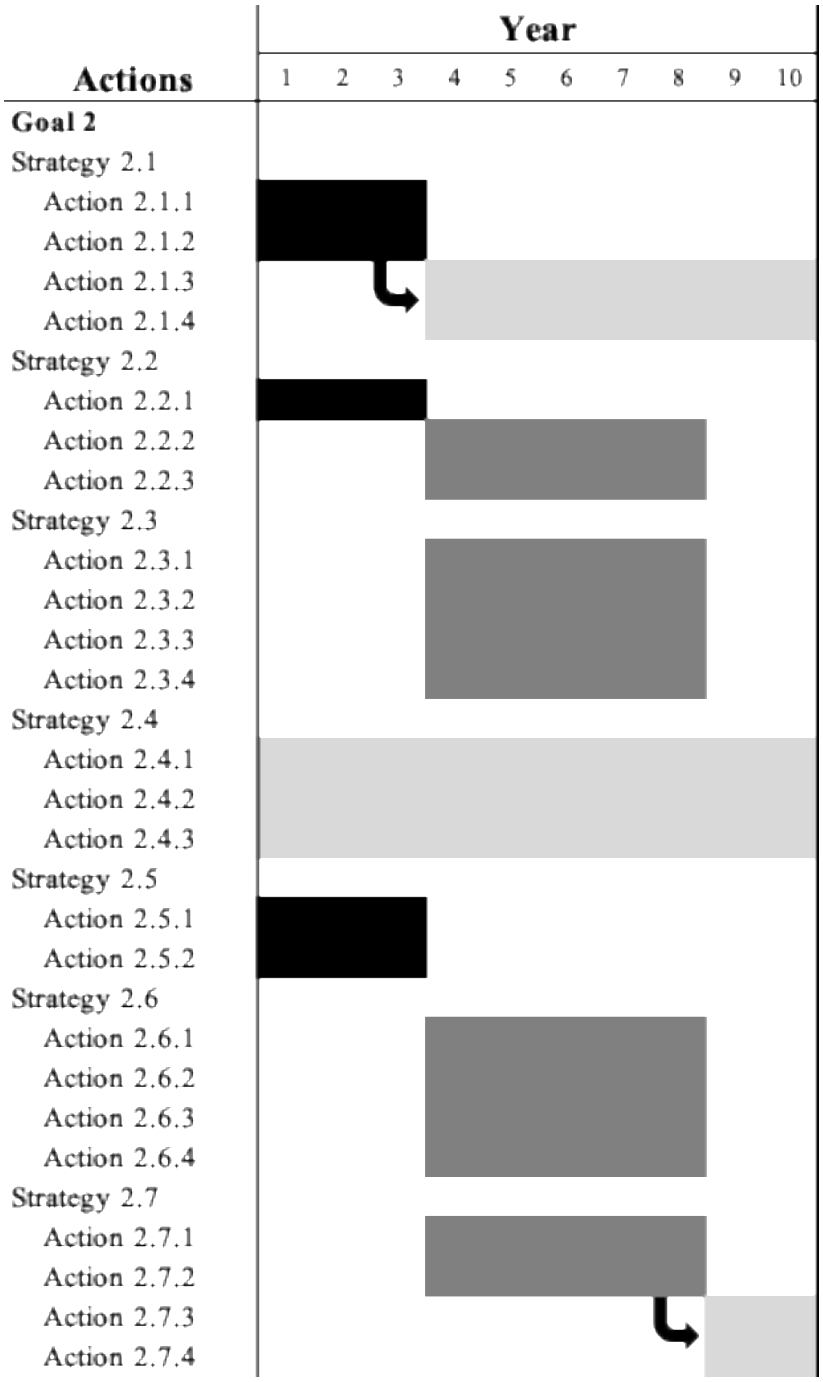


Figure 56. Implementation timelines of actions under Goal 2 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing.

Conservation Goal 3: Promote marine mammal conservation in Virginia through social marketing and information dissemination.

Marine mammal conservation fundamentally includes human beings, and the most successful conservation actions are those aligned with the values, well-being, and perspectives of people. When conservationists work to address the needs of protected marine species, they are often trying to change or reinforce human behavior that will benefit the targeted species or species groups.

Because of their empathy and curiosity, children are often the most effective promoters of behavioral change, making them excellent endangered species ambassadors, especially for highly charismatic species such as marine mammals (Young *et al*. 2018). Getting children engaged in marine mammal conservation at an early age can result in lasting and cascading conservation behaviors that often touch and influence parents, siblings, and other family members.

Another important component of effective marine mammal conservation and management is to ensure that regulatory agencies receive accurate up-to-date information on the biology, distribution, behavior, and habitat use of marine mammals in Virginia to inform project reviews, Environmental Assessments, Environmental Impact Statements, Biological Opinions, and other related documents, as changes may occur (*i.e.* changing distribution and abundance of species) and/or risks increase and diversify.

Strategy 3.1. – Promote marine mammal conservation in Virginia through effective social marketing techniques.

Strategic use of social marketing can increase the adoption of evidence-based conservation practices and behaviors through effective messaging targeting the appropriate audience, such as beachgoers or vessel operators. One imminent need for social marketing techniques is to encourage the proper and safe viewing of marine mammals, such as hauled-out seals or mother-calf pairs of dolphins.

Similar social marketing techniques can also be used to change the behavior of recreational boaters, anglers, and other water enthusiasts in ways that reduce human-marine mammal interactions on the water. Creative and targeted messaging can persuade and educate the public how to properly report marine mammal strandings, entanglements, and other situations that require response by the VMMSN, law enforcement, or some other entity. Messaging can also encourage safe boating practices for vessels of all sizes to avoid collisions with large whales, especially because more whales are utilizing the unprotected lower Chesapeake Bay and vessels of many size ranges can seriously injure and/or kill whales.

Action 3.1.1. – Convene a temporary working group made up of marine mammal biologists, education/outreach staff, and social marketing experts to: (1) review existing materials and identify those that warrant updating and public dissemination; (2) update existing education/outreach materials and tools where needed; (3) identify specific audiences, messages, and information dissemination pathways and platforms (*e.g.* public service announcements, websites, social media, signage, blogs, fishing club newsletters and other trusted outlets); and (4) identify and develop new messaging materials, tools and outlets (Entities: **DWR**, CZM, MRC, DCR, VIMS, Back Bay National Wildlife Refuge, Chincoteague National Wildlife Refuge, Eastern Shore National Wildlife Refuge, TNC, VAQS).

Action 3.1.2. – Contract with a marketing organization to develop, test, and implement a social marketing campaign to promote human behaviors such as safe boating practices that minimize disturbance and injury/mortality to marine mammals in the water or on land (Entity: **DWR**, CZM).

Action 3.1.3. – Launch and periodically update state social marketing campaigns (Entities: **DWR**, CZM, MRC, DCR, VAQS).

Strategy Timeline: Actions 3.1.1 and 3.1.2 will be near-term; Action 3.1.3 will be ongoing and implemented as soon as feasible following completion of previous actions.

Additional Resource Requirements: Additional funding will be needed to engage a social marketing company and to develop, disseminate and evaluate all forms of outreach materials (Entities: **DWR**, CZM).

Strategy 3.2. – Develop marine mammal educational materials for a variety of audiences and messages.

Marine mammals are highly charismatic and well loved by people of all ages. The most effective means of ensuring the adoption of relevant conservation practices and behaviors is through the early exposure to a well-developed educational curriculum about marine mammal conservation, demography, and ecological roles.

Action 3.2.1. – Identify and review existing marine mammal curricula for K-12 schools and update as needed or develop a new one(s) that includes information on the important roles marine mammals play in marine ecosystems, such as controlling prey species or serving as an indicator of ocean health, and the possible effects of climate change and the disappearance of marine mammals from the marine environment (Entity: **DWR**, CZM).

Action 3.2.2. – Identify and review other existing marine mammal educational materials and curricula that target adults, children, and underserved populations in a variety of settings and update or develop new materials, as needed (Entity: **DWR**, CZM).

Action 3.2.3. – Develop a public relations packet for marine mammal harassment events and nuisance animal scenarios regarding messaging for the public, including the MMPA and what to do in these scenarios (Entities: **DWR**, VAQS, MRC, CZM, NOAA Fisheries, USFWS).

Strategy Timeline: Actions 3.2.1 - 3.2.3 will be longer-term.

Additional Resource Requirements: Additional funding will be needed to contract with educational resource specialists to help develop educational curricula, *etc.* (Entity: **DWR**).

Strategy 3.3. – Prepare and regularly update guidance documents to assist with the review of proposed human activities that may negatively affect marine mammals in Virginia.

The accurate review of human activities and projects that may impact marine mammals or their in-water and haul-out habitats requires accurate, up-to-date information on

marine mammal demographics, distribution, and ecology that is specific to Virginia. One such example is the construction of the Coastal Virginia Offshore Wind Project, which involved multiple review agencies, required close monitoring of marine mammal presence and behavior, and strict adherence to numerous environmental provisions. Similar marine mammal biological and ecological information is required for the development of NEPA documents, biological opinions, and project best practices. Providing regulatory agencies, developers, and action agencies with the necessary information upfront will help streamline and provide transparency in the permitting process and promote consistency among regulatory agencies, as there is currently a federal review process for any federal action, funding, permit, or work.

Action 3.3.1. – Schedule an information session with MRC Fisheries and Habitat divisions, alongside DWR and CZM, to re-establish baseline knowledge of each agency's roles and responsibilities concerning marine mammals (Entities: **MRC**, DWR, DEQ, CZM).

Action 3.3.2. – Develop a general adaptive document that includes information on marine mammal biology and ecology, known seasonal occurrences in state coastal waters, documented seal haul-out sites, in-water habitat preferences, and other key pieces of information needed to develop environmental documents and inform project reviews for use by a variety of state agencies (Entity: **DWR**).

Action 3.3.3. – Upload and maintain marine mammal-related documents that assist with environmental permitting processes compiled under Action 3.3.2 in a public portal that is accessible to all state and federal regulatory agencies and permit applicants (Entity: **DWR**).

> *Strategy Timeline:* Action 3.3.1 will be near-term. Action 3.3.2 will be ongoing as documents are completed. Action 3.3.3 will be longer-term, occurring as soon as feasible after completion of Action 3.3.2.

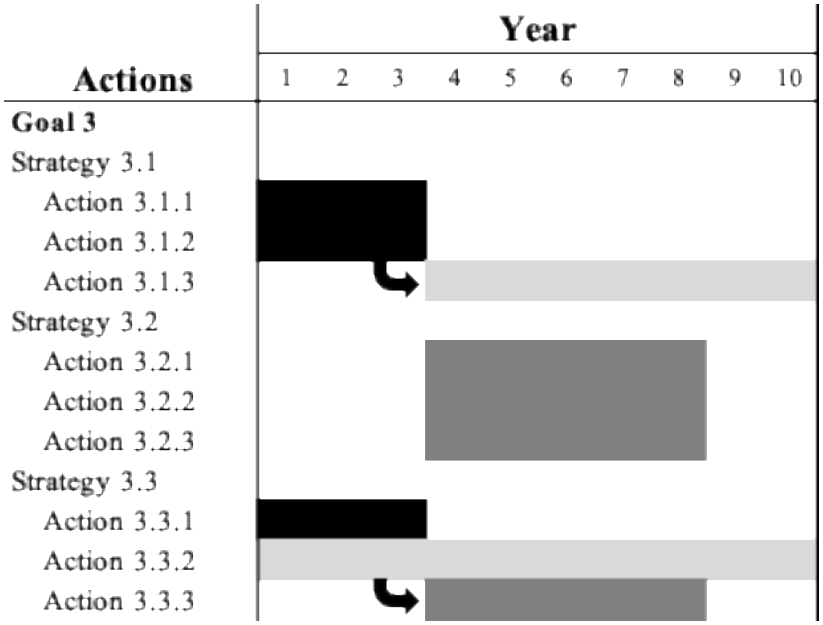


Figure 57. Implementation timelines of actions under Goal 3 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing.

12. SUMMARY

Marine mammals are a natural resource shared across national and international borders. Their conservation requires coordinated efforts among many entities. Chesapeake Bay and Virginia ocean waters are home to a variety of marine mammal species, including many threatened and endangered species, with differing spatial and temporal distribution, habitat requirements, and life-histories.

Oversight and implementation of this Plan will be conducted by the DWR, with assistance from other key partners. The DWR will also be managing the Virginia Sea Turtle Conservation Plan, which includes many strategies and actions similar to this Plan. Much of the work described in these Plans require new or redirected resources, which will be critical in accomplishing the Actions listed in each Plan. Conservation plan updates are recommended every ten years, and interim assessment of progress toward achieving conservation goals and associated strategies and actions will be ongoing. Adoption and implementation of the Virginia Marine Mammal Conservation Plan will encourage inner-departmental coordination, align Virginia's conservation planning with regional and federal efforts, and promote efficient use of resources to provide marine mammals in Virginia with a sustainable future.

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14. APPENDICES

APPENDIX I: 2022 – 2025 VAQS FEDERAL MARINE MAMMAL STRANDING RESPONSE AGREEMENT

Marine Mammal Stranding Response Agreement
Between

Greater Atlantic Regional Fisheries Office
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
Department of Commerce

AND

Virginia Aquarium & Marine Science Center Foundation

Effective through October 15, 2025

Table of Contents

ARTICLE 1: GENERAL PROVISIONS - 3

ARTICLE II: PURPOSE AND GENERAL RESPONSIBILITIES - 5

ARTICLE III: DEAD ANIMAL RESPONSE - 11

ARTICLE IV: LIVE ANIMAL RESPONSE - FIRST RESPONSE - 14

ARTICLE V: LIVE ANIMAL RESPONSE - REHABILITATION AND FINAL DISPOSITION - 19

ARTICLE VI: GOOD STANDING AGREEMENT - 20

ARTICLE VII: COMMUNICATIONS AGREEMENT - 22

ARTICLE VIII: PARTICIPANT'S AUTHORIZED PERSONNEL - 25

ARTICLE IX: RIGHTS OF STATES AND LOCAL GOVERNMENTS - 25

ARTICLE X: EFFECTIVE DATES, RENEWAL AND APPLICATION PROCEDURES - 26

ARTICLE XI: REVIEW, MODIFICATION AND TERMINATION - 28

ACCEPTANCE OF AGREEMENT - 29

Articles III, IV, V, and VI are reserved and issued at the discretion of the NMFS Regional Administrator.

Article I: General Provisions

A. Authority

1. This Marine Mammal Stranding Agreement (hereinafter Agreement) is entered into between the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) Greater Atlantic Region, and the Stranding Network Participant, Virginia Aquarium & Marine Science Center Foundation (VAQS; Participant), under the authority of section 112(c) and section 403 of the Marine Mammal Protection Act of 1972 (MMPA), as amended. **This Agreement supersedes all pre-existing Stranding Agreements between these parties. An organizational representative with signatory authority (e.g. Executive Director, President, CEO) must sign this Agreement on behalf of the Stranding Network Organization.**

2. NMFS has been delegated authority by the Department of Commerce to administer the MMPA. To assist in the implementation and administration of the MMPA, the Stranding Network has been established to respond to stranded marine mammals within NMFS' Greater Atlantic Region of the United States. For the purposes of this Agreement, the Greater Atlantic Region consists of the following coastal states: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland and Virginia.

B. Scope

1. Under the MMPA, NMFS is responsible for mammals of the **Order Cetacea** and the **Order Pinnipedia** other than walruses (hereinafter marine mammals).

2. The geographic response area assigned to Participant consists of the following: rescue and rehabilitation of marine mammals within the state of Virginia, and from other areas within the Greater Atlantic Region as needed. The Participant may assist in stranding response within the Region outside of their assigned response area, if requested by NMFS or by another Participant. Outside the Greater Atlantic Region, the Participant may assist with stranding response upon request from the appropriate regional NMFS Regional Stranding Coordinator(s).

C. Limitations

1. This Agreement creates an authorization for the Participant to take marine mammals, which would be otherwise prohibited by the MMPA. This taking authorization only applies to the Participant and its authorized personnel (see Article VI) for activities that are consistent with this Agreement.

2. In particular, this Agreement does <u>not</u> authorize:

a. The taking of any marine mammal species listed as endangered or threatened under the Endangered Species Act of 1973 (ESA), as amended. Authorization to take ESA listed species is provided under MMPA/ESA Permit No. 18786, issued to the NMFS National Marine Mammal Health and Stranding Response Program Coordinator and **requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal.**

b. The sale or offer of sale of any marine mammal or marine mammal parts including cells, gametes, or cell cultures.

D. Definitions

All terms used in the Agreement must be interpreted to have the meaning specified in the MMPA section 3 and section 409 and NMFS implementing regulations 50 CFR 216.3 unless the context or specific language requires otherwise. Additional terms and definitions for this Agreement are provided in Attachment A.

Article II: Purpose and General Responsibilities

A. Purpose of Agreement. NMFS and the Participant enter into this Agreement for the following purposes:

1. To provide for rapid response and investigation of stranded marine mammals (pinniped and cetacea) within the Greater Atlantic Region in accordance with the purposes and policies of the MMPA.

2. To implement Title IV (Marine Mammal Health and Stranding Response Program) of the MMPA:

   a. To facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild;

   b. To correlate the health of marine mammals and marine mammal populations the wild with available data on physical, chemical, and biological environmental parameters; and

   c. To detect and coordinate effective responses to Marine Mammal Unusual Mortality Events (UMEs).

3. To specify the activities during which the Participant may take stranded marine mammals (pinniped and cetacea) or marine mammal parts for the primary purpose of ensuring the appropriate response, disposition, and utilization of stranded marine mammals or marine mammal parts under MMPA sections 109(h), 112(c), and 403 and the Agreement.

4. To define the nature and extent of services that the Participant will provide NMFS under this Agreement and NMFS' responsibilities to the Participant.

5. To specify the requirements for the preparation and maintenance and reporting of records containing scientific data obtained from dead and live stranded marine mammals or parts from dead stranded marine mammals.

6. To provide for the timely exchange of information for use by both parties and other network members in furthering the objectives of the MMPA under this Agreement.

B. Joint Responsibilities

NMFS and the Participant will work cooperatively to:

1. Implement Title IV of the MMPA.

2. Effectively respond to and investigate the causes and impacts of UMEs.

3. Collect the appropriate data for determination of serious injuries and mortalities due to human interactions.

4. Collect reference data on marine mammal health and diseases.

5. Collect data on the frequency and causes of strandings.

6. Interpret findings and identify health trends and diseases of concern to include emerging, reportable, and zoonotic diseases.

C. NMFS Responsibilities

NMFS must:

1. Provide the Participant with notice of any changes to laws, regulations, policies and/or guidelines applicable to or promulgated by NMFS that may apply to the Participant's activities. This includes criteria for issuance, renewal and termination of stranding agreements. Notwithstanding this provision, it is the responsibility of the Participant to comply with all laws, regulations, policies and/or guidelines that apply to the Participant's activities.

2. Conduct periodic compliance reviews of Stranding Agreements as stated in Article IX.

3. Provide guidance and assistance regarding investigation of marine mammal unusual mortality events including financial and physical resources (example: NOAA laboratory assistance) and financial resources when available and authorized (in accordance with section 405 of the MMPA – UME National Contingency Fund) and in coordination with the Working Group on Marine Mammal Unusual Mortality Events.

4. Alert the Participant when NMFS has been notified that there are diseases of concern that are emerging, reportable, and/or zoonotic within the Greater Atlantic Region.

5. Pursuant to criteria established under the MMPA section 407, provide access to the National Marine Mammal Health and Stranding Response Program Database, as developed, and access to marine mammal tissues in the National Marine Mammal Tissue Bank following NMFS data and tissue access procedures and policies.

6. As needed and as resources are available, provide specialized marine mammal stranding response and investigation training on a local, regional or national basis. Pursuant to MMPA section 402, collect and update periodically and make available to stranding network participants and other qualified scientists, existing information on:

    a. Procedures and practices for rescuing and rehabilitating stranded marine mammals;

b. Species by species criteria used by the stranding network participants, for determining at what point a marine mammal undergoing rescue and rehabilitation is returnable to the wild based on its ability to survive in the wild and risk to the wild population of marine mammals;

c. Procedures and practices for collecting, preserving, labeling, and transporting marine mammal tissues for physical, chemical, and biological analyses;

d. Relevant scientific literature on marine mammal health, disease, and rehabilitation;

e. Compilation and analyses of strandings by region to monitor species, numbers, conditions, and causes of illness and death in stranded marine mammals; and

f. Other life history and reference level data, including marine mammal tissue analyses that would allow comparison of the causes of illness and death in stranded marine mammals with physical, chemical, and biological environmental parameters.

8. Identify a Greater Atlantic Region Marine Mammal Stranding Program Coordinator who will serve as the Participant's primary point of contact for notification, coordination, reporting, and response activities as specified throughout this Agreement. The NMFS Regional Administrator will serve as the Participant's primary point of contact for administration of the Agreement, as well as dispositions and other management activities as specified throughout the Agreement. **The NMFS Regional Administrator's designated point of contact for this Agreement is the NMFS Greater Atlantic Region Marine Mammal Stranding Response Coordinator, Greater Atlantic Regional Fisheries Office, Protected Resources Division** (please see Attachment B for contact information).

9. In certain circumstances such as large scale events (e.g. mass stranding, unusual mortality events, live right whale stranding), NMFS may establish a formal Incident Command System (ICS) for response, including the identification of an Incident Commander. For events such as oil spills, NMFS will follow direction from United States Coast Guard (USCG). Opportunities for ICS training can be accessed through the Federal Emergency Management Agency (see http://www.training.fema.gov/EMIWeb/IS/is100.asp), USCG, or NMFS. If necessary, guidance will be provided by NMFS on a case-by-case basis.

10. Relay reports of stranded marine mammals (live or dead) within the Participant's geographic range to the Participant and inquire whether the Participant has the capability to respond. If the Participant cannot respond, the Stranding Coordinator may make requests to other regional Stranding Participants to respond.

11. Coordinate regional activities to maximize geographic coverage while facilitating appropriate division of responsibilities among regional Participants according to

institutional abilities and authorities.

12. Respond to the Participant's completed requests for authorizations such as requests for parts authorizations, parts transfers, and release determinations.

13. Provide information regarding availability of Prescott Grants and any other relevant NMFS funding opportunities.

14. For emergency stranding events (live or dead), provide and maintain a 24-hour stranding hotline number: 1-866-755-NOAA (6622).

D. Participant Responsibilities

The Participant must:

1. Comply with laws, regulations, policies and/or guidelines applicable to or promulgated by NMFS that apply to activities under this Agreement; or any Federal, state or municipal laws that pertain to stranding network operations (e.g., municipal water management laws).

2. Cooperate with other members of the Greater Atlantic Region Stranding Network and the National Marine Mammal Stranding Program as well as Federal, state, and local officials and employees in matters supporting the purposes of this Agreement.

3. Be subject to the direction of a designated employee (e.g., NMFS Marine Mammal Stranding Coordinator or NMFS Special Agent) representing the NMFS Greater Atlantic Region Regional Administrator or Office of Law Enforcement with respect to the taking of a stranded marine mammal.

4. Manage any and all expenses that the Participant incurs associated with the activities authorized by this Agreement. NMFS does not have funds to reimburse volunteers for expenses incurred in responding to stranding events. However, under the marine mammal UME process, funding may be available for costs associated with specific analyses and additional requests in accordance with section 405 of the MMPA UME National Contingency Fund and in coordination with the Working Group on Marine Mammal Unusual Mortality Events. Additionally, competitive funding opportunities for Stranding Network Participants may be available through the Prescott Stranding Assistance Grant Program (see http://www.nmfs.noaa.gov/pr/health/prescott/).

5. Promote human and public safety by taking precautions against injury or disease to any network personnel, volunteers, and the general public when working with live or dead marine mammals.

6. Notify immediately the NMFS Stranding Coordinator upon learning of any diseases of concern (e.g., emerging, reportable, and/or zoonotic diseases) that are detected and/or

confirmed that could be a potential hazard for public health or animal health (NMFS will provide guidance on reportable diseases as it becomes available).

7. Follow requirements for the transfer of marine mammal parts (50 CFR 216.37):

   a. Non-diagnostic parts, tissues, cells, gametes, or cell cultures to be used for scientific research, species enhancement, or education must be transferred only to persons or labs that have received prior written authorization from the NMFS MMPA/ESA scientific research permit or a Regional Parts Authorization Letter. A unique field number assigned by NMFS (e.g., NMFS Registration Number) or the Participant must be marked on or affixed to the marine mammal part or container.
   b. Diagnostic parts, tissue samples, fluid specimens, parts, or cells may be transferred to labs within the United States for diagnostic use without any additional authorizations.

8. Work cooperatively with the NMFS and the USCG in a hazardous waste spill (i.e., oil spills) ICS if implemented.

9. Notify the NMFS Regional Administrator in writing within 30 days of any changes in its Designee organizations, key personnel (see Attachment A), capabilities, and/or ability to respond within its geographic coverage area.

10. If requested, coordinate with NMFS to develop and implement a media plan relating to stranding events.

11. Photo documenting (still or video) for other than diagnostic or identification purposes (such as dorsal fin identification, documentation of lesions, scars, etc.) that does not interfere with or influence the conduct of the stranding responders and response in any way or cause additional harassment to marine mammals.

12. If requested by the NMFS Regional Stranding Coordinator, the Participant will provide copies of any photographs, films, and/or videotapes documenting any stranding, particularly for those strandings when human interactions are reported or suspected. Reimbursement for this request is subject to negotiation between NMFS and the Participant. Any photography, film and/or videotape of the stranding response used for educational or commercial purposes of stranding response should by the Participant should include a credit, acknowledgment, or caption indicating that the stranding response was conducted under a Stranding Agreement between NMFS and the Participant under the authority of the MMPA. NMFS will not reproduce, modify, distribute, or publicly display the photograph, film, and/or videotape without consent of the owner, unless required to release a copy under Federal law or order (such as the Freedom of Information Act).

13. By its nature, the handling of stranded marine mammals (dead or alive) is potentially a dangerous activity. The Participant must indemnify and hold harmless the United States

Government from any and all losses, damages, or liability -or claims therefore -on account of personal injury, death, or property damage of any nature whatsoever, arising out of the activities of the Participant, his/her/its employees, his/her/its qualified representatives, designees, subcontractors, volunteers, or agents. Liability for person(s) acting under this agreement is addressed in sections 406(a) and (b) of the MMPA [16 U.S.C. 1421(e)].

14. Provide accurate and honest information in all reports to NMFS.

15. Except where a longer period is specified (e.g., 15 years for rehabilitation cases, see Attachment D *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standard for Rehabilitation Facilities*), maintain records upon which required reports are based for at least 3 years on-site.

16. Upon request by the NMFS Regional Administrator, allow the Regional Stranding Coordinator, other appropriate NMFS employees, or any other appropriate person duly designated by the Regional Administrator, to inspect the facilities and inspect and/or request records that pertain to stranding network activities.

17. Verbally report any right whale sightings that occur or are reported as part of their normal activities. See Attachment B for contact information.

Article III: Dead Animal Response

A. The Participant may take species of marine mammals under the MMPA for the purpose of dead animal investigation and response.

Subject to the conditions contained in this Agreement, the MMPA, and the implementing regulations, the Participant may take dead stranded marine mammals or parts therefrom for the collection of data on the health and health trends of wild populations, for the detection of marine mammal UMEs, for the detection of signs of human interaction, for research or education on marine mammal biology and life history, for the determination of cause of death, for the detection of human caused and natural mortality, or for other research as deemed appropriate by the NMFS. These activities specifically include: obtaining measurements and biological samples from dead stranded marine mammals; disposing, or assisting in the disposal, of dead stranded marine mammals at an appropriate landfill or other suitable location; and taking and transporting dead stranded or floating dead marine mammals, or parts therefrom, to facilities or individuals approved pursuant to 50 CFR. 216.22 for scientific research, maintenance in a properly curated, professionally accredited scientific collection, or for educational purposes.

B. Terms and Conditions for Dead Animal Response

1. Response

a. The Participant must respond as practicable to reports of dead stranded marine mammals within the geographic range or response specified under Article I, Number B.2. If the Participant is the closest and/or first responder, the Participant is considered to be the on-site coordinating organization and is in charge of all on-site activities. In certain circumstances such as a UME, mass stranding, or endangered marine mammal stranding, NMFS may implement the ICS structure and designate an on-site coordinator to be in charge of the event (see Article II C9). In all situations, the Participant will cooperate with Federal, state and local government officials and employees and other stranding network participants when responding to these strandings. If the Participant receives a verified report of a dead stranded marine mammal and does not have the capability to respond appropriately to the report, the Participant must notify the NMFS Regional Stranding Coordinator and/or adjacent stranding network participants within 24 hours if feasible.

b. If the Participant leaves a dead animal at the stranding site or in thecase of a UME or mass stranding response, the Participant must, if feasible, mark each animal with a tag or mark, such as roto-tags or grease stick, to assist with data collection and to prevent multiple reports on the same animal(s).

c. If requested by NMFS Regional Stranding Coordinator and if feasible and practicable, the Participant will assist with stranding response in neighboring areas outside the Participant geographic range (specified in Article I B2).

2. Data Collection and Reporting. The Participant must collect and provide the following information for each stranded marine mammal they respond to:

a. Complete the NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form) for each stranded marine mammal. Completed forms must be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after responding to the stranding event. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant must provide preliminary data (verbal or written) from the Level A - Marine Mammal Stranding Report within 24 hours.

b. As resources are available, collect additional Level B and Level C data.

c. Notify the Regional Stranding Coordinator of the following cases within 24 hours or according to the specific reporting guidance provided by the Stranding Coordinator:

1) Possible or confirmed human interactions (including military activity);
2) Suspected UMEs;
3) Extralimital or out-of-habitat situations;
4) Mass stranding events and/or mass mortalities;
5) Large whale strandings; and
6) Any stranding involving endangered or threatened species or identified species of concern.

d. In certain circumstances (e.g., listed or rare species stranding, UME, possible human interaction case, extralimital or out-of-habitat situation), the NMFS Regional Stranding Coordinator may request necropsies be conducted by a Necropsy Team Leader, or that additional and expedited reporting (verbal or written) of Level B and C data such as analytical results and necropsy reports if available. NMFS will not reproduce, modify, distribute, or publish the data without consent of the Participant unless required to release the data under Federal law or order (such as the Freedom of Information Act);

e. Collect and make available any samples, gear, debris, or other objects (e.g., tissues, bullets, arrows, net webbing, etc.) recovered from a stranded marine mammal that may provide evidence of human interaction or may otherwise be necessary for law enforcement or Federal litigation. The Participant must comply with chain of custody procedures or any other instructions as specified and supported by NMFS Greater Atlantic Region and/or NMFS Office of Law Enforcement personnel.

3. Parts Disposition. Diagnostic parts, tissue samples, fluid specimens, parts or cells may be transferred to labs within the United States for diagnostic use without any additional

authorizations. For non-diagnostic parts or samples:

a. Retention: Marine mammal parts may be retained by the Participant for education and/or research purposes, provided they are properly indicated in the "Specimen Disposition" field of NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form). Parts and/or containers must be marked with the field identification number assigned by the Participant or by NMFS (i.e., NMFS registration number). Authorization to take parts from ESA listed species in the Greater Atlantic Region is currently provided under MMPA/ESA Permit No. 18786-05, as amended, issued to the NMFS Marine Mammal Health and Stranding Response Program Coordinator, and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal, prior to any action by the Participant.

b. Transfer: Report to the NMFS Regional Administrator (See Attachment B) within 30 days of the stranding event, the transfer of any parts salvaged from the stranded marine mammal collected under this Agreement as required by 50 CFR 216.22 or 50 CFR 216.37. The Participant must provide the institution name where specimen materials have been deposited and ensure that the retained or transferred parts are marked with the field identification number or assigned NMFS Registration number in the "Specimen Disposition" field on the NOAA Form 89864, OMB #0648-0178 (the Marine Mammal Stranding Report – Level "A" Form) and ensure that retained or transferred parts are marked with the field identification number or the NMFS Registration Number. If parts are being transferred, the Participant must ensure the receiving institution is authorized by the NMFS Regional Administrator to receive marine mammal parts.

4. **Site cleanup**. The Participant must make every reasonable effort to assist in the clean-up of beach areas where their activities (e.g., necropsy or specimen collection) occur under this Agreement that may contribute to soiling of the site.

Article IV: Live Animal Response - First Response

A. The Participant may take species of marine mammals covered under the MMPA for the purpose of live stranding first response (initial assessment and care at the site of stranding and assist in the appropriate disposition of the animal), beach triage, beach release, temporary holding for assessment and triage, translocation and/or transportation to a NMFS authorized rehabilitation center within the Greater Atlantic Region.

1. The Participant must take live stranded marine mammals in a humane manner (as defined in 50 CFR 216.3, see Attachment A) for the protection or welfare of the marine mammal. If the animal dies during the course of response and/or investigation, then the terms and responsibilities contained in Article III of this Agreement become operative. In addition to the activities authorized in Articles I, II, III), the Participant is authorized to implement the following activities under this article:

    a. Take measurements and collecting blood or other diagnostic samples from live stranded marine mammals for health assessment;

    b. Return live stranded marine mammals, as directed by the NMFS Regional Stranding Coordinator, to their natural habitat and tagging such animals;

    c. Transport live stranded marine mammals for rescue and rehabilitation to a NMFS approved rehabilitation facility or temporary holding facility; and

    d. Perform humane euthanasia. Euthanasia must only be performed by the attending veterinarian or by a person acting under the direction of the attending veterinarian and following approved guidelines such as those referenced in Attachment C (*2007 Report of the American Veterinary Medical Association Panel on Euthanasia, 2nd Edition of the CRC Handbook of Marine Mammal Medicine, 2006 Journal of the American Association for Zoo Veterinarians*). When using controlled drugs, such person(s) must comply with all applicable state and Federal laws and regulations (i.e., registered with the Drug Enforcement Administration). Authorization for euthanasia of ESA-listed species is provided under MMPA/ESA Permit No. 18786-05, as amended, and requires prior approval and direction from the NMFS Regional Stranding Coordinator.

2. This Agreement does not authorize any projects involving "intrusive research" (as defined in 50 CFR 216.3). Measurements or sampling for scientific research purposes (i.e., outside the scope of accepted diagnostic and treatment practices for the care of an animal) must be authorized under a NMFS MMPA/ESA scientific research permit.

B. Terms and Conditions for Live Stranding: First Response

1. **Response for Live Stranding**

a. The Participant must respond to reports of live stranded marine mammals *(pinniped and cetacea)*. If the Participant is the closest and/or first responder, the VAQS is considered to be the on-site coordinator and is in charge of all on-site activities. In certain circumstances such as a UME, mass stranding, or endangered marine mammal stranding, NMFS may implement the ICS structure and designate an on-site coordinator to be in charge of the event (see Article II C9). In all situations, the Participant will cooperate with Federal, state and local government officials and employees and other stranding network participants when responding to these strandings. If the Participant receives a verified report of a live stranded marine mammal and does not have the capability to respond appropriately to the report, the Participant must notify the NMFS Regional Stranding Coordinator without delay. Also, if the NMFS Regional Stranding Coordinator receives a report of a live stranded marine mammal, the Regional Stranding Coordinator may contact the Participant to determine whether the Participant has the capability to respond to the stranding. If the Participant cannot respond in a timely manner, the NMFS Regional Stranding Coordinator may request another Stranding Network participant to respond.

b. The Participant must take all steps reasonably practicable under the circumstances to prevent further injury to any live stranded marine mammal, injury to any network personnel, volunteers, government personnel and the general public.

c. The Participant must tag or mark any animals that are immediately released to their natural habitat using a NMFS approved tag, such as one-bolt roto tag, cattle ear tags, or freeze branding. Application of other tagging methods must first be approved by the NMFS Regional Stranding Coordinator. Tagging and post-tagging activities are restricted to monitoring the success of marine mammals released to the wild. Any projects outside the scope of monitoring the success of a release must be authorized under a NMFS MMPA/ESA scientific research permit.

d. If the Participant determines that it is necessary to temporarily hold or triage a stranded marine mammal at a separate site from the NMFS approved rehabilitation facility, the animal(s) cannot be moved until the Participant obtains verbal approval from the NMFS Regional Stranding Coordinator.

Written documentation of the need for an interim location and written concurrence from the NMFS Regional Stranding Coordinator with any associated conditions must be provided at the earliest time practicable within 24 hours.

e. If the Participant considers responding to an "out-of-habitat" or free-swimming marine mammal in distress (e.g., entanglement), the Participant must first contact the NMFS Regional Stranding Coordinator for approval and discuss plans for live capture, any required authorizations, and/or needs for assistance. The NMFS Regional Stranding Coordinator may require a NMFS employee to be present at the time of capture.

f. The Participant must follow the guidance provided by the Greater Atlantic Region in Attachment E, Disposition of Live Stranded Marine Mammals, and must consult with the NMFS Stranding Coordinator and the attending veterinarian to make a determination regarding immediate release, rehabilitation, or euthanasia of live stranded marine mammals or cetaceans.

2. **Data Collection and Reporting.** The Participant must collect and provide the following information for each stranded marine mammal they respond to:

a. Complete the NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form) for each stranded marine mammal. Completed forms must be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after responding to the stranding event. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant must provide preliminary data (verbal or written) from the Level A - Marine Mammal Stranding Report within 24 hours.

b. If temporarily holding a stranded animal prior to transferring to a NMFS approved rehabilitation facility acting in accordance with this Article, the Participant must complete the NOAA Form 89878, OMB # 0648-0178 (the Marine Mammal Rehabilitation Disposition Report). This report must be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after responding to the stranding event. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant must provide preliminary data (verbal or written) from the Marine Mammal Rehabilitation Disposition Form within 24 hours.

c. As resources are available, collect additional Level B and Level C data.

d. Notify the NMFS Regional Stranding Coordinator of the following cases within 24 hours or according to the specific reporting guidance provided by the Stranding Coordinator:

1) Possible or confirmed human interactions (including military activity);
2) Suspected UMEs;
3) Extralimital or out-of-habitat situations (see B.1.e. of this Article);
4) Mass stranding events and/or mass mortalities;
5) Large whale strandings; and
6) Any stranding involving endangered or threatened species or identified species of concern.

e. In certain circumstances (e.g., UME, possible human interaction case, extralimital or out-of-habitat situation), the NMFS Regional Stranding Coordinator may request additional and expedited reporting (verbal or written) of Level B and C data such as analytical results and necropsy reports if available. NMFS will not reproduce, modify, distribute, or publish the data without consent of the Participant unless required to release the data under Federal law or order (such as the Freedom of Information Act).

f. Collect and make available any gear, debris, or other objects (e.g., bullets, arrows, net webbing, etc.) recovered from a stranded marine mammal that may be evidence of human interaction. The Participant must comply with chain of custody procedures or any other instructions as specified and supported by NMFS Greater Atlantic Region and/or NMFS Office of Law Enforcement personnel.

3. Parts Disposition. Diagnostic parts, tissue samples, fluid specimens, parts or cells may be transferred to labs within the United States for diagnostic use without any additional authorizations. For non-diagnostic parts or samples:

a. Retention: Marine mammal parts may be retained by the Participant for education and/or research purposes, provided they are properly indicated in the "Specimen Disposition" field of NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form). Parts and/or containers must be marked with the field identification number assigned by the Participant or by NMFS (i.e., NMFS registration number). Authorization to take parts from ESA listed species in the Greater Atlantic Region is currently provided under MMPA/ESA Permit No. 932-1489-09, as amended, issued to the NMFS Marine Mammal Health and Stranding Response Program Coordinator, and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal, prior to any action by the Participant.

b. Transfer: Report to the NMFS Regional Administrator (See Attachment B) within 30 day of the stranding event, the transfer of any parts salvaged from the stranded marine mammal collected under this Agreement as required by or 50 CFR 216.37. The Participant must provide the institution name where specimen materials have been deposited and ensure that the retained or transferred parts are marked with the field identification number or assigned NMFS Registration

number in the "Specimen Disposition" field on the NOAA Form 89864, OMB #0648-0178 (the Marine Mammal Stranding Report – Level "A" Form) and ensure that retained or transferred parts are marked with the field identification number or the NMFS Registration Number. If parts are being transferred, the Participant must ensure the receiving institution is authorized by the NMFS Regional Administrator to receive marine mammal parts.

4. **Site Cleanup.** The Participant must make every reasonable effort to assist in the cleanup of beach areas where their activities (e.g., euthanasia, necropsy, or specimen collection) under this Agreement.

ARTICLE V: Live Animal Response - Rehabilitation and Final Disposition

A. The Participant may take live stranded marine mammals in a humane manner with the goal of rehabilitation and release. If the animal dies during the course of rehabilitation, then the terms and responsibilities contained in Article III of this Agreement become operative. In addition to the activities authorized in Articles I, II, III, and IV of this Agreement and subject to the conditions contained in this Agreement, the MMPA, and the implementing regulations, the Participant is authorized to implement the following activities under this article:

1. In accordance with applicable regulations and NMFS guidelines and best practices, transfer marine mammals to another NMFS approved rehabilitation facility within the Greater Atlantic Region for:

   a. Release back to the wild;

   b. Temporary placement in a scientific research facility holding a current NMFS scientific research permit and a United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) Research License; or

   c. Permanent disposition at an authorized facility (i.e. holds an APHIS exhibitors license {7 U.S.C. 2131 *et seq.*}) after consultation with, and authorization by, the NMFS Office of Protected Resources Permits, Conservation and Education Division.

2. Conduct scientific research on stranded animals in a rehabilitation facility, only if the responsible individual has a NMFS scientific research permit and the facility holds an APHIS research license in accordance with the Animal Welfare Act (see 50 CFR 216.27 (c)(6)).

3. Return rehabilitated stranded marine mammals to their natural habitat. A decision regarding whether or not a marine mammal has the potential to be released must be made as early as possible during the rehabilitation period. Any marine mammal eligible for release must be released as early as possible and no later than six months after being taken for rehabilitation unless the attending veterinarian determines that: the marine mammal might adversely affect marine mammals in the wild; release is unlikely to be successful due to the physical condition and behavior of the marine mammal; or more time is needed to make a determination. Release plans must be submitted to the NMFS Regional Administrator at least 15 days prior to the release, unless advanced notice is waived by the NMFS Regional Administrator. The NMFS Regional Administrator may require the participant to provide additional information, modify the release plan, or dispose of the marine mammal in another manner (see 50 CFR 216.27(a) and the *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release.*)

4. Tag rehabilitated stranded marine mammals, strictly for purposes of monitoring success

of release to the wild using a NMFS approved tag, such as one-bolt roto-tag, cattle ear tags, or freeze branding. Application of other tagging methods must first be approved by the NMFS Regional Stranding Coordinator. Tagging and post-tagging activities are restricted to monitoring the success of marine mammals released to the wild. Any projects outside the scope of monitoring the success of a release must be authorized under a NMFS MMPA/ESA scientific research permit.

5. Perform humane euthanasia. Euthanasia shall only be performed by the attending veterinarian or by a person acting under the direction of the attending veterinarian and following approved guidelines such as those referenced in Attachment C (*2007 Report of the American Veterinary Medical Association Panel on Euthanasia, 2nd Edition of the CRC Handbook of Marine Mammal Medicine, 2006 Journal of the American Association for Zoo Veterinarians*). When using controlled drugs, such person(s) shall comply with all applicable state and Federal laws and regulations (i.e., registered with the Drug Enforcement Administration). Authorization for the euthanasia of ESA-listed species provided under MMPA/ESA Permit No. 932-1489-09, as amended, and requires prior approval and direction from the NMFS Regional Stranding Coordinator.

B. Terms and Conditions for Live Animal Response: Rehabilitation, Release, or Final Disposition Determination

1. Rehabilitation

a. The Participant shall comply with laws, regulations, policies, and/or guidelines applicable to or promulgated by NMFS that apply to activities under this Agreement. The Participant must also have all applicable Federal, state, and local permits for rehabilitation facilities, and must comply with all Federal, state, and municipal laws related to operations of the facility.

b. The Participant shall be responsible for the custody of any living marine mammal taken pursuant to this Article using standards for humane care and for practicing accepted medical evaluation and treatment as described in the *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standard for Rehabilitation Facilities* (Attachment D).

c. The Participant shall not exceed their maximum holding capacity for cetaceans and pinnipeds based on the minimum standard space requirements, the number of animals housed in each holding area, and the availability of qualified personnel as described in the *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standard for Rehabilitation Facilities* (Attachment D) unless a written waiver is first received from the NMFS Regional Administrator. The NMFS Regional Stranding Coordinator may offer assistance for relocating animals to another rehabilitation facility and in supporting decisions to euthanize when necessary. Other considerations for determining maximum holding capacity include:

(1) On-site veterinary care, volunteer support, and experienced staff;
(2) Adequate food and medical supplies and medical test capabilities;
(3) Isolation for marine mammals;
(4) Adequate water quality;
(5) Limited public access; and
(6) Ability to maintain current, accurate and thorough records

d. The Participant shall follow contingency plans approved by NMFS for the care of marine mammals in rehabilitation during planned events (e.g., construction) or unexpected events such as mass strandings, UMEs, natural disasters (e.g., hurricanes, harmful algal blooms, El Niño), and/or hazardous waste spills.

e. The Participant shall isolate rehabilitating marine mammals from other wild or domestic animals and from any animal in permanent captivity.

f. The Participant shall prohibit the public display and training for performance of stranded rehabilitating marine mammals as required by 50 CFR 216.27(c)(5). This includes any aspect of a program involving interaction with the public.

g. The Participant shall follow any additional requirements for rehabilitation (e.g., isolation) and release prescribed by NMFS in consultation with the Working Group for Marine Mammal Unusual Mortality Events during a marine mammal UME, as recommended in the *National Contingency Plan for Response to Unusual Marine Mammal Mortality Events;* D.W. Wilkinson, NOAA Technical Memorandum NMFS-OPR-9, September 1996.

h. The Participant must temporarily refuse admittance of new cases of stranded marine mammals due to the severity of a disease outbreak when instructed by the NMFS Regional Stranding Coordinator, in consultation with the UME Working Group or other experts, if diseases of concern have been reported (e.g. diseases associated with a UME, or any emerging or zoonotic diseases).

i. The Participant shall not transfer a marine mammal being rehabilitated under this Agreement to another facility without prior approval form the NMFS Regional Stranding Coordinator.

j. If a marine mammal dies while in rehabilitation, Article III applies.

2. Release

a. Release Recommendation. The Participant shall make a final written recommendation for each animal in rehabilitation as early as possible, and no more than six months after its date of rescue, for release or non-release determination to the NMFS Regional Administrator according to any

applicable NMFS release guidelines and regulations including 50 CFR 216.27 (release, non-releasable, and disposition under special exception permits for rehabilitated marine mammals). This final recommendation shall include a release recommendation signed by the Participant's attending veterinarian, attesting that the marine mammal is medically and behaviorally suitable for release in accordance with the NMFS Standards for Release, and a concurrence signature from the Participant's Authorized Representative or Signatory of the Stranding Agreement (see Attachment D, *NMFS /FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*).

b. Release Plan. If the Participant recommends release, a release plan must also be included with the final recommendation letter. This information must be submitted to and approved by the NMFS Regional Administrator at least 15 days prior to the release, unless advanced notice is waived by the NMFS Regional Administrator, as required by 50 CFR 216.27(a).

3. Data Collection and Reporting

a. Diseases of Concern Reporting. The Participant shall notify immediately the NMFS Regional Stranding Coordinator upon learning of any diseases of concern (e.g., emerging, reportable, and/or zoonotic diseases) that are detected and/or confirmed that could be a potential hazard for public health or animal health (NMFS will provide guidance on Reportable Diseases);

b. Disposition Reports. Upon release or other disposition of any marine mammal under this Article, the Participant shall complete the NOAA Form 89878, OMB # 0648-0178 (the Marine Mammal Rehabilitation Disposition Report Form). Completed forms shall be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after final disposition of the marine mammal. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant shall provide preliminary data (verbal or written) from the Marine Mammal Rehabilitation Disposition Report within 24 hours.

c. Annual Summary Reports. The Participant shall submit an annual report (due January 31 each year) summarizing the Participant's rehabilitation activities for the past calendar year. NMFS will not reproduce, modify, distribute, or publish the data without consent of the Participant unless required to release the data under Federal law or order (such as the Freedom of Information Act).

The reports shall include the following for each animal in rehabilitation:

i. Species and field number
ii. If the animal was released:
    (a) Date, location of release (latitude and longitude).

(b) Type and specifics of post-release monitoring (roto-tag, satellite, etc.) and any roto-tag or freeze brand numbers used.
(c) Photos if possible.
(d) Duration of post-release monitoring.
(e) Status of post-release monitoring.
(f) Indications from monitoring relative to the success of the rehabilitation effort.
(g) Disposition of tracking data if applicable.

iii. If the animal was transferred to permanent care:
(a) Date of physical transport (if applicable).
(b) Location of permanent care.

iv. If the animal was euthanized, provide the date of euthanasia.

v. If the animal died, provide the date of death.

Article VI: Good Standing Agreement

Greater Atlantic Region Marine Mammal Stranding Network
Good Standing Agreement

To be considered in "good standing" the Greater Atlantic Region Marine Mammal Stranding Network Member (Network Member) must meet all of the following criteria:

General Criteria

1. If the Network Member is a designated Principal Investigator of an MMPA or Endangered Species Act (ESA) scientific research or enhancement permit holder, the applicant must have fulfilled all permit requirements, including but not limited to submission of all reports, and must have no pending or outstanding enforcement actions under the MMPA or ESA.

2. The Network Member must comply with the terms and responsibilities of its Stranding Agreement (SA), MMPA Section 109(h) authorization, or researcher authorization letter. This includes, but is not limited to, the following response and reporting requirements:
   a. Timely (within 24 hours) response to all stranding reports in Network Member's area of responsibility in accordance with SA;
   b. Respond to stranding in an effective manner that protects both the health and safety of the responders and the stranded animals;
   c. Timely (immediate) notification to NMFS regarding any unusual stranding circumstances (UME, out of habitat, large cetacean stranding, etc.) according to the timelines as specified in the SA;
   d. Adhere to the *Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation and Release;*
   e. Reporting of stranding events to NMFS as specified in SA;
   f. Submission of complete reports on basic or Level A data to the Regional Coordinator (includes investigator's name, species, stranding location, number of animals, date and time of stranding and recovery, length and condition, and sex; marine mammal parts retention or transfer; annual reports) as specified in SA;
   g. Collecting information or samples as necessary and as requested; and
   h. Prompt notification to NMFS for any article of SA (or points above) with which the Network member cannot comply.

3. The Network Member must cooperate with NMFS in collecting and submitting Level B (supplementary information regarding sample collection related to life history and to the stranding event) and Level C (necropsy results) data and samples, when requested and within the requested timeframe.

4. The Network Member must have no current enforcement investigation for the 'take' of marine mammals in violation of the Marine Mammal Protection Act and Endangered

Species Act.

5. The Network Member must have no record of a pending NMFS notice of violation(s) regarding the policies governing the goals and operations of the Stranding Network and Stranding Agreement, if applicable (e.g., probation, suspension, or termination).

Coordination and Cooperation Criteria

The following coordination/cooperation requirements must be satisfied:
1. Cooperation with state, local, and Federal officials;
2. Cooperation with state and local officials in the disposition of stranded marine mammals; and
3. Cooperation with other stranding network participants.

If the Network Member feels they are in danger of not being in "good standing", please refer to *Communication Agreement.*

If NMFS determines a Network Member is in danger of not being in "good standing":
1. The Network Member will receive a written warning from the Regional Administrator
2. The Network Member must reply to this warning within 30 days
3. The reply must include remediation efforts with a proposed timeline
4. Efforts and timeline must be agreed to by the Regional Administrator

If the Network Member fails to meet the timeline, and no further remediation letter is received from the Network Member, the Network Member will no longer be considered in "good standing".

AGREEMENT

I have read and understand the conditions above for participating as a member of the Greater Atlantic Region Stranding Network. I agree to abide by all applicable provisions of the Good Standing Criteria established by National Marine Fisheries Service Greater Atlantic Region. By signing this agreement I understand and acknowledge the consequences of not complying with The Good Standing Criteria will lead to ineligibility for Prescott Grant funding and suspension or termination of the Stranding Network Member's SA.

ARTICLE VII: Communications Agreement

Greater Atlantic Region Marine Mammal Stranding Program
Communication Agreement

If the Greater Atlantic Region Marine Mammal Stranding Network Member (Network Member) foresees a problem or potential for non-compliance with their Stranding Agreement (SA), the Network Member will notify NOAA's National Marine Fisheries Service (NMFS) regional stranding staff immediately, no matter how small the problem. Should a Network Member foresee a problem or potential for non-compliance with their SA, the Network Member must:

1. Contact Marine Mammal Stranding Coordinator, or if not available;
2. Contact Marine Mammal and Sea Turtle Program Coordinator, or if not available;
3. Contact Assistant Regional Administrator for Protected Resources.

*** If an emergency situation; call the Stranding HOTLINE: 866-755-6622**

If NMFS foresees a problem or potential for non-compliance with a Network Members SA, NMFS will provide a written warning to the Network Member (see Good Standing Criteria) and will work with the Network Member to identify the deficiency as:

1. Minor
2. Intermediate
3. Major

Minor Deficiency: a deficiency that will likely require little or no time to correct. Minor deficiencies have little impact on the operational capability of the Network Member and do not directly affect the rescue or care of live animals or the collection of data from live and dead animals.

Intermediate Deficiency: a deficiency that may require a short period of time to correct (less than 6 months) and require a small amount of resources (expense) to address. Intermediate deficiencies may cause the Network Member to become non-compliant with the NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release and may impact the operational capability of the Network Member. These deficiencies may also affect the rescue and care of live animals and data collection capabilities from live and dead stranded animals.

Major Deficiency: a deficiency that will require a prolonged period of time to correct (greater than 6 months) and require significant resources (expense) to address. Major deficiencies will cause the Network Member to become non-compliant with Federal, state and local laws and regulations as well as the NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release and will impact the operational capability of the Network Member. These deficiencies will likely be controversial and affect the rescue and care of live animals and data collection capabilities from live and dead stranded animals.
The roles and responsibilities for each level of deficiency is as follows:

Minor Deficiency

Network Member responsibilities

1. Notify NMFS Regional Stranding Staff immediately.
2. Submit remediation efforts within timeframe specified by NMFS.
3. Work with NMFS on correcting the problem.
4. Keep NMFS informed of progress on meeting deadline (if applicable).
5. Notify NMFS immediately if problem progresses or new issues develop.
6. Submit report verifying steps taken to correct deficiency and future steps to prevent deficiency from reoccurring.

NMFS responsibilities

1. NMFS staff will provide consultation to help correct problem if applicable.
2. NMFS staff will develop timeline for corrective measures and consider an extension if requested.

Intermediate Deficiency

Network Member responsibilities

1. Notify NMFS Regional Stranding Staff immediately.
2. Develop an Action Plan to correct the problem, in consultation with NMFS.
3. Keep NMFS informed of progress on meeting deadlines (if applicable).
4. Notify NMFS immediately if problem progresses or new issues develop.
5. Seek guidance from NMFS staff or external experts.
6. Submit report verifying steps taken to correct deficiency and future steps to prevent deficiency from reoccurring.

NMFS responsibilities

1. NMFS staff will provide consultation to help correct problem if applicable.
2. NMFS will develop a timeline for corrective measures and consider an extension if requested.
3. NMFS staff will work with Network Member to identify cause of problem and identify solutions.
4. Seek guidance from additional NMFS staff or external experts.

Major Deficiency

Network Member responsibilities

1. Notify NMFS Regional Stranding Staff immediately.
2. Develop an Action Plan to correct the problem, in consultation with NMFS.
3. Keep NMFS informed of progress on meeting deadlines (if applicable).
4. Notify NMFS immediately if problem progresses or new issues develop.
5. Seek guidance from NMFS staff or external experts.
6. Convene other staff members to meet with NMFS to address problems: such as board members, attending veterinarians and veterinary technicians, upon request.

7. Provide requested data and files to NMFS as requested.
8. Submit report verifying steps taken to correct deficiency and future steps to prevent deficiency from reoccurring.

NMFS responsibilities

1. NMFS staff will provide consultation to help correct problem if applicable.
2. NMFS will develop a timeline for corrective measures and consider an extension if requested.
3. NMFS staff will work with Network Member to identify cause of problem and identify solutions.
4. Outside consultation from experts in the field may be sought to help address solutions to deficiencies.
5. If applicable, NMFS staff will seek consultation of NOAA Office of Law Enforcement and General Council.

If deadlines are disregarded without correction of deficiency, the Network member will be subject to disciplinary action: probation, suspension and/or termination (as outlined in the SA). NMFS will make every effort to notify the Network Member in writing of failure to comply with agreed upon remedies for deficiency. In cases of willfulness, or those in which public health, interest, or safety requires immediate attention, NMFS, Greater Atlantic Regional Administrator reserves the right to immediately suspend or terminate the Network Member's stranding agreement (as outlined in the SA).

AGREEMENT

I have read and understand the conditions above for participating as a member of the Greater Atlantic Region Stranding Network. I agree to abide by all applicable provisions of the Communication Agreement established by National Marine Fisheries Service Greater Atlantic Region.

Article VIII: Participant's Authorized Personnel

A. Personnel and Volunteers

Takings of marine mammals authorized in this Agreement may only be directed by the Participant's personnel and trained volunteers identified by the Participant in writing to the NMFS Regional Administrator. The Participant may use other (i.e., not previously identified to NMFS) volunteers to carry out activities in this Agreement only if they are under the close direction of previously identified trained personnel or volunteers. The Participant may not delegate authority to take marine mammals to another person except as provided in this article.

In the event of changes in key personnel, the prospective Participant must notify the NMFS Regional Administrator in writing (see Attachment B) within 30 days and provide a description of the experience of new key personnel for review and approval by NMFS. New key personnel must be meet the qualification terms identified in the *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement* (Attachment D).

B. Untrained Citizens

If the Participant requests the assistance of untrained citizens (e.g., during a mass stranding), the Participant is responsible for the actions of those citizens during the response; must take precautions against injury or disease to those volunteer citizens; and must ensure that the citizens' actions do not cause unnecessary harassment of marine mammals.

Article IX: Rights of States and Local Governments

Nothing in this Agreement must be construed to affect the rights or responsibilities of other Federal, state, or local government officials or employees acting in the course of their official duties with respect to taking of marine mammals in a humane manner (including euthanasia) for protection or welfare of the marine mammal, protection of public health and welfare or non-lethal removal of nuisance animals (MMPA section 109(h)).

Article X: Effective Dates, Renewal and Application Procedures

A. Effective Dates

The terms of this Agreement must become effective upon the signature by both VAQS and the NMFS Greater Atlantic Regional Administrator.

B. Period of Agreement

1. **Duration:** Unless terminated as provided in this Agreement, this Agreement must expire at the end of the following applicable period, October 15, 2025.

    1 year for new Stranding Network Participants
    1 year for a Stranding Network Participant on probation
    3 years for a live animal responder and rehabilitator (Articles IV and V)
    6 years for a dead animal only responder (Article III only)

2. **Stranding Agreement Renewals**: No later than 90 days prior to the expiration date of this Agreement, NMFS will provide the Participant with a written notice of expiration, and prescribe information needed from the Participant for renewal (see *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement*, Attachment D). No later than 60 days prior to the expiration date, the Participant must indicate in writing to NMFS (see Contacts, Attachment B.) that a renewal of this Agreement is requested and must provide the prescribed information. Following NMFS review of the submitted information to determine if Participant meets applicable requirements, the Agreement may be renewed if agreed to in writing by both parties.

    If no written renewal request is received from the Participant, this Agreement becomes null and void upon the above expiration date.

3. **Provisional Stranding Agreements Renewals**: For new participants, the NMFS Regional Administrator will enter into this Agreement for a provisional period of one year from the effective date. The performance of the Participant will be reviewed to determine if the services provided by the Participant under this agreement have been satisfactory to NMFS. If NMFS determines that the new Participant has satisfied the terms and conditions of this stranding agreement, this Agreement may be extended for a multi-year period. New participants operating without any deficiencies (see Article IX. D), are considered to be in "good standing" under this Agreement.

4. **Denial of Stranding Agreement Renewal**: The decision to renew or deny a Stranding Agreement is solely at the discretion of the NMFS Regional Administrator and is not compelled by the Participant's adherence to the Stranding Agreement criteria. If the NMFS Regional Administrator denies a renewal request, the denial will be issued in writing by certified mail from the NMFS Regional Administrator to the Participant within

30 days of the Participant's submission of a completed application, and will be based upon the Regional Administrator's judgment of:

a. Past performance of the Participant;
b. Existing capabilities of the Participant; and
c. Geographic and programmatic needs of NMFS' stranding program.

A Stranding Agreement for which renewal is denied by the NMFS Regional Administrator becomes null and void upon the expiration date listed above.

ARTICLE XI: Review, Modification and Termination

A. Review

The NMFS Greater Atlantic Region ARA for Protected Resources must review this Agreement from time to time for performance adequacy and effectiveness.

B. Modification

The Participant or the Greater Atlantic Regional Administrator may request a modification to the Stranding Agreement, including, but not limited to, procedural or administrative changes, such as a change in contact information, and a request for expansion or reduction of activities authorized by this Agreement. A request for authority for additional activities may require submission of information identified in Attachment D, *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement*. Modifications and reductions in authority, as well as notice of issuance or denial of a request for increased authorizations, will be given in writing within 30 days of receipt of a completed request. The Participant and the NMFS Regional Administrator may determine that a new Stranding Agreement is warranted.

C. Suspension or Termination request by Participant

The Participant may request suspension of all or part of this Stranding Agreement for a stated period of time, or may terminate this Agreement, upon 30 days written notice to the NMFS Regional Administrator. Suspension of the authorization of activities at the request of the Participant may be given without prejudice to the reinstatement of authorization or renewal of a Stranding Agreement.

D. Non-Compliance with Stranding Agreement or Violations of Law by Participant

Except in cases of willfulness, or those in which public health, interest, or safety requires immediate suspension, or termination of this Agreement, NMFS must provide the Participant with notice and an opportunity to correct any deficiencies within a time period specified by NMFS, in writing, if the Participant fails to satisfy the terms and condition of this Agreement or violates any laws, regulations, or guidelines applicable to this Agreement, or Federal, state or municipal laws related to stranding network operations. The NMFS Region may take the following actions based on the circumstances:

1. **Probation.** The Participant may be put on probation for up to three years if deficiencies are not corrected. The NMFS Regional Stranding Coordinator and the Participant will develop a timetable with reasonable and measurable milestones that must be achieved to correct deficiencies during the probation period. Probation requires annual reviews of the Participant's activities for up to three years. A participant on probation may not be in "good standing" with the Stranding Network.

2. **Suspension.** The NMFS Regional Administrator may suspend the Participant's authority, or any portion of their authority, as appropriate (e.g., suspend rehabilitation authority, but not live or dead animal response), with 30 days written notice, for up to 1 year or until NMFS is satisfied that all deficiencies and violations have been adequately addressed. A notice of suspension listing deficiencies and a timetable with reasonable and measurable milestones required to correct those deficiencies will be issued in writing, delivered in person or by certified mail, from the NMFS Regional Administrator, in the judgment of the Regional Administrator, the Participant has:

   a. Submitted false information or statements in applications or reports;
   b. Not satisfied the terms and conditions of the Stranding Agreement;
   c. Failed to correct deficiencies in a timely manner; or
   d. Violated applicable Federal, state, or municipal laws, regulations, guidelines, or other requirements.

A participant on suspension is <u>not</u> in "good standing" with the Stranding Network.

3. **Immediate suspension.** The NMFS Regional Administrator may require immediate suspension of authorization under a Stranding Agreement, or any part of the Agreement, without prior notice if, in the judgment of the Regional Administrator, suspension is needed to protect marine resources, in cases of willfulness, or as otherwise required to protect public health, welfare, interest, or safety, (which includes interest in the welfare of marine mammals). During the suspension period, the NMFS Regional Stranding Coordinator may ask other Stranding Network participants to respond in the Participant's area of geographic coverage. If the Participant's Stranding Agreement is suspended while animals are in rehabilitation, NMFS reserves the right to either confiscate the animals or to arrange for another participant to take over rehabilitation or take custody of the animals. A written notice of immediate suspension will be issued in person or by certified mail.

   A participant on immediate suspension is <u>not</u> in "good standing" with the Stranding Network.

4. **Termination**. The NMFS Regional Administrator may terminate this Agreement, or any part thereof, upon at least 30 days written notice to the Participant, delivered in person or by certified mail. The Agreement may be terminated for any reason, including the Participant's:

   a. Submission of false information or statements in applications or reports;
   b. Failure to satisfy the terms and conditions of the Stranding Agreement;
   c. Failure to correct deficiencies in a timely manner; or
   d. Violation of applicable Federal, state, or municipal laws, regulations, guidelines, or other requirements.

   The NMFS Regional Stranding Coordinator may ask another Stranding Network

participant to respond in the Participant's area of geographic coverage. If the Participant's Stranding Agreement is terminated while animals are in rehabilitation, NMFS reserves the right to either confiscate the animals or to arrange for another participant to take over rehabilitation of or to take custody of the animals.

Termination of the Agreement for any reason must automatically terminate any designations by the Participant to any designee organizations under this Agreement.

Acceptance of Agreement

Pursuant to the terms and conditions described above in this Stranding Agreement between NMFS Greater Atlantic Region and VAQS, the Participant, is authorized:

- **Under Article III to respond to strandings of dead marine mammals *(cetaceans and pinnipeds); and***
- **Under Article IV to provide first response to live stranded marine mammals (*cetaceans and pinnipeds*).**
- **Under Article V to rehabilitate and release live stranded marine mammals (*pinnipeds*).**

THIS STRANDING AGREEMENT IS ENTERED INTO AND MADE EFFECTIVE THIS

Date October 15, 2022 **Date** 10/17/2022

APPROVED:

NMFS Greater Atlantic Region
55 Great Republic Drive
Gloucester, MA 01930

Virginia Aquarium & Marine Science Foundation
717 General Booth Blvd
Virginia Beach, VA 23451

Signature of Assistant Regional Administrator

Jennifer Anderson

Jennifer Anderson
Assistant Regional Administrator
for Protected Resources

Signature of Authorized Representative

DVM

Dr. Allyson McNaughton
Chief of Veterinary Services

THIS STRANDING AGREEMENT REMAINS IN EFFECT UNTIL: October 15, 2025

27

Attachment List

Attachment A: List of Terms and Definitions under 50 CFR 216.3, Glossary of Terms, etc.

Attachment B: Regional contact information, 24 hour numbers, etc.

Attachment C[1]: Euthanasia guidance

Attachment D[1]: NOAA National Marine Fisheries Service *Best Practices* for Marine Mammal Stranding Response, Rehabilitation, and Release Documents:

- Evaluation Criteria for a Marine Mammal Stranding Agreement (New Applicants and Renewals of Existing Participants)
- Standards for Release
- Standards for Rehabilitation Facilities
- Level A Forms (Marine Mammal Stranding Report and Marine Mammal Rehabilitation Disposition Report)

Attachment E[1]: NMFS Greater Atlantic Region Disposition of Live Stranded Marine Mammal Guidance.

[1] Once finalized, this guidance may be replaced by the appendices in the Programmatic Environmental Impact Statement for the Marine Mammal Health and Stranding Response Program.

APPENDIX II: LIST OF ALL MARINE MAMMAL SPECIES SIGHTED OR STRANDED IN VIRGINIA INSHORE, NEARSHORE, OFFSHORE, AND PELAGIC WATERS

Common Name	Scientific Name	IUCN	ESA Status	SGCN	Strategic Stock	TRT	Active UME
Bottlenose dolphin	*Tursiops truncatus* (pelagic); *Tursiops errebenus* (nearshore, inshore, offshore)	Least Concern	N/A	Yes	Yes (3 coastal stocks); No (offshore stock)	Yes (3 coastal stocks); No (offshore stock)	No
Harbor porpoise	*Phocoena phocoena*	Least Concern	N/A	No	No	Yes	No
Common dolphin	*Delphinus delphis*	Least Concern	N/A	No	No	No	No
Atlantic spotted dolphin	*Stenella frontalis*	Least Concern	N/A	No	No	No	No
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Least Concern	N/A	No	No	No	No
Striped dolphin	*Stenella coerubeoalba*	Least Concern	N/A	No	No	No	No
Short-finned pilot whale	*Globicephala macrorhynchus*	Least Concern	N/A	No	No	Yes	No
Long-finned pilot whale	*Globicephala melas*	Least Concern	N/A	No	No	No	No
Rough-toothed dolphin	*Steno bredanensis*	Least Concern	N/A	No	No	No	No
Risso's dolphin	*Grampus griseus*	Least Concern	N/A	No	No	Yes	No
Pygmy killer whale	*Feresa attenuata*	Least Concern	N/A	No	No	No	No
Melon-headed whale	*Peponocephala electra*	Least Concern	N/A	No	No	No	No
Sperm whale	*Physeter macrocephalus*	Vulnerable	Endangered	No	Yes	No	No
Pygmy sperm whale	*Kogia breviceps*	Least Concern	N/A	No	No	No	No
Dwarf sperm whale	*Kogia sima*	Least Concern	N/A	No	No	No	No
Blainville's beaked whale	*Mesoplodon densirostris*	Least Concern	N/A	No	No	No	No
Gervais' beaked whale	*Mesoplodon europaeus*	Least Concern	N/A	No	No	No	No
Sowerby's beaked whale	*Mesoplodon bidens*	Least Concern	N/A	No	No	No	No
True's beaked whale	*Mesoplodon mirus*	Least Concern	N/A	No	No	No	No
Cuvier's beaked whale	*Ziphius cavirostris*	Least Concern	N/A	No	No	No	No

North Atlantic right whale	*Eubalaena glacialis*	Critically Endangered	Endangered	Yes	Yes	Yes	Yes
Humpback whale	*Megaptera novaeangliae*	Least Concern	N/A	Yes	No	Yes	Yes
Minke whale	*Balaenoptera acutorostrata*	Least Concern	N/A	No	No	No	Yes
Fin whale	*Balaenoptera physalus*	Vulnerable	Endangered	Yes	Yes	Yes	No
Sei whale	*Balaenoptera borealis*	Endangered	Endangered	No	Yes	No	No
Blue whale	*Balaenoptera musculus*	Endangered	Endangered	No	Yes	No	No
Harbor seal	*Phoca vitulina*	Least Concern	N/A	No	No	No	Yes
Gray seal	*Halichoerus grypus*	Least Concern	N/A	No	No	No	Yes
Harp seal	*Pagophilus groenlandica*	Least Concern	N/A	No	No	No	No
Hooded seal	*Crystophora cristata*	Vulnerable	N/A	No	No	No	No
West Indian manatee	*Trichechus manatus (latirostris)*	Vulnerable	Threatened	Yes	Yes	No	Yes

APPENDIX 5: VIRGINIA SEA TURTLE CONSERVATION PLAN

2025

Virginia Sea Turtle Conservation Plan



Prepared by

Virginia Department of Wildlife Resources

With

Virginia Coastal Zone Management Program

National Oceanic and Atmospheric Administration

2025

Virginia Sea Turtle Conservation Plan

Virginia Department of Wildlife Resources

This document serves as a final report to the Virginia Coastal Zone Management Program of the Department of Environmental Quality in fulfillment of Award Number NA 21NOS4190152 FY21 Task # 92.03 from the National Ocean Service of the National Oceanic and Atmospheric Administration.

Cover image: A loggerhead turtle that stranded and was rehabilitated by the Virginia Aquarium Stranding Response Program makes its way back into the ocean after release (credit: Virginia Aquarium & Marine Science Center).

2025
Virginia Sea Turtle
Conservation Plan

Prepared by:
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Approved: _____

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Virginia Department of Wildlife Resources

Date: _____

Table of Contents

Table of Contents iiii

List of Figures and Tables iv

Disclaimer v

Acknowledgements v

List of Acronyms and Abbreviations v

Executive Summary 1

Introduction 2

- Species Descriptions 3
- Loggerhead Turtle (*Caretta caretta*) 3
- Kemp's ridley Turtle (*Lepidochelys kempii*) 14
- Green Turtle (*Chelonia mydas*) 20
- Leatherback Turtle (*Dermochelys coriacea*) 25

Management of Sea Turtles in Virginia 31

Limiting Factors, Causes of Mortality, and Other Threats to Sea Turtles in Virginia 37

Sea Turtle Conservation Strategy 59

- Conservation Outline 60
- Conservation Narrative 63
- Conservation Goal 1: Maintain a permanent and effective Sea Turtle Stranding and Salvage Network in Virginia 64
- Conservation Goal 2: Identify and mitigate risks to sea turtle populations and habitats in Virginia through cost-effective monitoring, research, and best practices. 69
- Conservation Goal 3. Promote sea turtle conservation in Virginia through social marketing and information dissemination. 788

Summary 81

Literature Cited 82

Appendix – 2022-2027 Agent of State designation for VAQS 102

List of Figures and Tables

Figure 1. Modeled loggerhead density map for August……..….6

Figure 2. Modeled loggerhead density map for February……7

Figure 3. Monthly location of suitable habitat for loggerhead turtles…….……..…...……10

Figure 4. Decadal mean number of loggerhead turtle nests on southern Virginia beaches ……..11

Figure 5. Modeled Kemp's ridley density map for August……...17

Figure 6. Modeled Kemp's ridley density map for February……18

Figure 7. Monthly location of suitable habitat for Kemp's ridley turtles……...……...19

Figure 8. Modeled green turtle density map for August……22

Figure 9. Modeled green turtle density map for February…….23

Figure 10. Modeled leatherback turtle density map for August……26

Figure 11. Modeled leatherback turtle density map for February……27

Figure 12. Reconstructed satellite tracks of leatherbacks tagged off Massachusetts …..……28-30

Figure 13. Monthly frequency of lethal sea turtle takes in Virginia by hopper dredge.……...….50

Figure 14. Timeline of initiation of actions under Goal 1 following Plan completion……..……70

Figure 15. Timeline of initiation of actions under Goal 2 following Plan completion……..…78

Figure 16. Timeline of initiation of actions under Goal 3 following Plan completion……..……82

Table 1. Human interaction categories for stranded sea turtles in Virginia ……..45

Table 2. Total number of lethal sea turtle takes reported during hopper dredging operations from Atlantic Florida to Virginia, 2000-2023……51

Disclaimer

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Acknowledgements

The 2025 Virginia Sea Turtle Conservation Plan (Plan) was made possible by a team of dedicated partners and stakeholders representing state, federal and non-governmental agencies as well as Virginia Tribal Nations who provided considerable input, expertise and assistance with the preparation of the *DRAFT* 2015 Virginia and Maryland Sea Conservation Plan that was never formally adopted by the Commonwealth (Barco *et al.* 2015) but served as the principal foundation of this Plan. The Virginia Coastal Zone Management Program provided support and funding for this Plan. Bridie Farmer, Megan Perdue and other DWR staff provided editing assistance. We would like to thank numerous partners and colleagues for thoughtful reviews of an earlier draft for review of the draft version of this plan.

List of Acronyms and Abbreviations

AINS	Assateague Island National Seashore
ASMFC	Atlantic States Marine Fisheries Commission
Bay	Chesapeake Bay
BBNWR	Back Bay National Wildlife Refuge
BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management (US)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNWR	Chincoteague National Wildlife Refuge
CVOW	Coastal Virginia Offshore Wind, development off Virginia owned by Dominion Power

List of Acronyms and Abbreviations (*cont.*)

DCR	Department of Conservation and Recreation
DE Bay	Delaware Bay
DEQ	Department of Environmental Quality (VA)
DEQ-CZM	Department of Environmental Quality–Coastal Zone Management
DNNB	Dam Neck Naval Base
DOD	Department of Defense (US)
DPS	distinct population segment (of sea turtles)
DWH	Deep Water Horizon (oil spill)
DWR	Division of Wildlife Resources (VA)
EEZ	Unites States Exclusive Economic Zone which goes 200 NM from shore
EPA	US Environmental Protection Agency
ESA	Endangered Species Act (US)
FCSP	False Cape State Park
FINWR	Fisherman Island National Wildlife Refuge
GI	gastrointestinal (contents of digestive system)
HAB	harmful algal bloom
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
JEBFS	Joint Expeditionary Base – Fort Story Navy
JEBLC	Joint Expeditionary Base – Little Creek Navy
Mid-Atlantic Bight	section of the U.S. Atlantic continental shelf that extends from Long Island, New York to Cape Hatteras, North Carolina. It is often used in fishery management actions.
MARCO	Mid-Atlantic Regional Council on the Ocean MOU – Memorandum of Understanding
MRC	Marine Resources Commission (VA)
NEPA	National Environmental Policy Act (US)
NGO	Non-governmental organization
NM	nautical miles
NMFS	National Marine Fisheries Service also known as NOAA Fisheries (US)
NOAA	National Oceanic and Atmospheric Association (US)
NPS	National Park Service (US)
ODESS	US Army Corps of Engineers' Operations and Dredging Endangered Species System
ODU	Old Dominion University
OLE	Office of Law Enforcement (NOAA OLE)
OSW	offshore wind
PBDE	polybrominated diphenyl ethers
PCB	polychlorinated biphenyls

List of Acronyms and Abbreviations (*cont.*)

PCH	polychlorinated hydrocarbons
PFA	per-and polyfluoroalkyls
PFO	Perfluorooctane sulfonate
PSO	Protected Species Observer
RWSC	Regional Wildlife Science Collaborative for Offshore Wind
SGCN	Species of Greatest Conservation Need
STDN	Sea Turtle Disentanglement Network (US)
STSSN	Sea Turtle Stranding and Salvage Network (US)
TNC	The Nature Conservancy (NGO)
US	United States
USACOE	US Army Corps of Engineers
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
USFWS-VFO	US Fish and Wildlife Service Virginia Field Office
USMC	US Marine Corps
USN	US Navy
UXO	unexploded ordinance
VAMSC	Virginia Aquarium & Marine Science Center (the Department within the City of Virginia Beach responsible for the municipal portion of the Aquarium facility)
VAQF	Virginia Aquarium & Marine Science Center Foundation (NGO)
VAQS	Virginia Aquarium Stranding Response Program (program under VAQF that manages STSSN in VA)
VIMS	Virginia Institute of Marine Science (VA)
VOP	Virginia Ocean Plan
VPA	Virginia Port Authority
VSTSSN	Virginia Sea Turtle Stranding and Salvage Network
WFF	Wallops Island Flight Facility

Executive Summary

Loggerhead, Kemp's ridley, green, and leatherback turtles regularly occur in Virginia waters and all four species are protected under the Virginia and U.S. Endangered Species Acts. Loggerhead and green turtle populations that occur in Virginia are state and federally listed as threatened whereas leatherbacks and Kemp's ridleys are state and federally listed as endangered.

As highly mobile marine mega-vertebrates, none of these species spend their lives exclusively in Virginia. Juvenile loggerhead, Kemp's ridley and green sea turtles migrate seasonally to Virginia to forage during their development into adulthood. Adult male and female loggerhead turtles have been tracked to Virginia from nesting beaches south of Virginia, presumably to forage after breeding activities. All three species nest in Virginia, but only loggerheads nest regularly in the state. Leatherbacks occur in Virginia at any time of year but are most often present in the spring. To date, no leatherback nesting activity has been documented in Virginia despite the fact that nests have been reported in states to the north and south of the Commonwealth.

Because sea turtles that occur in temperate habitats are migratory animals with wide ranges, it is necessary to coordinate conservation efforts with those of other state, federal and international entities. Although threats to sea turtles in Virginia are consistent with those reported throughout the mid-Atlantic region, the density of turtles compared to areas north of Virginia appears to be relatively high in Virginia; thus, making the conservation and management of sea turtles and their habitats especially important in the Commonwealth. Sea turtle injuries and mortality are primarily attributed to anthropogenic activities including commercial and recreational fishing gear, hopper dredges, and vessel strikes. Although cold-stunning is a natural phenomenon, global climate change has contributed to an increase in the variability of fall and early winter coastal water temperatures, which has led to a rise in the numbers of turtles affected. Non-lethal, compounding stressors may also be compromising animals, making them more susceptible to disease, parasites, and cold stunning. These stressors include low levels of contaminants and poor prey and water quality (resulting from various types of pollution), shifting prey bases, invasive species, harmful algal blooms, marine construction, and military activities.

The overarching goal of this Plan is to enhance the survival and conserve the habitats of sea turtles in Virginia in a manner that is consistent with regional and federal research, management, and conservation efforts. There are three conservation goals under which strategies and actions with lead agencies and timelines are described. The three goals discussed below are:

Conservation Goal 1: Maintain a permanent and effective Sea Turtle Stranding and Salvage Network in Virginia

Conservation Goal 2: Identify and mitigate risks to sea turtle populations and habitats in Virginia through cost-effective monitoring, research, and best practices.

Conservation Goal 3. Promote sea turtle conservation in Virginia through social marketing and information dissemination.

As the agency responsible for conservation and management of protected species, the Virginia Department of Wildlife Resources (DWR) is responsible for developing state conservation plans. Coordination and communication between the DWR and the Virginia Marine Resources Commission, the two state agencies responsible for managing protected marine species in the Commonwealth along with NOAA Fisheries and the U.S. Fish and Wildlife Service, which provide national oversight, is a key aspect of sea turtle conservation in Virginia. This plan aligns with and builds on federal recovery efforts described in species recovery plans and status reviews. Moreover, the successful implementation of most of the conservation strategies and actions identified in this Plan rely heavily on the cooperation of many other collaborating agencies, organizations, and partners who will also be key to communicating with the general public. Since sea turtle conservation fundamentally includes human beings, the most successful conservation actions will be those aligned with the values, wellbeing, and perspectives of people who are expected to support lasting change. Finally, this Plan was developed in concert with the 2024 Marine Mammal Conservation Plan (MMCP) and many of its strategies and actions are similar to those identified for sea turtles. The coordination and implementation of related efforts outlined in both plans should be executed in a way that maximizes limited state resources and provides the greatest conservation benefits for both species groups. Lastly, the sea turtle and marine mammal conservation plans will serve as appendices to the 2025 Virginia Wildlife Action and the 2025 Virginia Ocean Plan which will help ensure that sea turtle and marine mammal conservation will be incorporated into the Commonwealth's future wildlife and ocean resources management priorities.

Introduction

Five species of sea turtles occur in the Chesapeake Bay and the coastal waters of Virginia with varying regularity. They include, in order of occurrence from stranding and survey data, the loggerhead turtle (*Caretta caretta*); the Kemp's ridley turtle (*Lepidochelys kempii*); the green turtle (*Chelonia mydas*); the leatherback turtle (*Dermochelys coriacea*); and the hawksbill turtle (*Eretmochelys imbricata*). There have also been suspected and confirmed hybrids in the stranding record (Virginia Aquarium Stranding Response Program (VAQS) *unpublished data,* May 2023). Loggerhead, Kemp's ridley, and green turtles occur annually in Virginia (Lutcavage and Musick 1985; Keinath *et al.* 1987; Byles 1988; Mansfield 2006; Costidis *et al.* 2021; Costidis *et al*. 2022; Epple *et al.* 2023). Leatherback turtles appear in the stranding record less frequently but are likely present in Virginia annually (DiMatteo *et al.* 2024). Loggerhead and Kemp's ridley turtles appear annually in the stranding record from April/May through December/January, and green turtles occur June/July through October/November (Costidis *et al.*

2021; Costidis *et al*. 2022; Epple *et al.* 2023). Occurrence of leatherback turtles is less predictable but strandings and/or entanglements are reported in most years with most strandings occurring in spring. The Hawksbill turtle, a tropical species, is the rarest of all species in waters north of Florida and has only been recorded twice in Virginia. Therefore, this species will not be directly addressed in this Plan.

The species summaries presented below represent what is currently known about the four regularly occurring species and focuses primarily on information that is pertinent to sea turtle populations in Virginia. Additional species information for the United States (US) can be found on the NOAA Fisheries Sea Turtle website (https://www.fisheries.noaa.gov/sea-turtles). Global information on sea turtles can be found on the State of the World's Sea Turtles (SWOT) website (https://www.seaturtlestatus.org/). Loggerhead sea turtles are the most abundant and widely distributed species in Virginia waters, and it is the only species that nests regularly in the state. Therefore, it is the most comprehensive of all the summaries and much of it is specific to Virginia and the mid-Atlantic region. As such, a great deal of the information presented in the loggerhead summary informed the development of the Plan's conservation strategies. Lastly, efforts were made to ensure that the strategies align with recovery actions outlined in federal recovery plans.

Species Descriptions

Loggerhead turtle (*Caretta caretta*)

Status

In 1978, the loggerhead turtle was listed as threatened by the USFWS and NOAA Fisheries (also known as NMFS-National Marine Fisheries Service) under the ESA of 1973 (43 FR 32800). The Federal status was adopted by the DWR in 1987, and the loggerhead is currently designated as a Species of Greatest Conservation Need (SGCN) in the Virginia Wildlife Action Plan (VDWR 2025). In 2011, the Northwest (NW) Atlantic Ocean loggerhead turtle distinct population segment (DPS) which encompasses all nesting assemblages within the NW Atlantic region (*i.e.,* US east coast; entire Gulf of Mexico; greater Caribbean region; and Dry Tortugas regions), was listed as threatened (76 FR 58868). The IUCN Red List lists the loggerhead turtle as vulnerable globally, with the Northwest Atlantic subpopulation listed as being of *Least Concern* for all criteria that were assessed (Casale and Tucker 2017). In August of 2014, NOAA Fisheries and USFWS designated critical in-water and nesting (79 FR 39755) habitats for the NW Atlantic Ocean loggerhead turtle DPS. No beaches or state waters in Virginia were designated as critical habitat; however, federal waters south of Cape Hatteras, North Carolina were designated as critical winter migratory habitat. The outer continental shelf and Sargasso Sea east of Virginia were designated as critical foraging habitat for hatchlings. After the most recent loggerhead

critical habitat designation, a paper was published which identified important foraging habitat in Chesapeake Bay for both loggerhead and Kemp's ridley turtles using boosted regression tree models with tag and environmental data (DiMatteo *et al.* 2022).

Distribution and abundance in Virginia and the region

Along the US Atlantic coast, loggerhead turtles are distributed seasonally from southern Florida to Atlantic Canada, with the majority of the population occurring south of Cape Hatteras in cooler months (January-March). Models developed by the US Navy (USN) suggest highest abundance in the lower Mid-Atlantic, an area defined as Delaware Bay to Cape Hatteras, occurs in August (Figure 1) and lowest abundance occurs in February (Figure 2; DiMatteo *et al.* 2024). The USN models were presented as long-term monthly average estimates of density, expressed as the number of individuals per square kilometer.

Loggerhead turtles are found seasonally in the Chesapeake Bay (Bay) from Baltimore south to the Bay mouth, in the estuarine portions of all the major rivers in the Bay watershed, along Virginia's entire Atlantic Coast, and into the channels and lagoons between and landward of the Commonwealth's barrier islands (Brady 1925; Lutcavage 1981; Lutcavage and Musick 1985; Keinath *et al*. 1987; Byles 1988; Musick and Limpus 1997; Mansfield 2006; VAQS *unpublished data,* May 2023). Habitat modeling suggests that preferred habitat in the Bay includes the deeper main stem waters (DiMatteo *et al.* 2022). The majority of loggerhead turtles observed in mid-Atlantic waters are juveniles and sub-adults (Musick and Limpus 1997) along with a number of adults, some of which were present in nesting areas during the breeding season (Ceriani *et al.* 2012; Pajuelo *et al*. 2012; Ceriani *et al.* 2014). Loggerhead turtles occur consistently in Virginia from May to October but may appear earlier and remain longer if water temperatures are above 20°C (Mansfield *et al*. 2009; DiMatteo *et al.* 2022), an important consideration for future climate change scenarios. When sea surface temperatures in Virginia drop below 20°C, sea turtles begin a southward migration to the waters south of Cape Hatteras, North Carolina, where a large portion of the turtles are likely to overwinter, while others travel to more southern wintering areas of the southeastern US (Conant *et al.* 2009; Mansfield *et al*. 2009; Barco *et al.* 2015; DiMatteo *et al.* 2024).

Aerial surveys in Chesapeake Bay and ocean waters from the shoreline to approximately 40 km from shore were conducted in Virginia and Maryland by the Virginia Aquarium Foundation (VAQF) and other partners in the spring, summer and fall of 2011, spring and summer of 2012 and summer of 2013 and represent the most recent survey data available for sea turtles in Chesapeake Bay. Abundance was corrected for subsurface turtles unable to be detected from the aircraft using a moderately deep availability correction factor of 0-1m from the surface in ocean waters, and only time directly on the surface was used to correct abundance in the more turbid waters of Chesapeake Bay. Sea turtle density and abundance in the ocean within 40 miles of the coastline decreased seasonally from a high of 2.514 turtles/km^2 and 60,993 turtles (CV = 0.30) in the spring, to 1.102 turtles/km^2 and 26,590 turtles (CV = 0.27) in the summer and down to 1.289

turtles/km^2 and15,562 turtles (CV = 0.54) in the fall. The density of all sea turtle species combined was estimated for Bay waters in spring and summer and was corrected for availability using a shallow correction of <0.5m depth. Chesapeake Bay spring and summer density and abundance estimates were 1.276 turtles/km^2 and13,006 turtles (CV = 0.68) and 1.184 turtles/km^2 and 12,293 (CV = 1.01) turtles, respectively (Barco *et al.* 2018). There were too few sightings to estimate fall abundance in Bay waters. More than 85% of the turtles identified to species in both Bay and ocean waters were loggerhead turtles. The density models generated by DiMatteo *et al*. (2024) predicted higher abundance in the mid-Atlantic in summer (August) than spring, and the observed higher ocean abundance compared to Barco *et al.* (2018) where higher abundance was calculated in spring. This differences between the two estimates can be explained by; 1) different analyses used (*i.e.,* density surface model vs calculated abundance), 2) use of different data sets (fine scale spring, summer and fall surveys 2011-13 in Barco *et al.* 2018 versus multiple year round surveys but not including those used in Barco *et al.* 2018 in DiMatteo *et al.* 2024), 3) scale of the study areas (Atlantic coast to outer continental shelf in DiMatteo *et al.* 2024 versus inshore to mid-continental shelf of Virginia and Maryland Barco *et al.* 2018) and 4) differences in correction factors used in the studies. It is likely that a significant portion of the loggerhead turtle population that migrates north of Virginia is present offshore of Virginia in spring, and the Barco *et al.* (2018) surveys captured some of that population.

Values generated from the 2011-2013 surveys in the Bay were significantly higher than those obtained from 2001-2004 surveys conducted by the Virginia Institute of Marine Science (VIMS) (Mansfield 2006; Barco *et al.* 2018) but were similar to estimates reported in the 1980s (Byles 1988 reviewed in Mansfield 2006). While the surveys used different aircraft, speed and altitudes which could account for the differing abundance estimates, if there was a true increase in abundance it could indicate population recovery or recruitment from other areas since the early 2000s (Barco *et al*. 2018).

Relationship of Virginia populations to rookery sources

There is still uncertainty surrounding the genetic origins of juvenile loggerhead turtle populations inhabiting the Mid-Atlantic Bight (ocean waters from Long Island, NY to Cape Hatteras, North Carolina), but recent research indicates mixed origins from more than one Recovery Unit of the NW Atlantic DPS. Several studies suggested that the Northern Recovery Unit of the NW loggerhead turtle DPS (NRU) contributes disproportionately to juvenile foraging stocks occurring in nearshore waters north of the Florida/Georgia border and that genetic relatedness, measured using haplotype frequency, were significantly correlated between coastal feeding

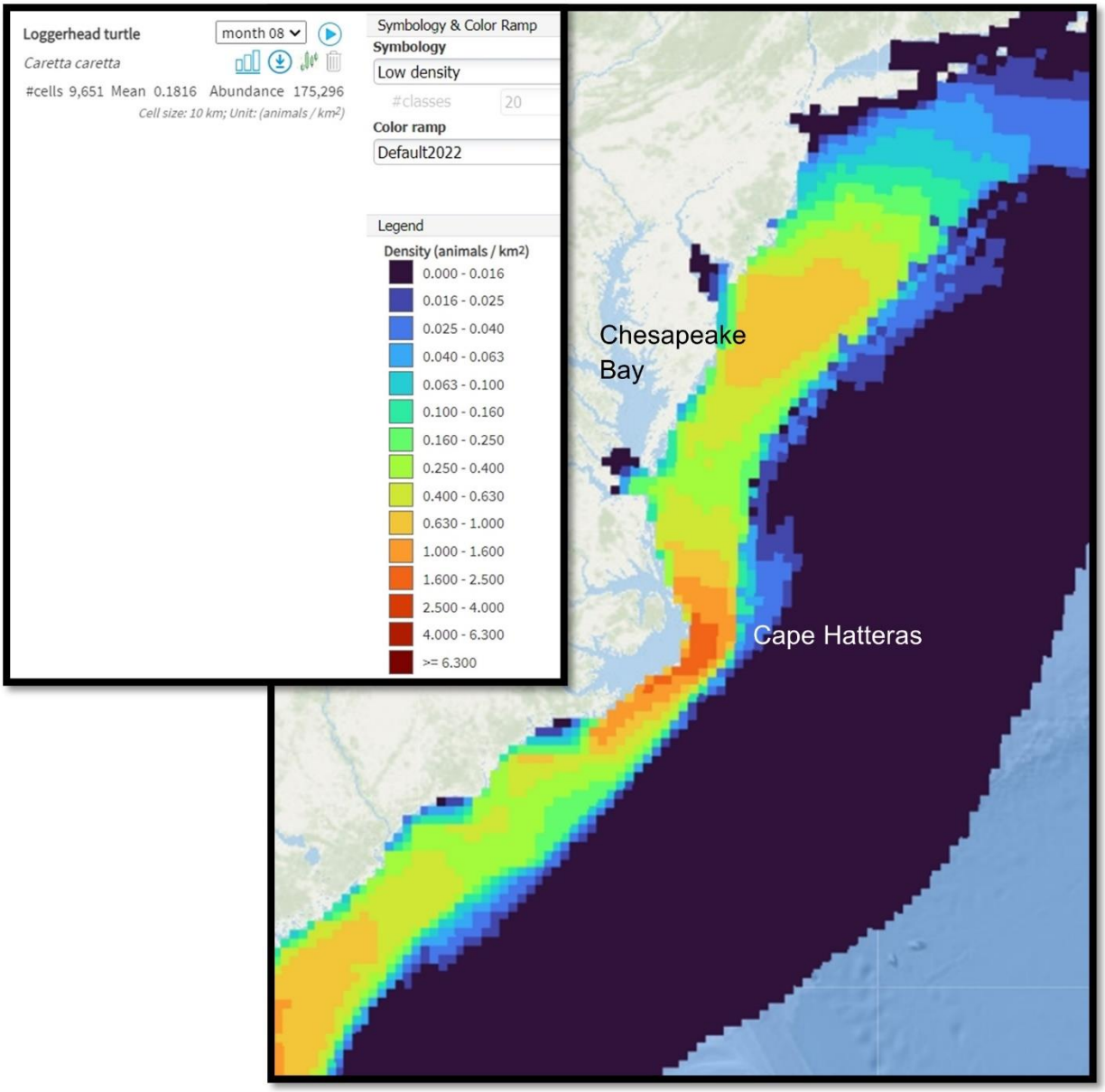


Figure 58. Modeled loggerhead density map for August, the month when density is predicted to be highest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

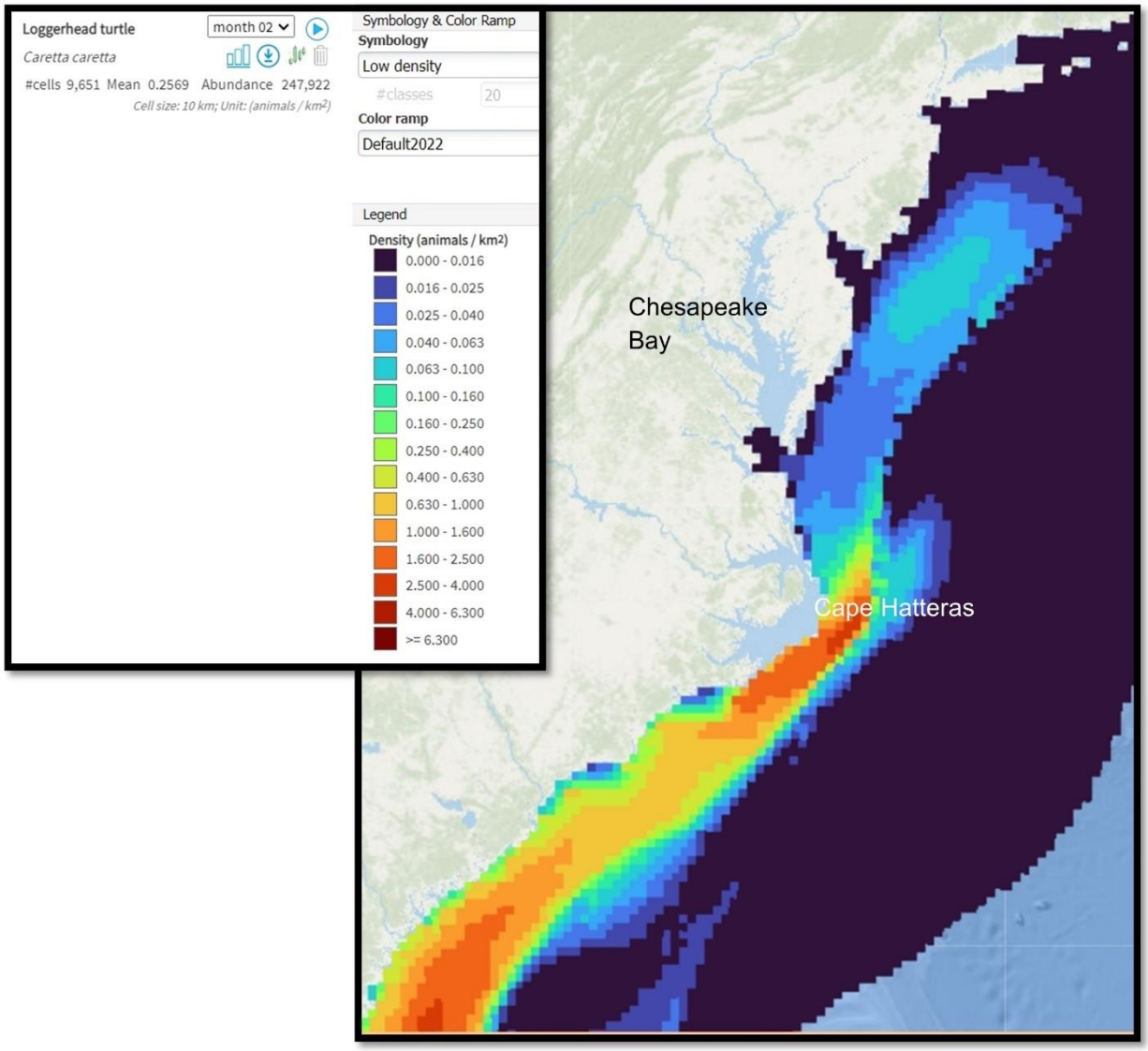


Figure 59. Modeled loggerhead density map for February, the month when density is predicted to be lowest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

populations and adjacent nesting populations (Bowen *et al.* 2004; Roberts *et al.* 2005; Mazzarella 2007; Conant *et al.* 2009). Stable isotope studies of nesting females in the NRU, which includes all females nesting north of Florida-Georgia border, suggest that these turtles forage predominantly in the Mid-Atlantic Bight, and females nesting in Florida forage in the subtropical NW Atlantic and Gulf of Mexico (Pfaller *et al.* 2020). Genetic samples collected from immature loggerhead turtles incidentally captured in sea scallop and offshore longline fisheries operating in the central North Atlantic are almost exclusively of NW DPS origin with the majority coming from the central eastern and south Atlantic Florida rookeries (Haas *et al.* 2008; LaCasella *et al.* 2013). In the NW Atlantic, juvenile loggerhead turtles incidentally captured a variety of ways such as research trawl and research dip netting, hopper dredge, and bycaught in a variety of fisheries including recreational hook and line, bottom trawl targeting

fish, scallop, and shrimp, dredge targeting scallop, and sink gillnet in the neritic region and both neritic and pelagic longline were nearly all from the NW Atlantic DPS. Nesting origin, however, varied by turtle size and location (Stewart *et al.* 2019). Large juveniles caught north of Cape Hatteras, North Carolina were more likely to be from the NRU while smaller juveniles captured north of Cape Hatteras, North Carolina were generally caught farther offshore and were more likely to have hatched in Florida. South of Cape Hatteras the nesting origin of large and small juveniles were split between central and southern Florida nesting units (Stewart *et al.* 2019). Many turtles incidentally captured in the Mid-Atlantic Bight statistical fishing area (Cape Hatteras to CT coast to mid-continental shelf) were from central eastern and south Atlantic Florida nesting beaches. Heavy representation of the Florida population may be due to the size of the eastern Florida rookeries, which are orders of magnitude greater than most other rookeries. Collectively, these studies suggest that loggerhead turtles that forage in the Mid-Atlantic Bight originate from more than one nesting unit, and though there may be some size and spatial structure to their distribution.

Diet and foraging in Virginia

Mollusks, true benthic crabs (decapod crustaceans of the infraorder Brachyura) and horseshoe crabs (*Limulus polyphemus*) make up the primary diet of the NW Atlantic loggerhead turtle population (Seney and Musick 2007; Barco *et al.* 2015; NMFS and USFWS 2023). Gastrointestinal (GI) tract content analyses conducted on sea turtles that stranded in Virginia from 1980 to 2002 revealed shifts in the diet of loggerhead turtles. In the early to mid-1980s, horseshoe crabs were the predominant prey item followed by a shift to blue crabs in the late 1980s and early 1990s. A second shift to mostly finfish of a variety of species but predominantly Menhaden (*Brevoorita tyrannus*) occurred in the late 1990s and early 2000s (Seney and Musick 2007). The latter data suggested that turtles were foraging in greater numbers in or around fishing gear and/or on discarded bycatch in response to local declines in horseshoe crab and blue crab populations (Seney and Musick 2007). Analyses of GI contents collected from stranded loggerheads in Virginia from 2008 to 2012 suggested a return to a more traditional diet of mollusks, decapod crustaceans, and horseshoe crabs, although there were differences in turtle size, geographic distribution of stranded turtles between the two studies (*e.g.,* earlier samples were primarily collected from turtles stranded in the lower and mid-Chesapeake Bay, later samples were collected from turtles stranded closer the Bay mouth and ocean coasts; Barco *et al.* 2015). Large whelks constituted the highest percent number of prey items (39%), followed by decapod crustaceans (27%), horseshoe crab (13%), moon snail (*Neverita duplicata*; 7%) and bony fishes (4%). Prey numbers in these categories were significantly affected by turtle size class (MANCOVA: p=0.001) and proximity to the ocean (p<0.001) but not by season (p=0.088). Decapod crustaceans and horseshoe crabs comprised the highest percent dry weight values (Barco *et al.* 2015). These data suggest that blue crab and horseshoe crab populations may have increased since the early 2000s.

Loggerhead turtles migrate to Virginia presumably because of increased foraging potential. Switching state-space modeling, a methodology used to identify different types of behavior, can be applied to satellite telemetry data and has been used to identify foraging behavior in sea turtles based on an animal's movement patterns (Jonsen *et al.* 2006; Jonsen *et al.* 2007; Eckert *et al.* 2008; Maxwell *et al.* 2011; Hart *et al.* 2012; Shaver *et al.* 2013). Switching state-space modeling using data obtained from satellite tagged loggerhead turtles in the Chesapeake Bay showed that they spent most of their time foraging (Barco *et al.* 2015; DiMatteo *et al.* 2022). A habitat model, using suitable "habitat days" based on environmental parameters for each species as its unit of measure, identified loggerhead turtle foraging habitat in the Bay and its major tributaries from May through November. The greatest number of suitable habitat days for loggerheads was in the mainstem of the lower Bay and tidal waters of the major tributaries (Figure 3).

Reproductive activity in Virginia

Loggerhead turtles are the only sea turtle species to nest consistently nearly every year in Virginia, and, thus, the only species with a section on reproductive activity in this Conservation Plan. Virginia is considered the northernmost extent of the NW Atlantic loggerhead turtle's regular nesting range (Conant *et al.* 2009; NMFS and USFWS 2023); however, records exist of nesting occurring as far north as New Jersey (Pritchard 1979; Brandner 1983). Up to 15 nests per year have been reported on the ocean-facing beaches of Virginia with an increasing decadal mean from 1.0/yr. in the 1970s to 8.3/yr. from 2011-2020 (Figure 4). Nest monitoring efforts on most of the Virginia barrier islands has not been nearly as frequent or consistent as those on the more populated southeastern Virginia coast (hereafter referred to as the southern mainland beaches that extend from the North Carolina/Virginia border north to the Joint Expeditionary Base-Fort Story in Virginia Beach) and northernmost parts of the coast. Daily monitoring for nests occurs from late May to early September annually on southern mainland beaches and on the Virginian section of Assateague Island and Wallops Island which is included in Chincoteague National Wildlife Refuge and Assateague Island National Seashore.

From 1970 to 2005, 94 loggerhead turtle nests were documented in Virginia, of which 80% (n = 75) were deposited on the southern mainland beaches (Boettcher *et al.* 2008). The remaining nests (N = 19) were documented on Virginia's barrier islands located on the seaward fringe of the lower Delmarva Peninsula with the majority occurring on Assateague and Wallops islands, which are consistently monitored as opposed to barrier islands with no vehicular access to the south. Although the majority of the state's nesting activity continues to occur on southern mainland beaches, decadal loggerhead turtle nesting activity on Assateague and Wallops islands combined, which, like the southern mainland beaches are monitored daily, more than doubled over the 50-year time span from the early 1970s to 2020 (DWR *unpublished data,* May 2023). Most of the barrier islands south of Wallops Island are monitored every 3 - 7 days primarily for

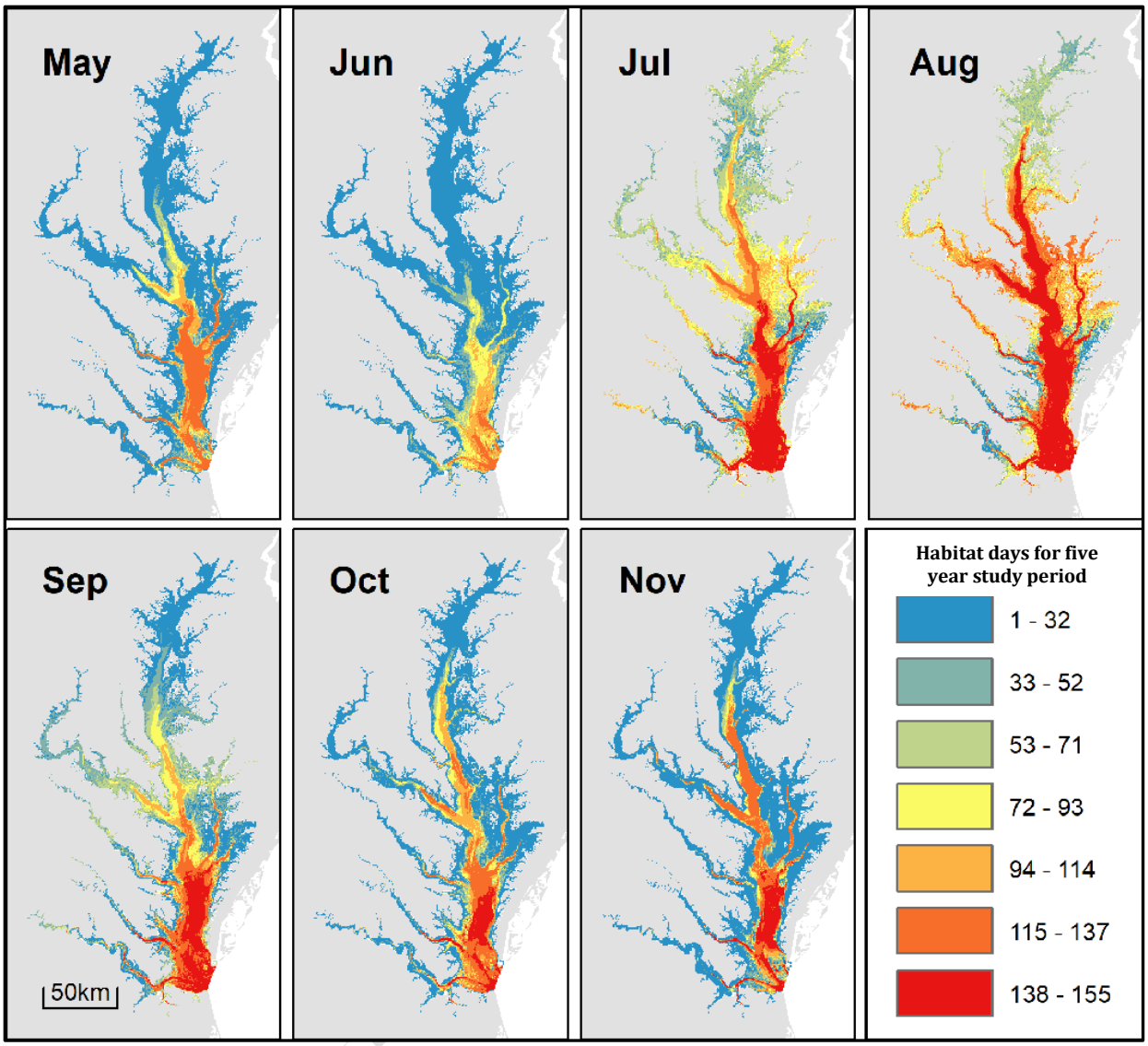


Figure 60. Monthly location of suitable habitat from models (in habitat days during the 5-year study period) for loggerhead turtles in Chesapeake Bay and its tributaries (Figure 4 in DiMatteo et al. 2022).

breeding shorebirds. Four loggerhead nests, eight false crawls (non-nesting emergences), and three undetermined crawls (crawls obscured by wind, rain and/or overwash which made it impossible to determine whether they were nesting or non-nesting emergences) have been detected since intensive shorebird studies began on most of these islands in 2004. For now, this level of coverage seems sufficient given these islands are remote, accessible only by boat (except for Fisherman Island which can be accessed by vehicle but is closed to the public year-round), under conservation ownership, and receive little to no human disturbance. Moreover, a coordinated mammalian predator management program has been in place on seven of the 14

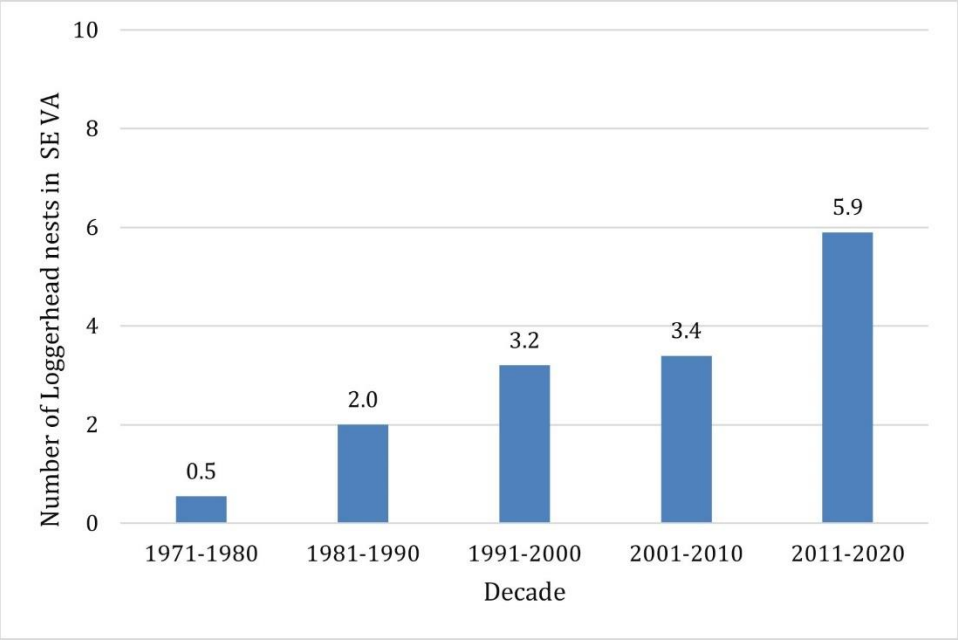


Figure 61. Decadal mean number of loggerhead turtle nests on the southern mainland beaches from the North Carolina/Virginia border to the Joint Expeditionary Base-Fort Story, Virginia. Number of nests per year ranged from 0 to 15 with a 50 year mean of 3 nests per year on the southern mainland beaches and 4.1 nests per year for the entire state (DWR unpublished data, April 2024).

islands since 2005, and most barrier island public use policies, such as the collaboratively funded and developed Explore our Seaside program, are designed to benefit wildlife. While it is likely that a few nests and false crawls were missed over the years, daily coverage is not warranted at this time due to the low level of nesting activity, logistical constraints, limited staff, and the fact that the all the islands except for NASA-owned Wallops Island, are under conservation ownership.

In late July 2015, the first reported loggerhead turtle nest was confirmed on Gwynn's Island, Virginia, along the western shore of the Chesapeake Bay. None of the eggs hatched because they were washed out in a fall hurricane. In 2021, three crawls were documented near Gwynn's Island in Matthews County, Virginia, but no eggs were found. Collectively, these records represent the first confirmed nesting emergences on estuarine beaches located more than 60km from the Atlantic Ocean (mouth of Chesapeake Bay) in Virginia (DWR *unpublished data,* May 2023).

Based on long-term tagging studies conducted on nesting beaches, breeding female loggerhead turtles were historically thought to exhibit a high degree of natal site fidelity returning to nest on or near their natal beach (Miller *et al.* 2003). Virginia has been participating in an on-going genetic mark-recapture study of the NRU nesting subpopulation within the NW loggerhead turtle Distinct Population Segment that is attempting to identify individual females and examine relatedness among nesting females (mother/daughter pairs or sister pairs), characterize genetic structure of the subpopulation, and determine clutch frequency, nesting site fidelity, inter-annual

nesting intervals, and female reproductive life span. Since 2010, 23 unique females have nested in Virginia, of which only eight have confined their nesting solely to Virginia beaches (B. Shamblin, *personal communication*, Aug 2015). Results of genetic testing on eggs recovered from Virginia have revealed that the nine loggerhead turtle nests documented in 2010 were laid by four different individuals. One of the females also laid two nests in North Carolina before arriving to lay a final nest in Virginia. Another female deposited one clutch in South Carolina, a second clutch in North Carolina and a third clutch in Virginia within a four-week period. A female that nested in Maryland the same year was an unidentified individual for which no match could be found among the sampled nesting population. The nine Virginia loggerhead turtle nests sampled in 2011 were laid by six different individuals, four of which nested in North Carolina before arriving in Virginia (B. Shamblin, *personal communication*, Aug 2015). In 2012, 15 loggerhead turtle nests laid by eight different individuals were deposited on Virginia beaches. Of these, only three nested in another state during the 2012 season; two laid clutches in North Carolina, and one deposited eggs on Assateague Island in Maryland. Five individuals laid six nests on Virginia beaches in 2013, of which two laid a subsequent nest on North Carolina's Outer Banks. These results indicate that nest site fidelity among nesting females may not be as strong as once believed, especially towards the northern extent of the nesting range (Shamblin *et al.* 2017).

Habitat requirements

Loggerhead turtles nest primarily on ocean-facing beaches and rarely on estuarine shorelines with suitable sand (NMFS and USFWS 2023). Nests are typically laid at night between the high tide line and the seaward base of the primary dune (Witherington 1986; Hailman and Elowson 1992). Wood and Bjorndal (2000) found that slope had the greatest influence on loggerhead nest site selection; however, a review of related studies found no consistency among factors analyzed or preferences for particular nest locations (Miller *et al*. 2003). Over 85% of the nests on the southern mainland beaches have been documented on state and federal lands (False Cape State Park [FCSP], Back Bay National Wildlife Refuge [BBNWR] and Dam Neck Naval Base [DNNB]), while the rest were deposited on municipal beaches adjacent to significant development. Nesting habitat on Virginia's transgressive barrier islands is mostly free from development and is largely under the protective ownership of federal, state and private conservation agencies. NASA-owned Wallops Island is the only barrier island that is partially developed. Because it supports assets worth billions of dollars, it continues to be subjected to a variety of shoreline stabilization activities that can affect the quality of sea turtle nesting habitat including, but not limited to, periodic beach renourishment and the installation of sea walls, rock revetments, geotubes, and more recently nearshore breakwaters.

Sea turtle eggs require a high-humidity substrate that provides sufficient gas exchange for embryonic development (Miller *et al*. 2003). Moisture conditions in the nest influence incubation period, hatching success, hatchling size and sex ratios (McGehee 1990, Carthy *et al*. 2003, Lolavar and Wyneken 2020). Mean clutch sizes range roughly between 100 and 126 eggs, and

the length of the incubation period is inversely related to nest temperature; the warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Prevailing sand temperatures during the middle third of the incubation period determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings. The pivotal temperature (*i.e.*, the incubation temperature that produces equal numbers of males and females) in loggerheads is approximately 29°C (Limpus *et al*. 1983, Mrosovsky 1988, Marcovaldi *et al*. 1997).

Immediately after loggerhead turtle hatchlings emerge from the nest, they find their way to the surf by orienting toward the bright oceanic horizon. Once they enter the water, they are swept through the surf zone and continue swimming away from land (Carr and Ogren 1960; Carr 1962; Carr 1982; Wyneken and Salmon 1992; Witherington 1995), relying on a store of energy and nutrients within their retained yolk sac (Kraemer and Bennett 1981). When neonate loggerhead turtles reach the shallow neritic waters along the continental shelf, they begin to feed on their own and no longer rely on their retained yolk (Witherington 2002). The post-hatchling swim frenzy may last for weeks (Witherington 2002; Mansfield and Putman 2013) until turtles move into the North Atlantic gyre or the Sargasso Sea (Bolten 2003; Mansfield and Putman 2013; Mansfield *et al.* 2014; Putman and Mansfield 2015, Putman *et al.* 2020; Phillips 2022). The life stage following the post-hatchling swim frenzy is currently being referred to as the juvenile dispersal stage (Phillips 2022) as opposed to the juvenile neritic stage when larger juveniles move shoreward and feed on primarily benthic prey. During the juvenile dispersal stage, young turtles inhabit areas where surface waters converge to form local downwelling that are characterized by floating material, especially *Sargassum,* and where primary productivity and chlorophyll are elevated. Juvenile dispersal stage turtles are not considered to be passive drifters. Comparison of tracks between tagged juvenile dispersal stage turtles and tags allowed to drift passively suggests active swimming behavior and orientation by these small turtles, and they appear to be influenced by the Earth's magnetic field, ocean circulation, and currents and other environmental cues (Mansfield and Putman 2013; Mansfield *et al.* 2014; Putman *et al.* 2020; Philips 2022). Juvenile dispersal stage turtles spend most of their time near the surface and likely feed on a wide variety of floating organisms commonly associated with the *Sargassum* community (Mansfield *et al.* 2014; Witherington 2002; Putman *et al.* 2020) and shelter under mats of *Sargassum* and other flotsam. North Atlantic loggerhead turtles inhabit the pelagic waters of the north Atlantic and western Mediterranean Sea for between six and twenty-five years whereupon they move back into the neritic zone off the US Atlantic coast and settle into the neritic environment at 42-50 cm straight carapace length (Bjorndal *et al*. 2000; Snover 2002; Avens and Snover 2013).

Juvenile neritic stage loggerhead turtles in the NW Atlantic commonly inhabit continental shelf waters from Atlantic Canada, south through Florida (Engstrom *et al*. 2002; Hall and James

2021). Temperate estuarine waters, including the Chesapeake Bay, comprise important inshore habitat, and turtles migrate into the area when waters warm to approximately 20°C (Musick and Limpus 1997; Mansfield *et al.* 2009; DiMatteo *et al.* 2024). Long-term in-water studies indicate that juvenile loggerhead turtles reside in specific developmental foraging areas for many years, while others move back and forth between neritic and oceanic waters (Mansfield 2006; McClellan and Read 2007; Mansfield *et al*. 2009). In Virginia's Chesapeake Bay waters, loggerhead turtles appear to prefer the deeper central mainstem of the Bay as opposed to Kemp's ridley turtles which appear to prefer shallower, nearshore habitat (DiMatteo *et al.* 2022). Little is known about any sea turtle species presence in Virginia's seaside coastal bays and few strandings are reported in that area. It is unclear whether low stranding numbers are the result of low turtle density, low human density resulting in poor coverage and reporting, low turtle mortality or a combination of factors.

Adult female loggerhead turtles from the northern recovery unit typically inhabit warm waters (between 18.2 and 29.2 °C) in depths of 3.0–89.0 m and exhibit repeated movement patterns and home range behavior within these waters (Keinath *et al*. 1987; Mansfield 2006; Hawkes *et al.* 2011). Additionally, studies have tracked post-nesting females from northern recovery unit beaches and Florida nesting sites to Mid-Atlantic Bight waters, where they presumably come to forage (Arendt *et al.* 2012a; Arendt *et al*. 2012b; Ceriani *et al.* 2012; Griffin *et al*. 2013).

Kemp's ridley turtle (*Lepidochelys kempii*)

Status

The Kemp's ridley turtle was listed as endangered throughout its range on December 2,1970 under the Endangered Species Conservation Act of 1970 (35 FR 8491) and has received Federal protection under the ESA since 1973 (NMFS and USFWS 2010). The Kemp's ridley turtle was listed in Appendix I by the Convention on International Trade in Endangered Species (CITES) on July 1, 1975, which prohibited all commercial international trade. The International Union for the Conservation of Nature (IUCN) Red List categorizes the Kemp's ridley turtle as Critically Endangered (NMFS and USFWS 2015, Wibbels and Bevan 2019). In Virginia, the Kemp's ridley sea turtle is listed as state endangered (Virginia Threatened and Endangered Faunal Species) and is a Tier I SGCN in the Virginia Wildlife Action Plan (VDWR 2025).

Distribution, abundance, and habitat use

The Kemp's ridley turtle nesting population has a restricted distribution and is largely limited to the beaches of the western Gulf of Mexico, primarily in Tamaulipas, Mexico (NMFS *et al.* 2010, Wibbels and Bevan 2019). Nesting also occurs regularly in Texas but infrequently in other US states. Adult female Kemp's ridleys nest during the day and exhibit synchronized nesting behavior, called arribadas, which means "arrival" in Spanish. They gather off nesting beaches in

northeastern Mexico and come ashore in large groups to nest simultaneously. Kemp's ridley arribadas have not been observed outside of the primary Gulf of Mexico nesting area. Kemp's ridley nesting in the Gulf occurs from April to July. Females lay two to three clutches per season and return to the beach to nest in one to three year intervals. After emerging from the nest, hatchlings orient seaward by moving away from the darkest silhouette of the landward dune or vegetation to crawl towards the brightest horizon.

Nesting in the US and Mexico beaches in the Gulf of Mexico increased steadily from the mid-1990s to 2010. Immediately after the 2010 Deep Water Horizon (DWH) oil spill, however, annual nest numbers declined (Bevan *et al*. 2016; Wibbels and Bevan 2019). From 2011-2022 nesting has been annually variable but has not returned to a steady increasing trend similar to the early 1990s to 2009 (Gladys Porter Zoo and Bi-National Mexico/USA Kemp's ridley Recovery Program *unpublished data,* May 2024). Though not showing an increasing trend, current nesting numbers are higher than those reported in the 1990s and 2000s (NMFS and USFWS 2015). In addition, late-stage embryo deformities have been observed more frequently on two nesting beaches in Texas, although there has been no change in clutch size or hatching success (Shaver *et al.* 2021).

Unlike adult Kemp's ridley turtles, which occur primarily in the Gulf of Mexico, juveniles have a broader distribution. In the NW Atlantic, foraging areas for a substantial population of coastal juvenile Kemp's ridley turtles are in shallow coastal waters, mainly in the large estuarine systems along the eastern US, extending from Florida to New England (NMFS *et al.* 2010; Wibbels and Bevan 2019). Modeling approaches to studying dispersal of oceanic stage hatchlings suggest that some proportion of oceanic Kemp's ridley turtles disperse into the NW Atlantic from the Gulf of Mexico nesting areas (Putman *et al.* 2013; Putman *et al.* 2020; Phillips 2022). Key juvenile developmental habitats include Chesapeake Bay where occurrences in foraging habitats are seasonal, spanning the warmer months (Lutcavage and Musick 1985; Keinath *et al.* 1987; Mansfield and Musick 2005; DiMatteo *et al.* 2022).

Using size structure of Kemp's ridley turtles captured in systematic trawl surveys off the southeastern US to model survival, Arendt *et al.* (2022) predicted high annual survival rates of juvenile Kemp's ridley turtles in the NW Atlantic from 1990 through 2019. Along the Atlantic coast of the US, Kemp's ridley turtles are distributed seasonally from southern Florida to Massachusetts, with most of the population occurring south of Cape Hatteras in cooler months (December-March). Models developed by the US Navy (USN) suggest highest abundance in the lower Mid-Atlantic (Delaware Bay to Cape Hatteras) occurs in August (Figure 5) and lowest abundance occurs in February (Figure 6; DiMatteo *et al.* 2024). In these models, surface time for Kemp's ridley turtles was estimated using data collected in the Gulf of Mexico which may skew the density estimates, most likely resulting in overestimates of density compared with, for example loggerhead turtles. Because many of the Kemp's ridley turtles distributed in the Mid-

Atlantic and Northeast US are small juveniles unable to be detected from aerial and shipboard platforms, these estimates may underrepresent the true abundance of this species.

Kemp's ridley turtles that migrate to Virginia presumably do so because of increased foraging potential compared to overwintering areas. Switching state-space modeling, an approach used to identify different types of behavior, can be applied to satellite telemetry data and has been used to identify foraging behavior in sea turtles based on an animal's movement patterns (Jonsen *et al.* 2006; Jonsen *et al.* 2007; Eckert *et al.* 2008; Maxwell *et al.* 2011; Hart *et al.* 2012; Shaver *et al.* 2013). Switching state-space modeling derived from satellite tagged Kemp's ridley turtles in the Chesapeake Bay showed almost all their time was spent foraging (Barco *et al.* 2015; DiMatteo *et al.* 2022). A habitat suitability model identified suitable Kemp's ridley turtle habitat in the mainstem of the Bay and river mouths from May through November with Kemp's ridley habitat identified as being close to shore in the mainstem Bay and throughout the tidal waters of major Bay tributaries (Figure 7). The model did not identify much suitable habitat for Kemp's ridley turtles in August, but the model was likely affected by sparse telemetry data acquired that month (DiMatteo et al 2022).

Thus far, no turtles tagged on the Atlantic coast as juveniles have been recorded nesting in Texas (NMFS *et al.* 2010), but at least two tagged juvenile rehabilitated and released turtles from Virginia were found stranded dead on barrier island beaches in Louisiana (VAQS *unpublished data,* May 2023).Tagging studies in the northern Gulf of Mexico show some neonate and juvenile dispersal to the Atlantic coast but the overall dispersal from that area is thought to be low (Gredzens and Shaver 2020; Phillips 2022).

Diet

Juvenile and adult Kemp's ridley turtles are considered to be carnivorous, feeding primarily on portunid, also called swimming crabs (*e.g.,* blue crabs) (Shaver 1991; Burke *et al*. 1993a, b; Marquez 1994; Seney and Musick 2005; Barco *et al.* 2015). Shaver (1991) suggested that the distribution of foraging Kemp's ridley turtles is related to the distribution and availability of all the major crab species that are consumed. Decapod crustaceans, predominantly blue crabs and spider crabs were the majority of prey for Kemp's ridley turtles in Virginia (Seney and Musick 2005; Seney *et al.* 2014). In a study examining the GI tract contents of 81 Kemp's ridley turtles that stranded in Virginia from 2010 to 2013, 85% of the samples contained decapod crustaceans and 28%, 25%, 23%, 7%, and 1% of samples contained mud snail shells, horseshoe crabs, bony fishes (primarily Menhaden), insects, and cartilaginous fish, respectively (Seney *et al*. 2014; Barco *et al.* 2015). Eight samples (~10%) contained anthropogenic items, including plastic, glass, and fishing twine.

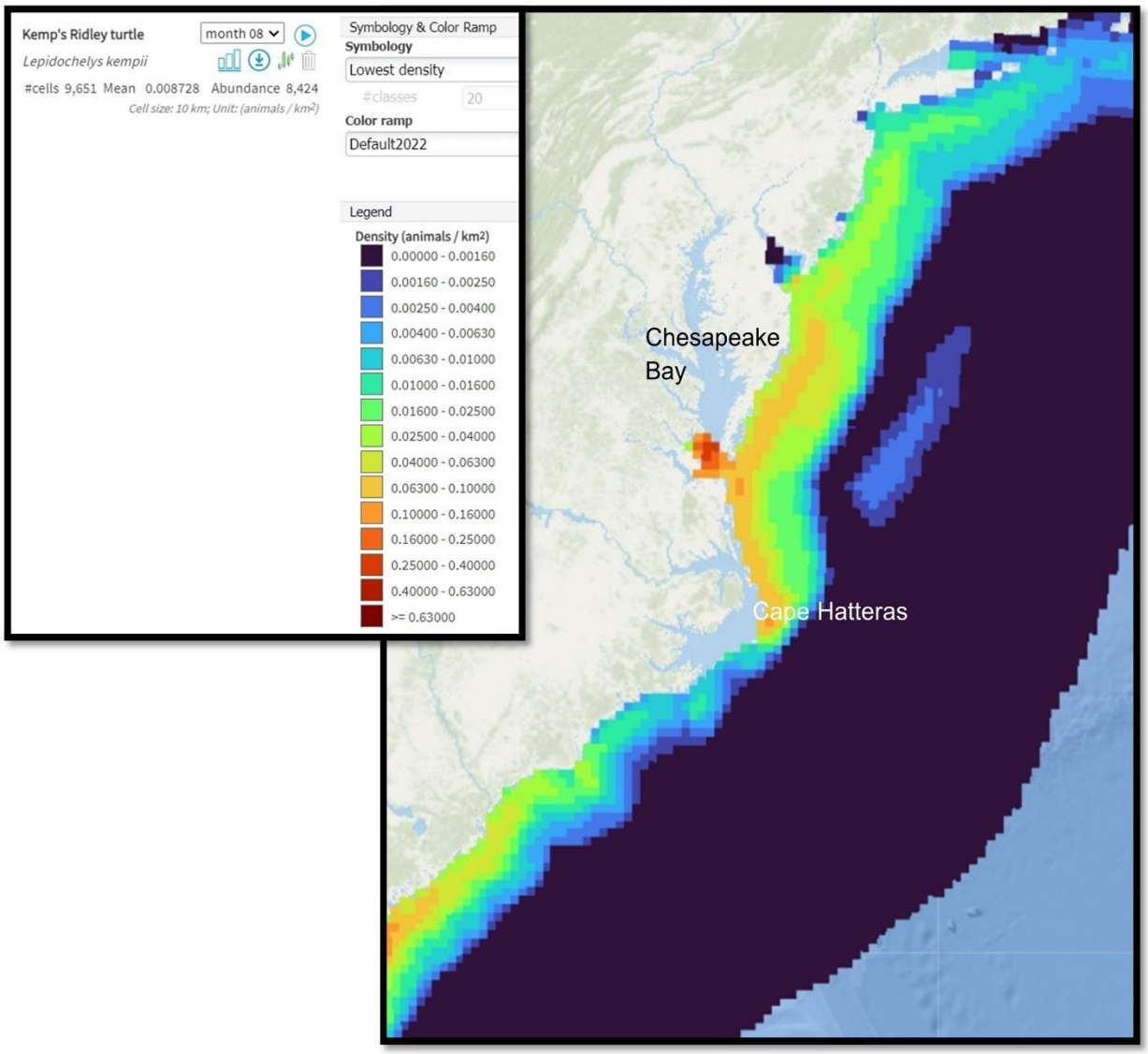


Figure 62. Modeled Kemp's ridley density map for August, the month when density is predicted to be highest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

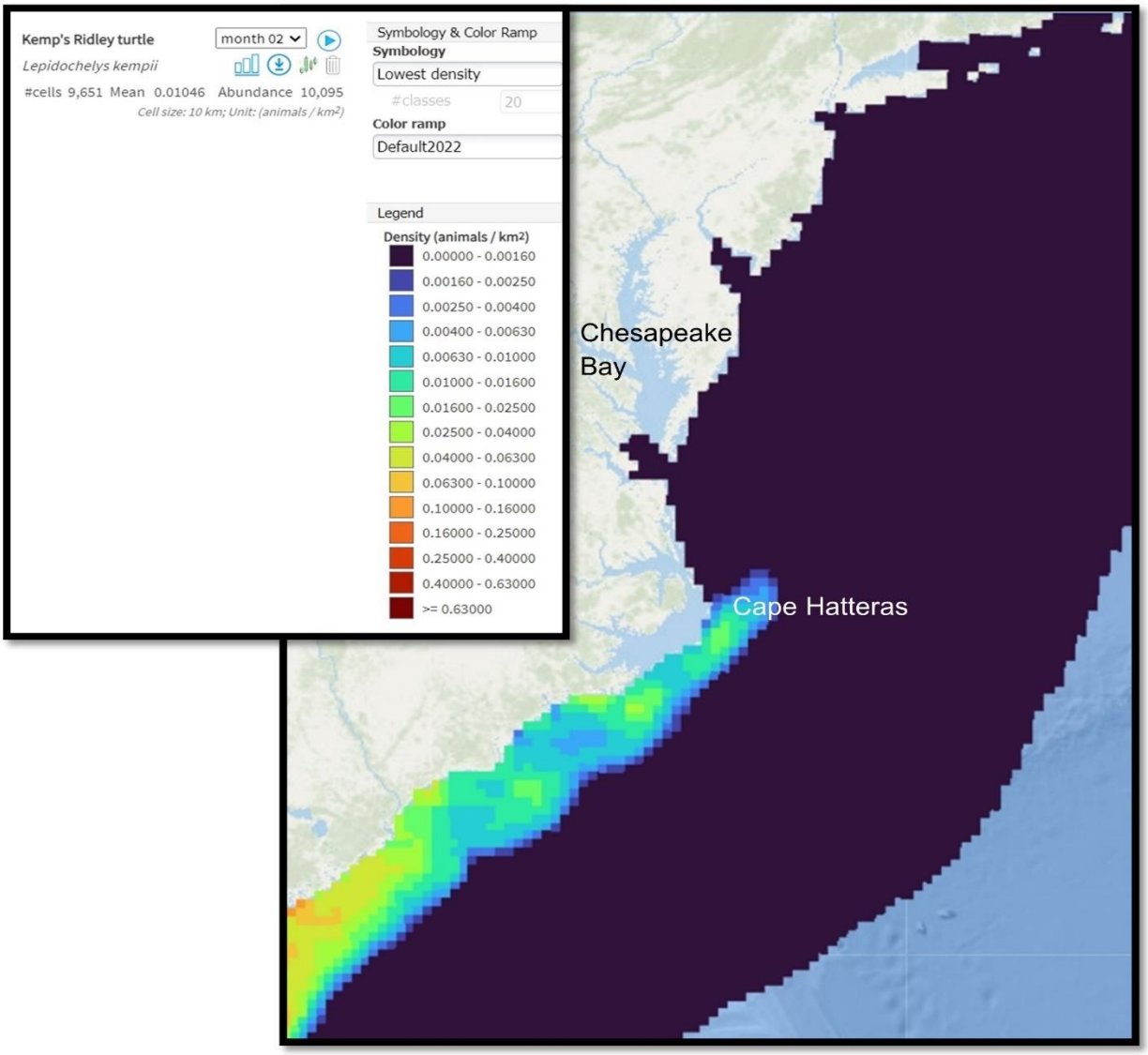


Figure 63. Modeled Kemp's ridley density map for February, the month when density is predicted to be lowest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

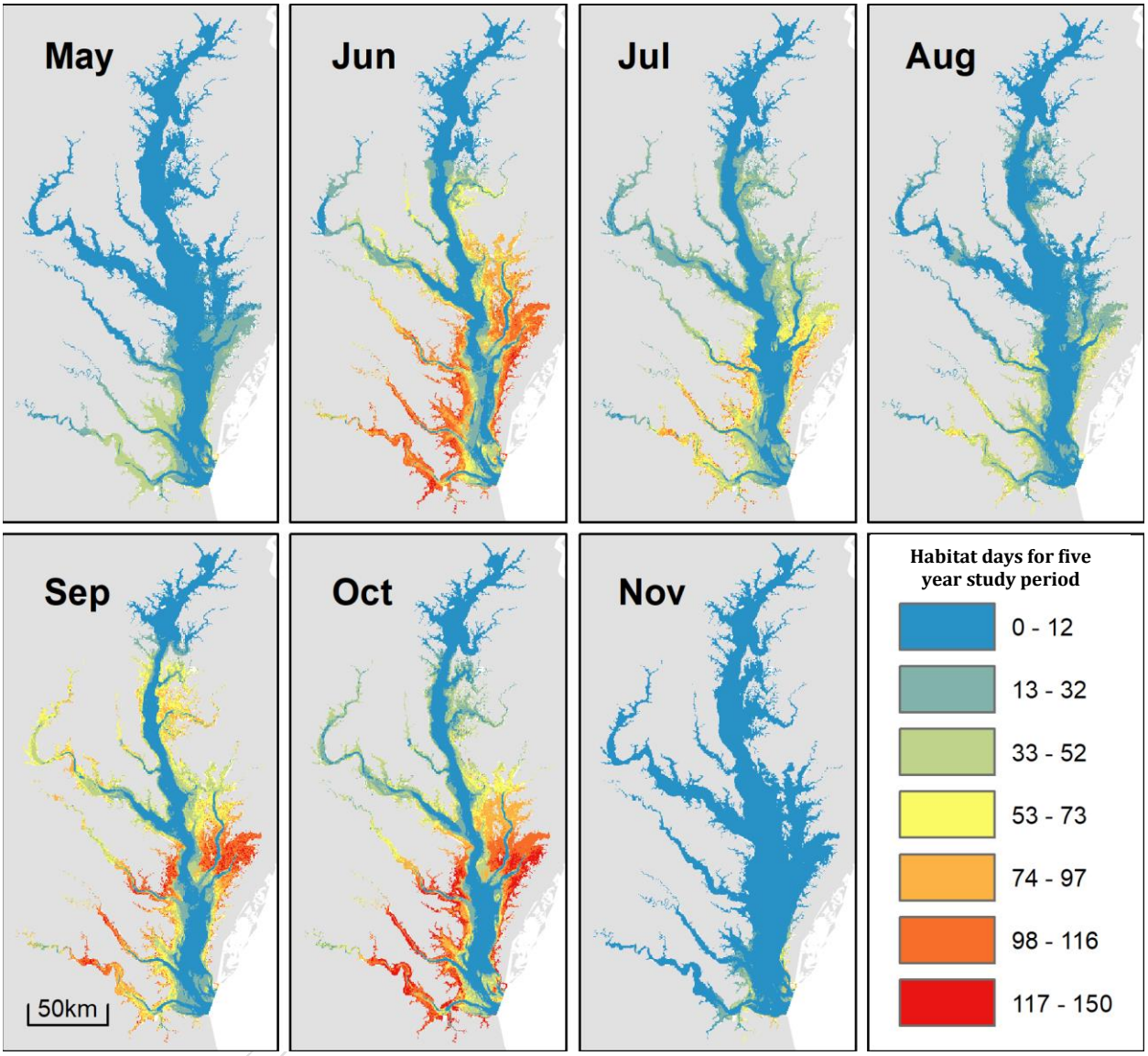


Figure 64. Monthly location of suitable habitat (in days) for Kemp's ridley turtles in Chesapeake Bay and its tributaries (Figure 3 in DiMatteo et al. 2022).

Habitat requirements and reproductive activity in Virginia

Kemp's ridleys share a life history pattern generally similar to loggerhead turtles (Bolten 2003). Females lay their eggs on coastal beaches where the eggs incubate in sand. After 45-58 days of embryonic development, hatchlings emerge, *en masse*, and swim offshore into deeper ocean water where they feed and grow until returning at a larger size to nearshore coastal habitats.

Kemp's ridley turtles occasionally nest along the Atlantic coast of the US including in Virginia where three nests have been documented in state records dating to the 1970s. The three

documented nests were all within the city limits of Virginia Beach. The first was reported at Dam Neck Naval Base (DNNB) in 2012, the second at False Cape State Park in 2014, and third at Sandbridge Beach in 2021. The 2014 nest failed but the 2012 and 2021 nests had hatching success of 82% and 84% and emergence success of 97% and 99% respectively.

Juvenile neritic stage Kemp's ridley turtles in the NW Atlantic commonly inhabit continental shelf waters from Cape Cod Bay in Massachusetts, south through Florida (NMFS *et al.* 2011). Temperate estuarine waters, including the Chesapeake Bay, comprise important inshore habitat, and turtles migrate into the area when waters warm in spring. In Virginia's Chesapeake Bay waters, Kemp's ridley turtles appear to prefer shallow, near shore waters of the Bay including river mouths as opposed to loggerhead turtles which appear to prefer deeper mainstem bay habitat (see Figure 7; DiMatteo *et al.* 2022). Little is known about any sea turtle species presence in Virginia's seaside coastal bays and few strandings are reported in that area. It is unclear whether low stranding numbers are the result of low turtle density, low human density resulting in poor coverage and reporting, low turtle mortality or a combination of factors.
Kemp's ridley turtles along the eastern seaboard migrate out of coastal foraging areas, such as the Chesapeake Bay, to more favorable southern overwintering sites in response to abrupt temperature declines each year in late fall (Lutcavage and Musick 1985; Byles 1988; Morreale and Standora 2005; Barco and Rose 2019). Kemp's ridley turtles leave the Chesapeake Bay in mid-October through early November (Barco and Rose 2019). An important area for seasonal migrants may be off central North Carolina (Morreale and Standora 1998, DiMatteo *et al.* 2024) where the water is warmer because of the nearby Gulf Stream. In May, as water temperatures rise, Kemp's ridley turtles begin to reappear in Virginia (Costidis *et al.* 2022; Epple *et al.* 2023; DiMatteo *et al.* 2024).

Neritic Kemp's ridley turtle juveniles tagged along the US Atlantic coast have been observed nesting at Rancho Nuevo, Tamaulipas, Mexico (Schmid 1995; Chaloupka and Zug 1997; Schmid and Witzell 1997; Schmid and Woodhead 2000), providing evidence of their recruitment to the adult stage in the Gulf of Mexico. A juvenile turtle originally tagged in the Maryland waters of the Chesapeake Bay, was observed nesting in Tamaulipas, Mexico, in two different nesting seasons, which were three years apart (NMFS *et al.* 2010).

Green turtle (*Chelonia mydas*)

Status

In 1978, the green turtle was listed as threatened except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered (43 FR 32800). Eleven distinct population segments (DPS) of green turtles were listed in 2016 as either endangered or threatened (81 FR20057). The North Atlantic green turtle DPS is currently listed as threatened, and thus, posed no change in Virginia's 1987 state threatened designation. Updated in-water

critical habitat for green turtles in the US was proposed in summer 2023 (88 FR 46572) and should be finalized in summer or fall 2024 (J. Shultz, NOAA Fisheries *pers. comm*., April 20 2024). For the North Atlantic DPS, proposed Atlantic coast critical habitat includes the east coasts of Florida and North Carolina (from the South Carolina border to Currituck Sound, North Carolina) from mean high water to 20m depth and offshore Sargassum habitat, as well as portions of Puerto Rico. The green turtle is globally listed as Endangered by the IUCN Red List (Seminoff 2004) and is listed on Appendix I of the CITES (NMFS and USFWS 1991b). Lastly, the green sea turtle is a Tier I SGCN in the Virginia Wildlife Action Plan (VDWR 2025).

Distribution, abundance, and habitat use

Green turtles range throughout tropical oceans and estuaries. In the western Atlantic, they occur from Argentina north to New England (Carr 1952; NMFS and USFWS 1991b). Along the US Atlantic coast green turtles are distributed seasonally from southern Florida to Massachusetts, with the majority of the population occurring south of Cape Fear, North Carolina during the cooler months (December-February). Models developed by the USN suggest highest abundance in the lower Mid-Atlantic (Delaware Bay to Cape Hatteras) occurs in August (Figure 8) and lowest abundance occurs in December-February (Figure 9; DiMatteo *et al*. 2024). In these models, surface time for green turtles was estimated using data collected in the Gulf of Mexico which may skew the density estimates, most likely resulting in overestimates of density compared with, for example loggerhead turtles. Because many of the green turtles distributed in the Mid-Atlantic and Northeast US are small juveniles unable to be detected from aerial and shipboard platforms, these estimates may underrepresent the true abundance of green turtles. Interestingly, the models suggest that there are large juvenile and, possibly, adult sized green turtles offshore of the Mid-Atlantic although few records of animals larger than small juveniles exist in the stranding records for that area (VAQS *unpublished data*, May 2024; Barco *et al.* 2018; DiMatteo *et al.* 2024).

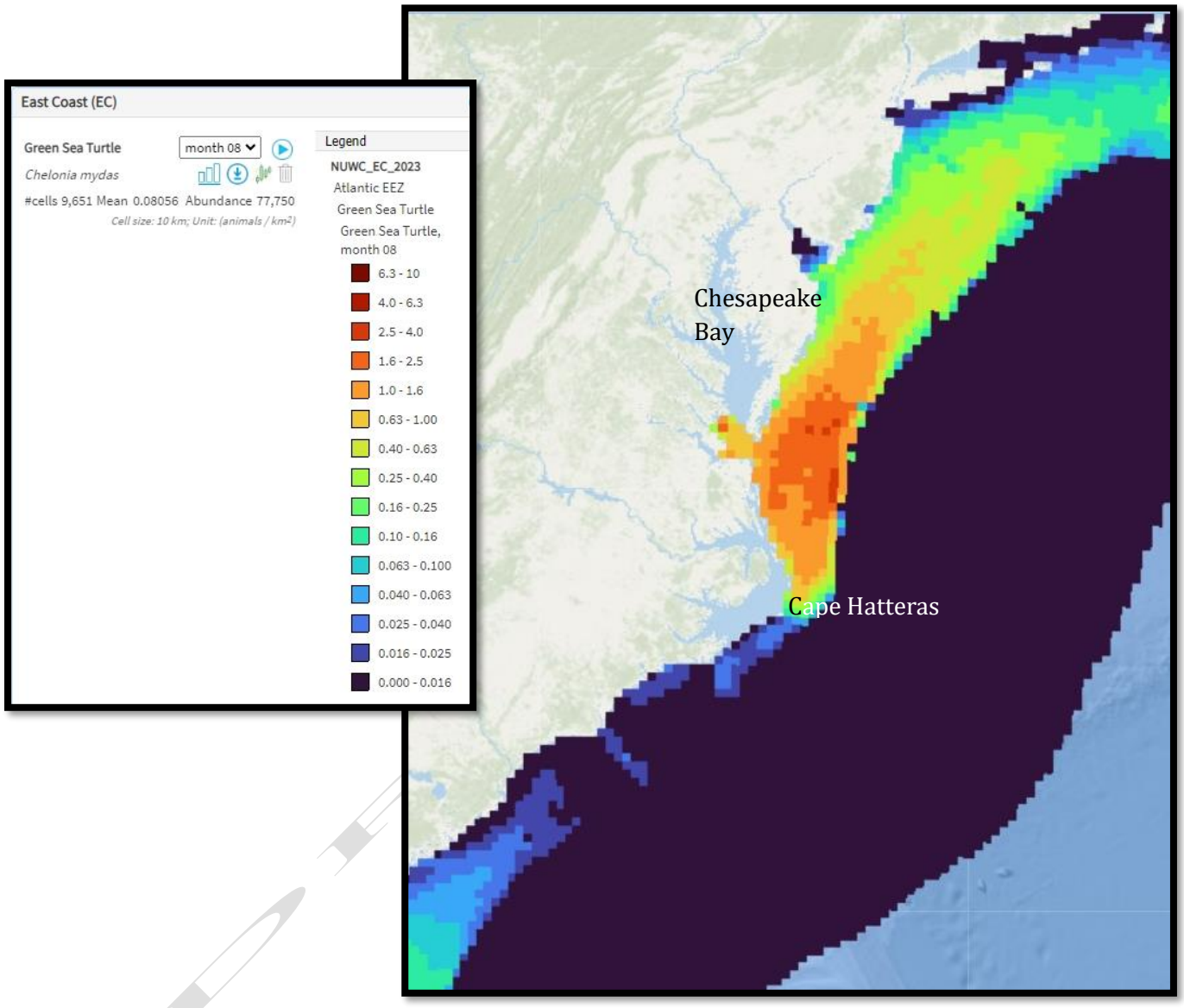


Figure 65. Modeled green turtle density map for August, the month when density is predicted to be highest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

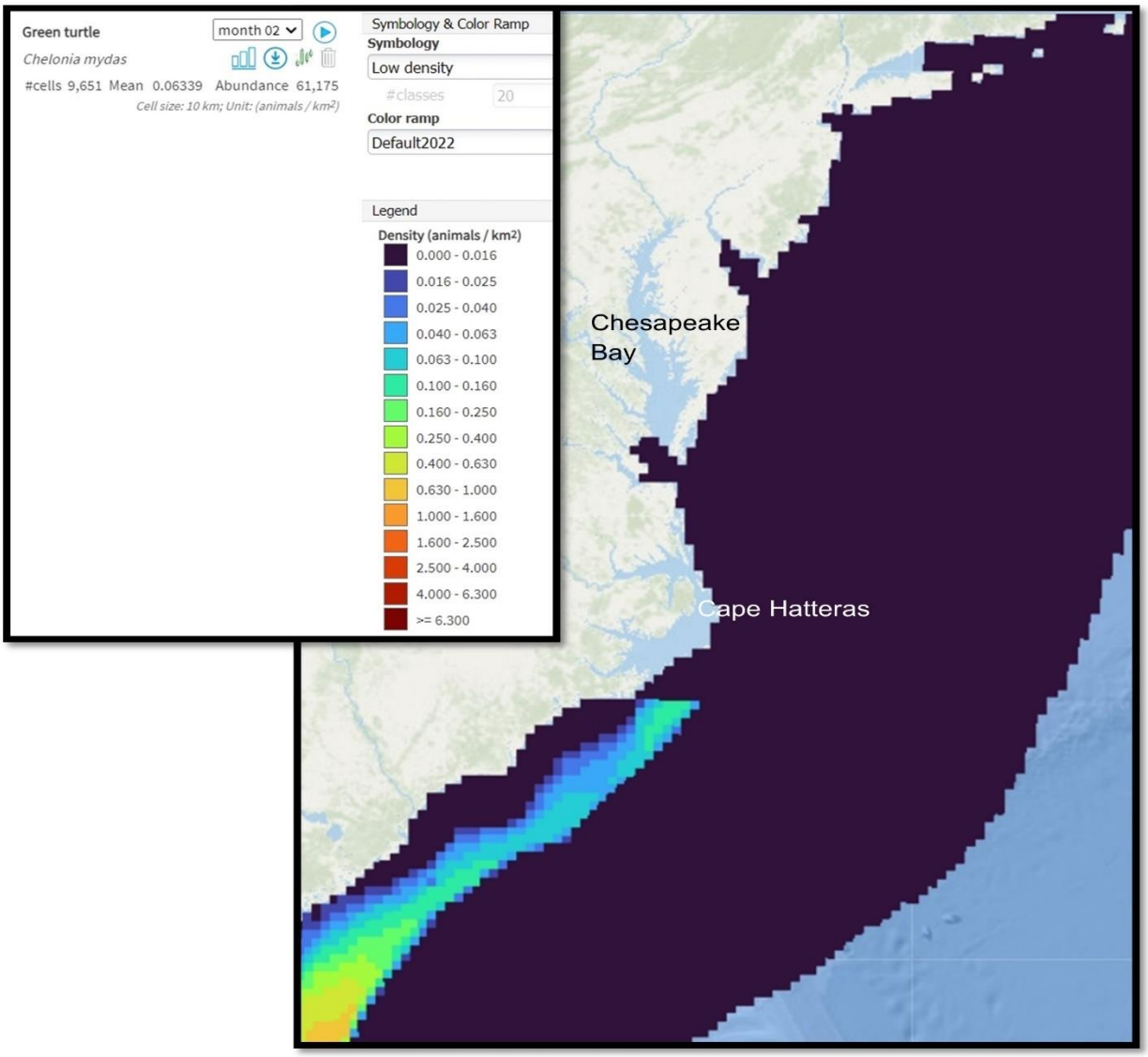


Figure 66. Modeled green turtle density map for February, the month when density is predicted to be lowest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

Diet

Unlike other sea turtle species, green turtles become primarily herbivorous once they shift to benthic habitats as young juveniles (Howell 2012) and remain so for the remainder of their lives (NMFS and USFWS 1991b). Stranding data indicate the majority of green turtles that occur in Virginia and Maryland waters appear to be small post-pelagic juveniles with straight carapace lengths < 40 cm (Costidis *et al.* 2021; Costidis *et al.* 2022; Epple *et al.* 2023). Past examinations of stomach contents of individuals stranded in Virginia included both eelgrass and macroalgae, especially sea lettuce of the genera *Ulva* (Bellmund *et al.* 1987; VAQS *unpublished data,* May 2023). More recently, preliminary examinations of GI tract contents collected from 27 green turtles between 2005 and 2011 revealed that all contained sea grasses. Eight (30%) of the

sampled GI tracts had both sea grass and small pieces (<5 cm^2) of plastic debris in them (VAQS *unpublished data,* May 2023) suggesting the presence of plastic debris in grass beds.

Habitat requirements

Although historically reported as abundant in Virginia's waters (Brady 1925), today green turtles occur in relatively low numbers compared to loggerhead and Kemp's ridley turtles and since 1994 comprised less than 10% of the state's annual sea turtle stranding totals (0 – 20 strandings per year) (Swingle *et al.* 2013; Swingle *et al.* 2014). Green turtle strandings in Virginia, however, have increased in recent years with 41 reported in 2022, suggesting that there may be a greater number of green turtles occupying Virginia's waters than previous years (Costidis *et al.* 2021; Costidis *et al.* 2022; Epple *et al*. 2023).

Green turtle nesting has been increasing annually on Florida Atlantic beaches and the region now hosts the largest green turtle nesting assemblage in the western North Atlantic (Seminoff *et al.* 2015). The number of green turtle nests on index beaches in Florida broke previous record highs in 2011, 2013, 2015, 2017, 2019, and 2023 reflecting both a well-documented two year reproductive cycle and steadily increasing nesting population in the state (Florida Fish and Wildlife Conservation Commission accessed May 2024). Recruitment of juvenile green turtles to neritic habitats in the Mid-Atlantic and Northeast US will likely result from increased nesting in the past decade. The relatively low abundance of green turtles in Virginia compared to green turtles in North Carolina may be correlated with significant losses of eelgrass (*Zostera marina*) in the lower Chesapeake Bay and seaside coastal bays since the 1930s (Orth & Moore 1983; Muehlstein 1989; Lefcheck *et al.* 2017). Efforts currently underway to restore eelgrass in Virginia have been met with considerable success, especially in the state's coastal bays (Orth & McGlathery 2012; Oreska *et al.* 2021). This may result in an increase in Virginia's Green Turtle population as more eelgrass beds become established in state waters. To date, there have been no systematic sea turtle surveys in Virginia's coastal bays and knowledge of sea turtle distribution and abundance in that part of the state is lacking.

In the past, green turtle nesting along the US Atlantic coast was thought to be largely confined to Florida (NMFS and USFWS 1991b). However, in more recent years, reports of green turtle nesting activity from Georgia through North Carolina have become more frequent (http://www.seaturtle.org/nestdb// accessed May 2023; Shamblin *et al.* 2018). Six green turtle nests have been documented in Virginia since 2005 (DWR *unpublished data,* September 2024), all within the southern half of Virginia Beach's city limits. These nests may have been laid by females also nesting in northern North Carolina (NCWRC *unpublished data,* May 2023). From 2018-2022, 206 green turtle nests (annual average = 41 nests; range 20-62 nests) were reported in North Carolina, nearly half of which nested on the state's northern shorelines (seaturtle.org accessed May 2023). Thus, it is possible that more individuals may move north across the state line and nest on Virginia's beaches in the future.

Leatherback turtle (*Dermochelys coriacea*)

Status

In 1970, the leatherback turtle was listed as endangered throughout its global range under the Endangered Species Conservation Act of 1970 (35 FR 8491) and has received Federal protection under the ESA since 1973. This status was adopted by the DWR in 1987 and is a Tier I SGCN in the Virginia Wildlife Action Plan (VDWR 2025). In 2020, all leatherback turtle Distinct Population Segments (DPS) were designated as endangered under the ESA (85 FR 48332) including the NW Atlantic DPS. In 2013, the species was globally listed as *Vulnerable* on the IUCN Red List, and the NW Atlantic subpopulation was designated as being *Endangered* in 2019 (NW Atlantic leatherback Working Group 2019). According to the most recent US ESA status review, the NW Atlantic DPS appears to be exhibiting a decreasing nest trend at most index beaches and the primary in-water threat to this subpopulation is the incidental capture of nesting females, foraging adults and juveniles by coastal and pelagic commercial fisheries including longline, gillnet and pot/trap fisheries (NMFS and USFWS 2020). This persistent in-water threat combined with the declining trend in nesting activity have led the NMFS and USFWS to consider the NW Atlantic DPS to be at a high risk of extinction (2020). Leatherback turtles are also listed in Appendix I of the CITES.

Distribution, abundance, and habitat use

Leatherback turtles range throughout tropical and temperate oceans of the world and are the most widely distributed of all reptiles (Pritchard 1980). Along the Atlantic coast of the US, leatherback turtles are distributed throughout the outer continental shelf waters year-round but appear to occur in coastal waters south of Cape Hatteras during cooler months (January-March; Dodge *et al.* 2014). Models developed by the US Navy suggest highest abundance in the lower Mid-Atlantic (Delaware Bay to Cape Hatteras) occurs in August (Figure 10) and lowest abundance occurs in February (Figure 11; DiMatteo *et al.* 2024).

Despite being highly migratory and known to spend a significant amount of time in pelagic waters (NMFS and USFWS 2020), they also occasionally wander into nearshore and inshore waters of the mid-Atlantic (Keinath 1986; Rider *et al.* 2024). Leatherbacks have been observed regularly in the lower Chesapeake Bay and nearshore ocean waters during aerial surveys and by commercial and recreational fishermen and boaters (Terwilliger & Musick 1995; Dodge *et al.* 2014; Barco *et al.* 2016). In the decade from 2013-2022, a mean of four (±3 SD; range 0-11) leatherback strandings, including live animals entangled in crab and whelk pot buoy lines and in pound net leaders were reported annually on Virginia shorelines and waters (VAQS *unpublished data,* May 2023). Leatherbacks occur in Mid-Atlantic waters primarily during warmer months (May to November).

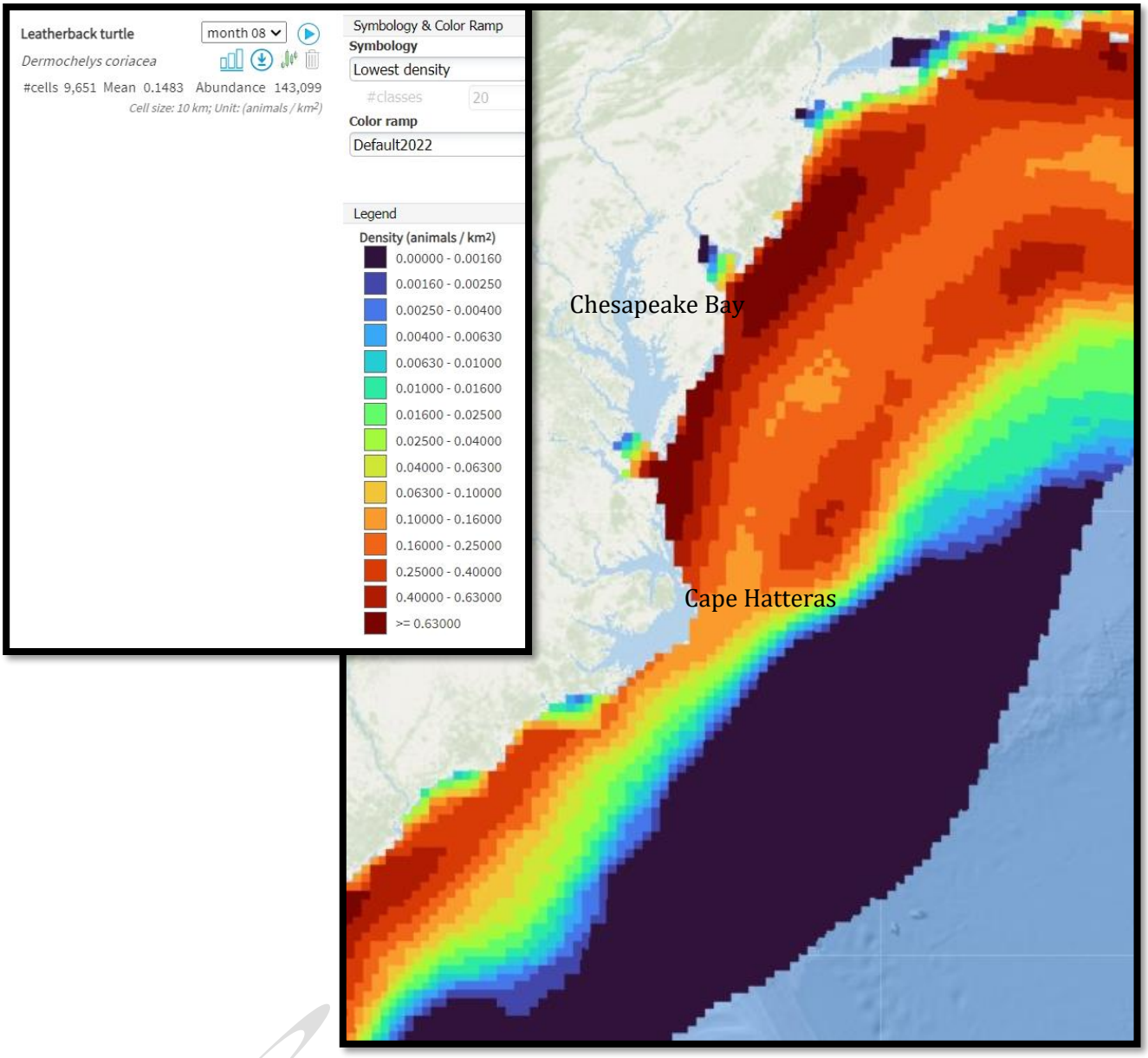


Figure 67. Modeled leatherback turtle density map for August, the month when density is predicted to be highest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

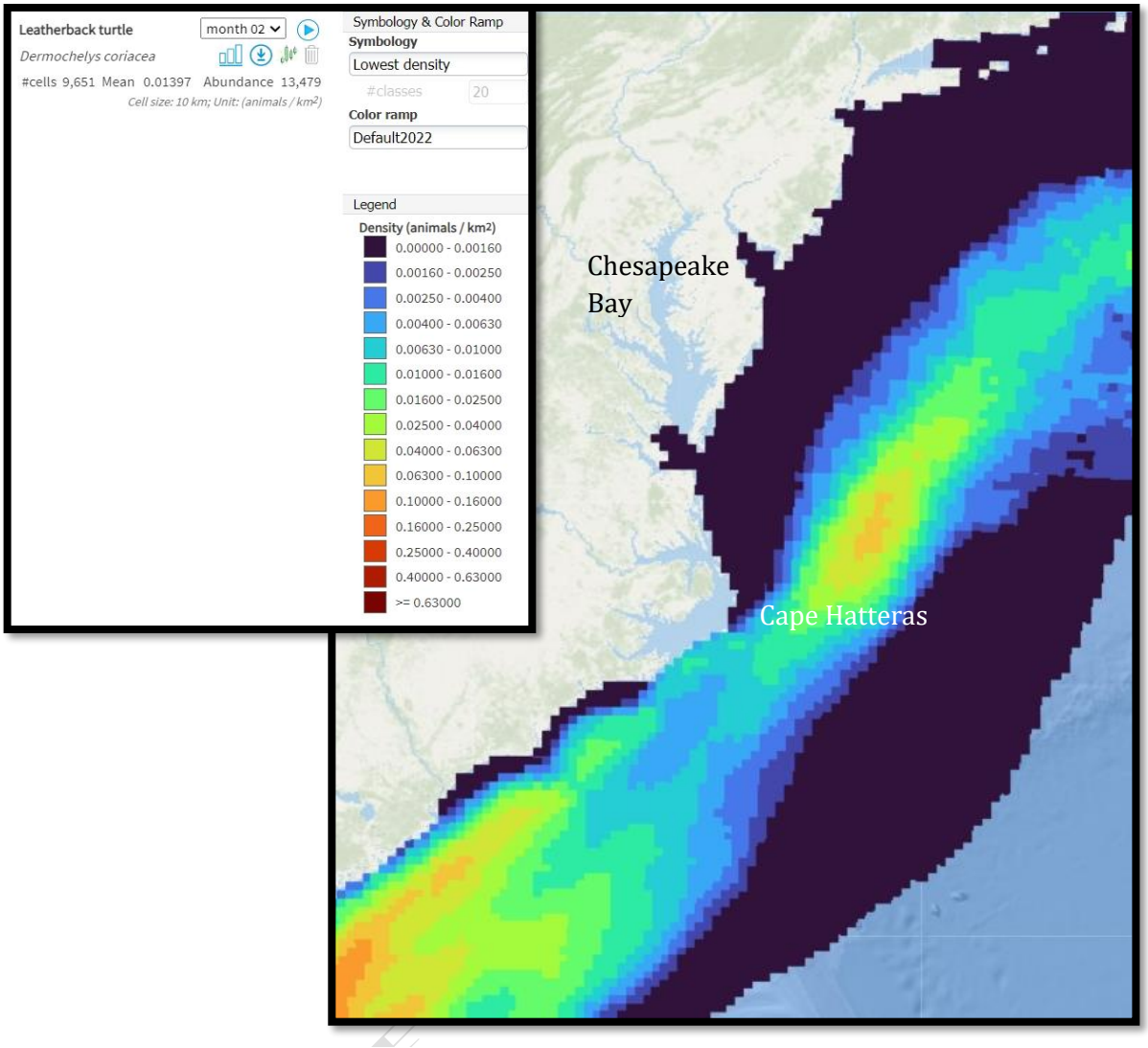


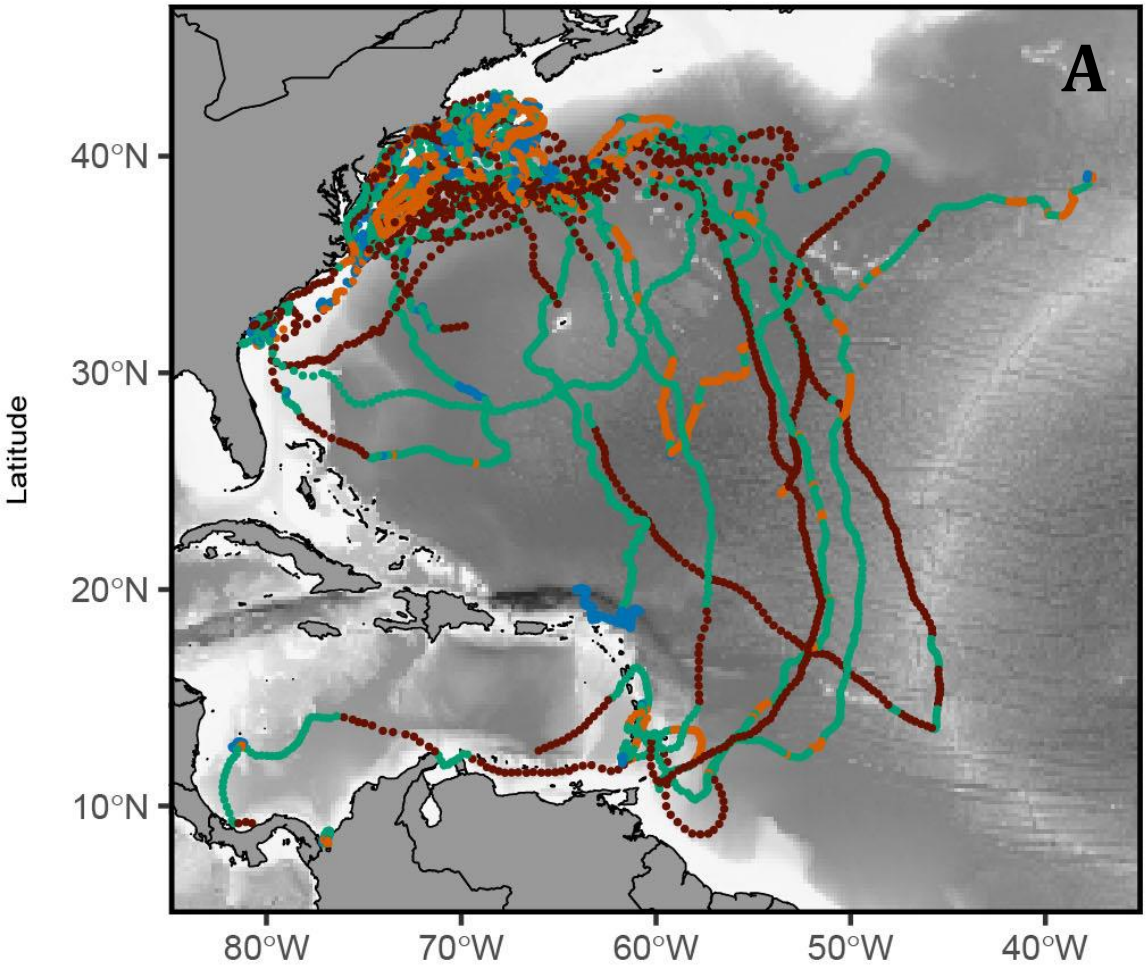
Figure 68. Modeled leatherback turtle density map for February, the month when density is predicted to be lowest in the Mid-Atlantic region (DiMatteo et al. 2024) [downloaded July 27, 2023: https://seamap.env.duke.edu/models/NUWC/EC/]

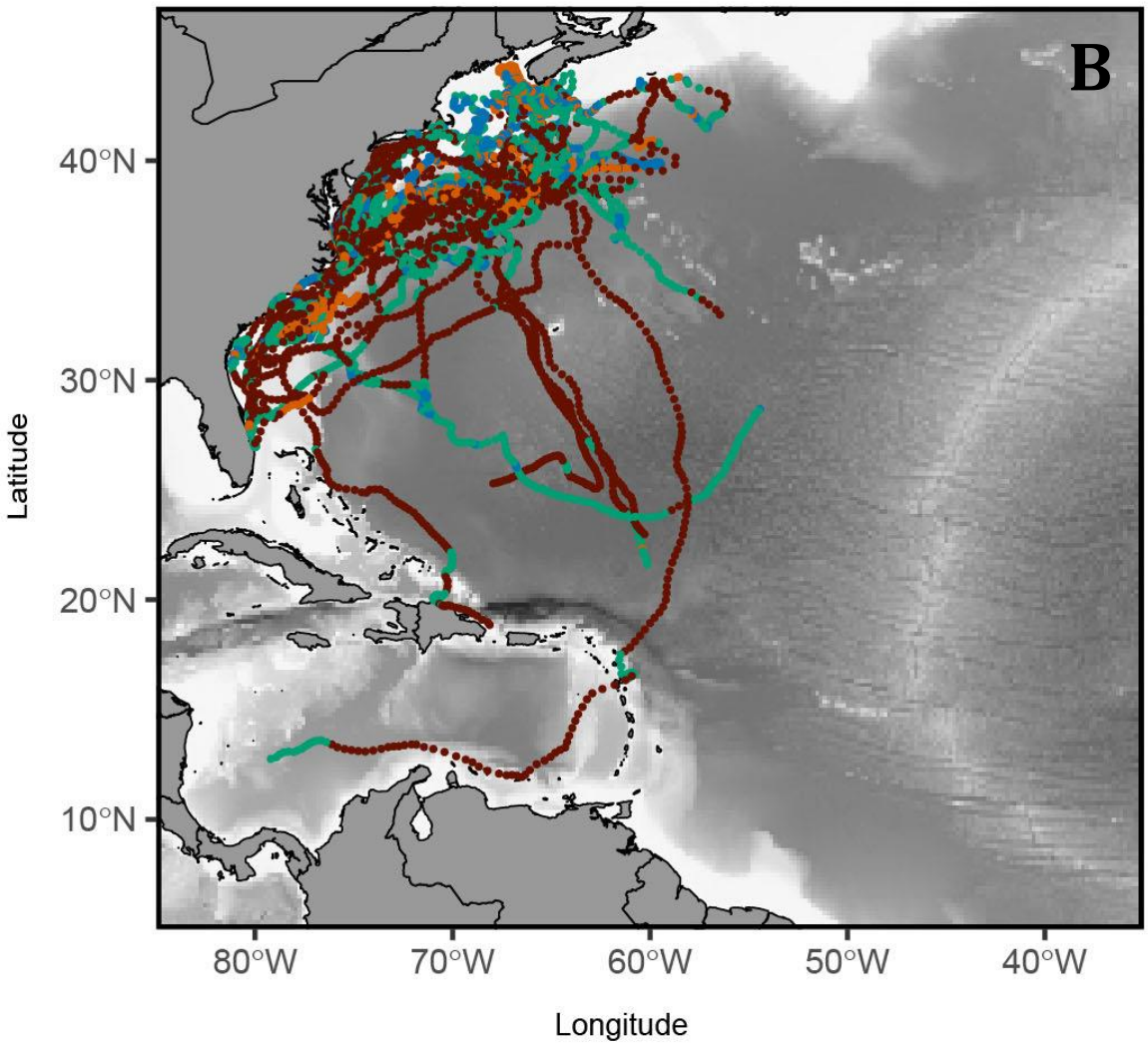
but have been observed in state waters in late fall and early spring when water temperatures are below the tolerance threshold of other sea turtle species (Barnard *et al*. 1989; DiMatteo *et al.* 2024). This may be because leatherback turtles have endothermic capacity (Standora *et al.* 1984), a heat-generating trait which permits their survival in cool waters.

Diet

In Virginia waters, leatherback turtles feed on soft-bodied invertebrates (Brongersma 1961, Pritchard 1971; Brongersma 1972; Pritchard 1980), primarily the sea nettle (*Chrysaora quinquecirrha*) and moon jellyfish (*Aurelia aurita;* Keinath *et al*. 1987; Musick 1988; Keinath & Musick 1990). Nordstrom *et al.* (2019) found that gelatinous prey distribution predicted leatherback turtle occurrence in Atlantic Canada and the same may be true for the Mid-Atlantic Bight, including Chesapeake Bay. Recent analyses of satellite tagged leatherbacks from North

Carolina and southern New England captures suggests that movement consistent with foraging (Area Restricted Surfacing or ARS) was prevalent in the Mid-Atlantic Bight, including Virginia Ocean waters (Figure 12; Rider *et al.* 2024). Leatherbacks in the Mid-Atlantic Bight tended to prefer water temperatures that hovered around 20°C associated with thermoclines between 10 and 20m deep in June and July and 30m deep in August and September (Rider *et al.* 2024). Jellyfish tend to concentrate near the thermocline and the Mid-Atlantic Bight has a high biomass of gelatinous zooplankton (Wallace *et al.* 2015).




B
40°N
30°N
20°N
10°N
Latitude
80°W
70°W
60°W
50°W
40°W
Longitude

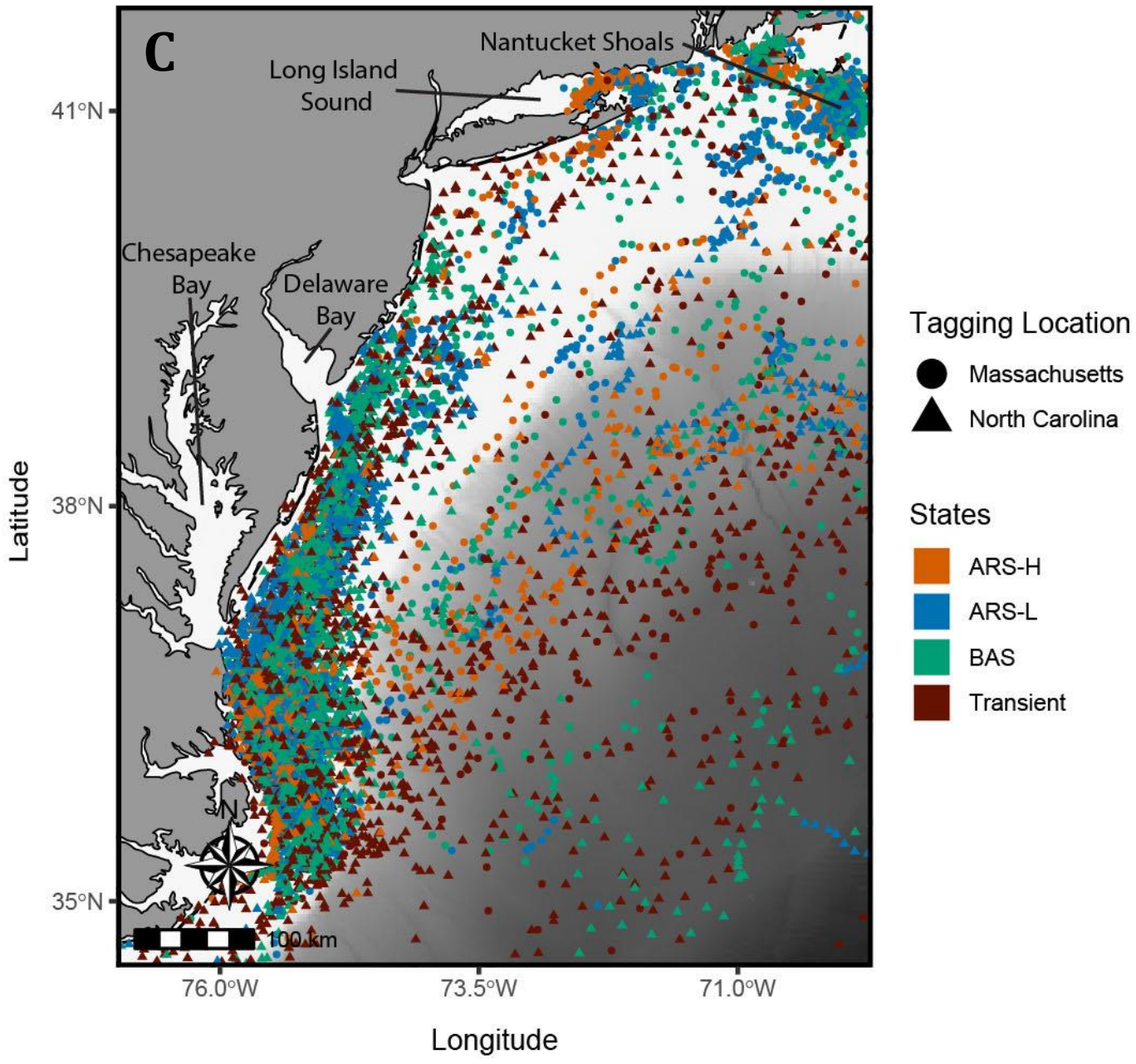


Figure 12. Reconstructed satellite tracks of leatherbacks tagged off Massachusetts in the summer (A) and North Carolina in the spring (B) between 2017 and 2022. Both turtles tagged in North Carolina (triangle) and Southern New England (circle) appeared in waters off Virginia. Colors correspond to the latent states predicted by the hidden Markov model: Area restricted search with high dive intensity (ARS-H), area restricted search with low dive intensity (ARS-L), broad area search (BAS), and transient [Figure 1 in Rider et al., 2024].

Leatherback turtle nesting along the US Atlantic coast is largely limited to Florida. However, occasional nesting has been documented as far north as North Carolina, where six nests were been documented from 2019-2023 (http://www.seaturtle.org/nestdb/index.shtml?view=1). To

date, there are no records of leatherback turtles nesting in Virginia, however, a daytime nesting emergence was documented on Assateague Island National Seashore, Maryland, in 1996. A potential egg chamber was found at the site; however, no eggs were found despite a thorough search of this area (Rabon *et al.* 2003).

Management of Sea Turtles in Virginia

Virginia Regulatory Agencies

Two state natural resource agencies in Virginia have authority to manage federally listed sea turtles, marine mammals, and marine fishes (hereafter collectively referred to as protected marine species). They are the Virginia Department of Wildlife Resources (DWR) and the Virginia Marine Resources Commission (MRC). The DWR is charged with the management of all wildlife and inland fish in the Commonwealth (*Code of Virginia* §§ 29.1-103 and 29.1-109). The Board of Wildlife Resources (DWR Board) is a gubernatorially appointed supervisory board of the DWR. Pursuant to the Virginia Endangered Species Act (Virginia ESA; *Code of Virginia* §§ 29.1-563–570), the DWR Board has authority to adopt the federal list of endangered and threatened species (§ 29.1-566); to list additional species as endangered or threatened in the Commonwealth, *id.* and the Department manages and protects those species throughout the Commonwealth (§§ 29.1-564, -567, and -570). Together DWR and the DWR Board develop, adopt, and enforce state regulations pertaining to all state and federally threatened and endangered wildlife species, excluding listed species of the Class Insecta (§ 29.1-566). Via the Cooperative Agreement entered into with the NOAA Fisheries Service (also known as the National Marine Fisheries Service or NMFS) as provided for under Section 6 of the Endangered Species Act of 1973, as amended, the DWR also is responsible for protection and management of species listed under the federal Endangered Species Act of 1973 (federal ESA), as amended, 16 U.S.C.S. §§ 1531 to 1544. The DWR has broad wildlife management responsibilities, which are addressed by three discrete units: Wildlife Division, Aquatics Division, and Nongame & Endangered Species Program in the Executive Office. Regarding protection and management of the Commonwealth's endangered or threatened wildlife and fish species, the DWR's Nongame and Endangered Species Program and Law Enforcement Divisions are primarily responsible for program development and implementation regarding protection and management of endangered or threatened species that occur throughout the Commonwealth's lands and jurisdictional waters.

The MRC has the authority to develop and enforce fishery regulations pertaining to the protection and conservation of state and federally protected marine species. However, it is not responsible for developing or enacting state threatened and endangered species laws or regulations and draws no authority from the Virginia or federal ESA. The MRC is charged with the conservation of marine life and has comprehensive management authority for all marine organisms and associated habitats within its jurisdiction that extends from the fall lines of all

tidal rivers to the 3-Mile Limit Line of the Territorial Sea (*Code of Virginia* § 28.2-101). This includes sea turtles and marine mammals as well as their prey bases *Code of Virginia* §§ 28.2-201 and -1204). The MRC has regulatory jurisdiction over activities affecting state-owned bottomlands in tidal waters only (*Code of Virginia* §§ 28.2-1200-1209). The MRC has authority over all commercial fishing activities within its jurisdiction, regulates the take of marine finfish and shellfish in Virginia's tidal waters, and has the ability to administer a protected species observer program for state fisheries with appropriate federal authorization and permits (*Code of Virginia* § 28.2-200-244). It is also responsible for establishing finfish and shellfish seasons, size and possession limits, species-specific landings, harvest quotas, and harvest size restrictions (*Code of Virginia* § 28.2-101). The Code of Virginia authorizes the MRC to promulgate regulations that conserve and promote the seafood and marine resources of the Commonwealth (*Virginia Code* § 28.2-201), establish and limit licenses, *id*., collect fisheries statistics (*Code of Virginia* § 28.2-204) and prepare fishery management plans (*Code of Virginia* §§ 28.2-201, -203 and -203.1). The MRC's Fisheries and Habitat divisions are responsible for development and implementation of programs that carry out these mandates.

The DWR conservation police officers and MRC marine police officers share some of the same powers; each is vested with the authority to enforce the criminal laws of the Commonwealth; see *Code of Virginia* §§ 28.2-106 (B) (providing that "Officers of the Virginia Marine Police shall have the same powers as (i) sheriffs and other law-enforcement officers to enforce all of the criminal laws of the Commonwealth, and (ii) regular conservation police officers appointed pursuant to Chapter 2 (§29.1-200 et seq.) of Title 29.1.") and 29.1-205 (providing that "Regular conservation police officers are vested with the same authority as sheriffs and other law-enforcement officers to enforce all of the criminal laws of the Commonwealth."). As it is a criminal violation to violate the provisions of the Virginia ESA, Virginia Code § 29.1-567(1), the Conservation Police and the Marine Police have equal authority to enforce the Commonwealth's endangered species laws. Moreover, the MRC has standing law enforcement agreements with National Oceanic and Atmospheric Administration (NOAA) Fisheries and the US Fish and Wildlife Service (USFWS), enabling marine patrol officers to collaborate with their federal counterparts on protected species investigations, patrols, inspections, warrants, and arrests. The DWR has a standing law enforcement agreement with the USFWS that allows conservation police officers to serve as Deputy US Fish and Wildlife Special Agents and conduct investigations both in-state and across state lines when violations of federal wildlife laws have been committed. Finally, the MRC Marine Police receives annual funding from NOAA Fisheries to assist with sea turtle and marine mammal stranding response and fishery management in the Commonwealth through a Joint Enforcement Agreement with NOAA Fisheries.

A third state entity, the Virginia Institute of Marine Science (VIMS), has conservation responsibilities as well, but has no authority to enact or enforce state regulations; s*ee Code of Virginia* §§ 28.2-1100 -1104 (establishing VIMS and setting forth its authority, duties, and responsibilities). VIMS is a part of both the College of William and Mary and Richard Bland

College (§23.1-2807). VIMS is specifically mandated to serve the state in matters of marine research and has marine conservation duties (*Code of Virginia* §28.2-1100). VIMS has a three-part mission to conduct interdisciplinary research in coastal and estuarine science; to educate students and citizens; and to provide advisory service to policy makers, industry, and the public (https://www.vims.edu/about/). VIMS' duties include advising, training, providing technical and scientific assistance, and conducting research for the MRC, federal agencies, and other public and private groups on the conservation and management of marine, coastal, and estuarine resources (*Code of Virginia* § 28.2-1100). Research at VIMS extends from inland watersheds to the open ocean and is conducted by teams of scientists with diverse expertise in areas such as plankton and nutrient dynamics; shoreline and wetlands processes; fisheries ecology and stock assessment; fisheries gear engineering and bycatch; aquaculture; genetics; immunology; toxicology; biological, chemical, and physical oceanography; aquatic diseases; computational modeling; and marine geological processes.

Federal Endangered Species Act (ESA)

In 1973, Congress passed the federal ESA (16 U.S.C. 1531 *et. seq.*), which enhanced federal abilities to protect endangered species and develop measures for their recovery. During each reauthorization of the Endangered Species Act, amendments have been added which reflect the experience and knowledge gained in administering its provisions. The 1978 amendments required the USFWS and NMFS to develop and implement recovery plans for species under their jurisdiction. Between 1991 and 1993 recovery plans were completed for all four species of sea turtles covered in this plan (NMFS 1991a, 1991b, 1992, USFWS and NMFS 1992). A second revision of the loggerhead turtle recovery plan for the NW Atlantic population was completed in 2008 (NMFS and USFWS 2008) and the second revision of the Kemp's ridley recovery plan was published in 2011 (NMFS *et al.* 2011). Five-year status reviews have been completed for the Kemp's ridley turtle (NMFS and USFWS 2015), the leatherback turtle (NMFS and USFWS 2020), North Atlantic green turtle (Seminoff *et al.* 2015) and the NW Atlantic loggerhead DPS (NMFS and USFWS 2023).

The federal ESA offers endangered and threatened species comprehensive protection and is administered jointly by the USFWS and NOAA Fisheries. The USFWS has authority over terrestrial and freshwater fish, wildlife, plants and insects while NOAA Fisheries has authority over marine and anadromous fish and wildlife. The two agencies share jurisdiction over sea turtles with responsibilities elucidated in the 2015 Memorandum of Understanding; NOAA Fisheries is responsible for the conservation and recovery of sea turtles in the marine environment, and the USFWS is responsible for the conservation and recovery of sea turtles on nesting beaches and in captivity/rehabilitation. Section 4 of the federal ESA contains provisions for the listing and recovery planning process, including the determination of critical habitat and the issuance of regulations deemed necessary and advisable to further the conservation and recovery of listed species. Section 6 allows for the establishment of cooperative agreements with

states that give state fish and wildlife agencies shared authority over the recovery and conservation of federally listed species within state boundaries. Federally -permitted, -funded, or -conducted actions known to impact sea turtles, such as dredging and in-water military training activities, are addressed under Section 7 through incidental take statements for intergovernmental consultation. Section 10 provides for the development of habitat conservation plans and incidental take permits for non-federal actions that threaten listed species, such as state commercial fishery operations.

USFWS and NOAA Fisheries Section 6 Cooperative Agreements

Section 6 of the federal ESA provides a mechanism for cooperation between states and the two federal agencies responsible for overseeing the conservation and recovery of federally threatened, endangered, and candidate species. Under section 6, NOAA Fisheries and USFWS are authorized to enter into agreements with any State that establishes and maintains an "adequate and active" program for the conservation of endangered and threatened species. Once a State enters into such an agreement, NOAA Fisheries and USFWS are authorized to assist in, and provide Federal funding for, implementation of the State's conservation program. The DWR entered into a cooperative agreement with the USFWS in 1976 and signed a cooperative agreement with NOAA Fisheries in 2009.

Virginia's Wildlife Action Plan

On November 5, 2001, President Bush signed the Department of the Interior and Related Agencies Appropriations Act, 2002, which created the State Wildlife Grants (SWG) program. As indicated within this legislation, these grants were established to help fund the development and implementation of programs for the benefit of wildlife and associated habitats, including nongame species. The SWG program receives annual Congressional appropriations that are administered by USFWS. USFWS apportions these funds, using a legislated formula based on human population and geographic area, to fish and wildlife management agencies within the 50 states, the five U.S. territories, and the District of Columbia. To receive annual SWG appropriations, Congress stipulated that each wildlife agency must produce a comprehensive Wildlife Action Plan (WAP), to be updated every 10 years. The 2025 WAP (https://dwr.virginia.gov/wildlife/wildlife-action-plan/2025-wildlife-action-plan/draft-wildlife-action-plan/), designates all four species of sea turtles covered by this plan as Species of Greatest Conservation Need (VDWR 2025).

Virginia ESA

Virginia's ESA (*Code of Virginia* §§29.1-563-570), administered by the DWR, provides for adoption of the federal endangered and threatened list (*Code of Virginia* § 29.1-566), listing at the state level, *id*., and protection of those species in the state (*Code of Virginia* § 29.1-567). Further protective legislation for non-endangered species is found in *Code of Virginia* §29.1-521, which provides for the protection of wildlife in general. The DWR Executive Office units along

with the following divisions are responsible for program development and implementation: Wildlife, Fisheries, Law Enforcement, Outreach, Planning and Finance.

Virginia Sea Turtle Nest Monitoring Program

Virginia is the nearly northern extent of the loggerhead nesting range along the US Atlantic coast and is part of the species' Northern Recovery Unit (NRU) within the NW Atlantic Ocean Distinct Population Segment (NMFS and USFWS 2008). Currently, an average of seven loggerhead nests are laid annually on Virginia's beaches. In addition, six green turtle and three Kemp's ridley nests have been documented in the Commonwealth since 2005 (DWR, *unpublished data*, September 2024). The monitoring of sea turtle nesting activity has been on-going since 1970. Over 77% (n = 192 nests) of all documented nests were laid on ocean-facing beaches between the North Carolina/Virginia border and the Joint Expeditionary Base - Ft. Story (hereafter referred to as the southern mainland beaches). All but one of the remaining nests (n = 65 nests) were deposited on the beaches of Virginia's barrier islands in Accomack and Northampton counties. The exception was a loggerhead nest found on Gwynn's Island in Matthew's County approximately 45 miles north of the mouth of the Chesapeake Bay.

Currently, daily nest patrols are conducted on the southern mainland beaches and on Assateague and Wallops islands, Virginia's northernmost barrier islands, which are owned and managed by Chincoteague National Wildlife Refuge and NASA, respectively. Of the 65 nests documented on the barrier islands since 1970, 46 were deposited on Assateague Island and 13 nests were laid on Wallops Island. Most other barrier islands are monitored every 3 – 7 days in conjunction with shorebird productivity studies. The level of coverage on islands south of Wallops has thus far proven to be adequate since they are remote and accessible only by boat (except for Fisherman Island which can be accessed by vehicle), undeveloped, under conservation ownership (*i.e.,* TNC, USFWS and DCR), and receive little to no human disturbance. Moreover, only four nests and 16 false crawls have been detected since shorebird studies began in 2004. While it is likely that some nests and non-nesting emergences were missed, daily coverage is not warranted at this time given the logistical constraints (*e.g.*, vehicles are not allowed and must be covered on foot) and overall lack of capacity. All sea turtle nest monitors are permitted by the USFWS or the DWR and follow nest monitoring and management protocols outlined in the Virginia Sea Turtle Nesting Handbook (VDGIF 2017).

Virginia Sea Turtle Stranding and Salvage Network (VSTSSN)

Nationally, the Sea Turtle Stranding and Salvage Network (STSSN) is overseen by the NOAA Fisheries as stated by the 2015 MOU. Virginia is the southernmost state in NOAA Fisheries' Greater Atlantic Region (GAR) which extends from Virginia to Maine. Individual states and organizations in GAR are authorized by the USFWS to recover, examine, and rehabilitate stranded sea turtles either through Section 6 Cooperative Agreements or endangered species permits. On-water disentanglement activities are authorized by NOAA Fisheries. Research on in-

water wild turtles requires a permit from the NOAA Fisheries Permit Division, and research on land based wild turtles, rehabilitated or captive turtles requires a permit from the USFWS. In Virginia, DWR's Section 6 Cooperative Agreement with USFWS includes authority to manage the VSTSSN, and DWR has designated staff and volunteers with the Virginia Aquarium & Marine Science Center's Stranding Response Program (VAQS) as agents of the state under DWR's authority (Appendix). VAQS recruits and trains staff and volunteers in sea turtle stranding response and rehabilitation and enters Virginia sea turtle stranding data into the NOAA Fisheries Sea Turtle Stranding and Salvage Database. VAQS also collects and manages additional necropsy and rehabilitation data and images. VAQS coordinates sea turtle response efforts with a variety of federal, state, NGO and municipal entities including the MRC Marine Police, US Coast Guard, NOAA Fisheries Office of Law Enforcement, DWR, state parks, federal wildlife refuges, The Nature Conservancy and military bases.

Virginia Ocean Plan

The Virginia Ocean Plan (VOP) is a resource and coordinating document that aims to improve ocean resource management in the waters offshore Virginia. Federal policy (Executive Order 13547) that coordinated regional development of ocean plans was revoked by Executive Order 13840 in 2018, effectively leaving ocean planning to the states. As a result, the VOP was developed with the following goals:

1. Promote a sustainable and growing "blue economy".
2. Document and characterize existing/emerging ocean uses and the existing policies/plans that relate to them.
3. Minimize/mitigate conflicts between existing and emerging ocean uses, and minimize/mitigate impacts to ocean habitat, marine life, and ecosystem functions.
4. Increase resilience of ocean uses, ocean habitat, and marine life to a changing ocean.
5. Develop processes for plan implementation, plan maintenance/updates, ongoing stakeholder collaboration, and conflict resolution.

To do this, input from over 120 experts and experienced ocean users was gathered through six different workgroups focused on topics like energy and infrastructure; transportation, navigation, and security; and sustainability and conservation. The latter workgroup developed recommendations related to the conservation of marine species and habitats, and the goal of making ocean uses more sustainable. This Marine Mammal Conservation Plan is included as an appendix in the VOP as the conservation plan's goals, strategies, and actions are critical components of Virginia's ocean resource management.

Tribal Nations in Virginia

Virginia is home to seven federally recognized and four state-recognized tribes. Many of these tribes are signatories to the Treaty of Middle Plantation, which specifically mentions tribal rights to oystering, fishing, and gathering a series of plants including edible roots, wild oats, rushes,

and other species. Several tribes participate in natural resources stewardship through cooperative monitoring of fisheries resources, oyster reef restoration activities, and monitoring water quality on tribal land. A significant effort was made with to invite Virginia's Native American tribes to comment on drafts of the Plan.

Limiting Factors, Causes of Mortality, and Other Threats to Sea Turtles in Virginia

A host of factors affect sea turtle populations and their habitats. The growth and subsequent expansion of human population has been well-documented and resulted in a decline in nesting, migration, and foraging habitat throughout these species' ranges. A five-factor analysis is used by NMFS and the USFWS when a species or population is considered for ESA listing, de-listing or undergoing a five-year status review. Here we use four similar factors that are most relevant to Virginia and the Mid-Atlantic region.

1) Human caused destruction, modification or restriction of habitat or range
2) Mortality or serious injury resulting from commercial, recreational, scientific, or educational activities
3) Predation and disease
4) Other natural or human created factors affecting each species' continued existence

Each of these factors is explained below in the context of those species that occur in Virginia state waters and adjacent federal waters. Under each factor are descriptions of risks and threats selected from recent sea turtle status reviews that are most relevant to Virginia and the mid-Atlantic region.

When a federal action is proposed that may affect protected marine species, the entity conducting the work must seek consultation with agencies overseeing federal protections. For protected marine species in the water, NOAA Fisheries is consulted through the Section 7 incidental take consultation process, and NOAA Fisheries scientists produce a Biological Opinion as to whether and how the action may harm the species involved which leads to required mitigation measures. Terrestrial actions that may affect sea turtles are reviewed through the USFWS Section 7 consultation process. In addition to actions that directly or indirectly affect federally listed or proposed species and their habitats, there is a federal action review process required for the National Environmental Policy Act (NEPA). The extent to which private entities must comply with these policies depends on the location, action, and funding source. For example, NOAA Fisheries reviews navigational channel dredging funded by the Army Corps of Engineers and any private dredge companies hired by the Corps must comply with terms and conditions detailed in the Reasonable and Prudent Measures and incidental take limits issued by NOAA through the Section 7 consultation. Commercial fishers using gear that is known to take sea turtles as bycatch must comply with any

applicable federal regulations and allow onboard observers, observation from separate vessels, or gear inspections when requested while commercial fishers in state waters using gear not deemed to take sea turtles have no applicable federal regulation that they must adhere to. Thus, many actions undergo a federal review process that determines whether harm may come to sea turtles and how that potential harm should be mitigated and monitored. Additional state actions can be required for actions that are federally reviewed but, in many cases, federal mitigation may be sufficient.

1) Human caused destruction, modification or curtailment of habitat or range

This factor includes the effects of activities such as dredging, sand mining, marine construction, shoreline stabilization, and other actions on sea turtle habitat. The presence of fixed structures and gear may displace, destroy, degrade or modify habitat which can result in range curtailment of animals sensitive to such changes. In some cases, human presence alone can curtail habitat (*e.g.,* people moving around and using lights on nesting beaches at night).

In Virginia, coastal habitat loss and degradation have affected overall species diversity, abundance, and distribution in the ocean as well as in the Chesapeake Bay and its tributaries (Kemp *et al.* 1983; Kemp *et al.* 2005). Sea level rise and/or land subsidence is considerable in parts of Virginia (Ezer and Atkinson 2015; Zhang and Li 2019; Ezer 2023), and this phenomenon threatens sea turtle nesting habitat. Nesting habitat can also be degraded by the presence of humans, human activities (such as beach driving), and recreational equipment (*e.g.*, boats, cabanas, and furniture). All sea turtle species in Virginia are affected by the destruction, degradation or modification of in-water habitats. Ocean-facing beaches are the primary terrestrial habitat which sea turtles inhabit. In Virginia, the loggerhead turtle is the species most affected by perturbations to beach habitats since they are the most frequent nesting species in Virginia. NMFS and USFWS (2023) lists threats that interfere with successful nesting, egg incubation, hatchling emergence, and transit to the sea, such as: erosion and erosion control, coastal development, artificial lighting, beach use (including beach driving and cleaning), and beach debris. Nesting females, eggs and hatchlings are all affected by these types of habitat modification and destruction. Equipment left on beaches and other beach debris can also deter, impede, and/or entrap nesting females and hatchlings, discouraging nesting (*e.g.,* higher prevalence of false crawls), and interfering with hatchling emergence and transit to the sea (Fuentes *et al.* 2023). Microplastic beach debris alters the temperature and permeability of sand (Andrady 2011; Fuentes *et al.* 2023), disturbing the incubating environment for marine turtles (Beckwith and Fuentes 2018).

Erosion, erosion control & beach replenishment

Beach erosion is a consequence of many processes including sea level rise, land subsidence, and increased frequency and intensity of storms. Structures built on sea turtle nesting beaches are

protected from erosion in a number of ways, including beach armoring structures such as rock revetments, bulkheads, and geo-textile tubes. These structures impede natural coastal processes by physically prohibiting dune formation from wave uprush and wind-blown sand. Beach armoring structures result in lower nest density and lower nesting success depending on the type of armoring, species and location (Rizkalla and Savage 2011; Hirsch *et al.* 2022). Similarly, groins and jetties prevent normal sand transport and cause accelerated beach erosion downdrift of the structures, a process that results in degradation of sea turtle nesting habitat well beyond the structures themselves (Conant *et al.* 2009, NMFS and USWFS 2020, 2023). Armoring structures can effectively eliminate a turtle's access to upper regions of the beach/dune system (Conant *et al*. 2009). Consequently, nests on armored beaches were generally found at lower elevations than those on non-walled beaches. Nests laid at lower elevations are subject to a greater risk of repeated tidal inundation and erosion, which can drown or destroy nests or alter thermal regimes within the nest cavity and thereby affect sex ratios of hatchlings (Ackerman 1997; Limpus *et al.* 2020; Martins *et al*. 2022). Beach armoring structures are present on several ocean-facing beaches in Virginia and include sea walls, jetties, groins and rock revetments.

Beach renourishment is often used to manage beach erosion by adding or redistributing sand; however, renourishment can result in diminished nesting and hatching success (Long *et al.* 2011; Hays 2012; Cisneros 2017). The renourishment process disrupts nesting beaches and may result in changes to beach characteristics such as sand grain size, compaction, and moisture content, *etc.* that can affect nesting, hatching success, and hatchling emergence success long after the renourishment process (Reine 2022). The Army Corps of Engineers recommends guidelines for proper mitigation, sand replacement choices and observations when renourishing sea turtle nesting beaches (Reine 2022). The guidelines are based on research primarily conducted in Florida but are relevant to Virginia.

In Virginia, beach armoring and renourishment that may negatively affect sea turtle habitat is permitted by state and federal regulatory agencies. Shoreline planning and project development is implemented by municipalities for land owned privately and by local government. Permitting agencies entities provide guidance and information for preferred actions (*e.g.* living shorelines and dune restoration as opposed to hard structures where possible). State agencies and other entities comment on permit applications to ensure species, habitats, and other resources are appropriately considered prior to permit issuance.

Beach use by human beings

Beach use by human beings in Virginia includes a variety of activities such as wading, walking, sun bathing, beach combing, surf fishing, beach driving, and resort activities such as festivals, sporting events, and concerts. Management of human beach use requires municipal beach cleaning and trash pickup, life guard and police patrols, and other maintenance activities. Many of these activities can contribute to the degradation of sea turtle habitat quality due to factors

such as increased human presence, modification of nesting substrate, light pollution and accumulation of trash and beach debris.

Nesting beaches within the city limits of Virginia Beach all have some degree of exposure to vehicular traffic, in the form of lifeguard vehicles, trash collecting trucks, beach cleaning equipment, municipal, state or federal patrol vehicles, or private vehicles permitted to use the beach as a roadway. In the commercial section of Virginia Beach's resort area, the beach is raked and graded daily during the summer months while the beaches in the residential areas are raked less regularly. Presence of vehicles on the beach has the potential to negatively impact sea turtles by running over nesting females, hatchlings, and nests. Ruts left by vehicles in the sand may prevent or impede hatchlings from reaching the ocean following emergence from the nest. Hatchlings impeded by vehicle ruts are at greater risk of death from predation, fatigue, desiccation, and being crushed by additional vehicle traffic (NMFS and USFWS 2020, 2023). In addition, beach driving and cleaning may change the sand albedo (light or radiation that is reflected by a surface) and affect temperature dependent sex determination (Hays *et al.* 2001). Vehicle lights and vehicle movement on the beach after dark can deter females from nesting and disorient hatchlings. Driving directly above incubating egg clutches can cause sand compaction, which may decrease hatching success and directly kill pre-emergent hatchlings. Additionally, vehicle traffic on nesting beaches may contribute to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune (NMFS and USFWS 2020, 2023).

Beach cleaning to collect debris and trash may damage turtle nests and hatchlings. Mechanical methods used to clean and rake beaches involve heavy machinery that can repeatedly run over nests and potentially compact the sand above them (NMFS and USFWS 2020, 2023). Beach cleaning vehicles also may leave ruts along the beach that hinder or trap emergent hatchlings. Mechanically pulled rakes and hand rakes, particularly if the tongs are longer than 10 cm, penetrate the beach surface and may disturb incubating nests or uncover pre-emergent hatchlings near the surface of the nest (NMFS and USFWS 2020, 2023).

Beaches with higher historical nest presence are surveyed daily prior to beach cleaning and sand raking. Within the highly developed commercial section of the resort area which radiates the most significant nighttime lighting, the beach is cleaned daily before daylight and only patrolled by equipment operators who receive annual training from nest monitors. Only five nests have been recorded in the commercial section, four of which were laid prior to 1997. All detected nests laid in Virginia are marked and thus are protected from being run over by vehicles, but ruts from vehicles are a problem for hatchlings in most areas. Each season, some fresh sea turtle nesting crawls may be obscured by wind and/or rain prior to daily morning nest patrols. Therefore, some clutches may not be detected during morning patrols and go unmarked, and, thus, are exposed to damage or destruction from vehicular traffic.

Beach goers often leave large items such as sun shades and tents on beaches overnight or fail to properly discard broken items such as beach umbrellas, chairs, tents, *etc.* Depending on the municipality, these large items may not be immediately removed leaving potential hazards for sea turtles. Large beach debris items pose threats both to nesting females and hatchlings as obstacles and/or potential entangling items (Triessnig *et al.* 2012; Fujisaki and Lamont 2016). In the three years of seasonal monitoring for nests on public beaches of northern Virginia Beach, observers noted large objects (*e.g.*, beach chairs, tents, sun shades) on beaches 94 of 364 days (26%; VAQS *unpublished data,* May 2024).

Light pollution

Both nesting and hatchling sea turtles are adversely affected by the presence of artificial lighting on or near the beach (NMFS and USFWS 2023). Artificial lighting deters adult female turtles from emerging from the ocean to nest (Witherington and Bjorndal 1991). Both loggerhead turtle nest site selection and hatchling disorientation can be negatively affected by artificial lighting (Witherington and Martin 1996; Price *et al.* 2018). Because adult females rely on visual brightness cues after nesting, those turtles that nest on lighted beaches may become disoriented (unable to maintain constant directional movement) or misoriented (able to maintain constant directional movement but in the wrong direction) by artificial lighting and have difficulty finding their way back to the ocean. Hatchling sea-finding behavior is also guided strongly by visual cues (Witherington and Bjorndal 1991; Salmon *et al*. 1992; Witherington and Martin 1996; Lohmann *et al*. 1997; Lohmann and Lohmann 2003). Although the mechanism involved in sea-finding is complex, involving cues from both brightness and shape, it is clear that intense, bright stimuli can override other competing cues (Witherington and Martin 1996).

Prior to 2001, all sea turtle nests laid on the southern mainland beaches in southeastern Virginia were moved into a hatchery at BBNWR where human disturbance was virtually nonexistent and light pollution was relatively minimal. Current nest management strategies in Virginia include leaving all nests not threatened by regular tidal inundation *in situ*. This means that hatchlings emerging from nests laid on the heavily developed beaches may be exposed to significant artificial lighting and will need to be monitored for dis-orientation and mis-orientation. Efforts to assess and manage artificial lighting on military and municipal-owned beaches in Virginia are in place and have been implemented in cases when a manageable number of bright lights are visible to turtles on otherwise dark beaches. Moreover, municipal landowners, businesses, and homeowners are encouraged to turn off, dim or shield artificial lights in the vicinity of nests near the time of predicted hatching. While large scale management of outdoor lighting on developed nesting beaches is highly desirable from a sea turtle conservation perspective, it has not been gained traction in Virginia largely because the state's nesting population is so small.

Military activities

Military activities along the shoreline and in the waters of Virginia that involve beach disturbance, vessel use and/or aquatic acoustic disturbances (*e.g.,* hovercraft maneuvers, shore-based and in-water training exercises involving explosives, the use of low frequency sonar, *etc*.) have the potential to disrupt or injure sea turtles in the area. In-water military maneuvers involving explosives and/or active sonar may potentially harm sea turtles in all life stages, but information on the scope and extent of the impacts is not well known (NMFS and USFWS 2023; Ciminello *et al.* 2012). Like other permitted activities, the military is expected to report observed takes but total takes are usually estimated based on estimations of density and abundance. Military training activities are permitted and subject to both NEPA, MMPA and ESA oversight/consultation/review. Moreover, the DNNB and JEBFT have Integrated Natural Resource Management Plans in place that provide protections for sea turtle nests, nesting females and hatchlings that are reviewed annually by state and federal natural resource agencies.

Inshore and offshore energy development

Effects of wind energy development, gas and oil exploration, and drilling and production activities on sea turtles is a concern. The Deepwater Horizon (DWH) oil spill and the effects of oil, dispersant, burning, and clean up on sea turtle mortality, fitness, nesting, *etc*. is still being determined (DWH Natural Resource Damage Assessment Trustees 2016; Lauritsen *et al.* 2017; Mitchelmore *et al.* 2017; Stacy *et al.* 2017; Frasier *et al.* 2020; Shaver *et al.* 2021). Excessive noise pollution, increased vessel traffic, increased recreational fishing, sediment and oceanographic changes, potential contaminants entering the ocean environment, and offshore lighting are just some of the potential impacts that may result from the construction and operation of offshore wind (OSW) and gas and oil exploration and production infrastructure. Examples of energy development activities and infrastructure include installation and operation of pipelines used to transport fossil fuels from the offshore platform to land, construction and operation of drill platforms, drill ship anchoring systems, construction and operation of wind turbines, installation of subsurface transmission lines from the turbines to land, and wind turbine anchoring systems. The installation of underwater infrastructure in migratory corridors will likely attract prey, which may disrupt sea turtle migratory behavior, but could also encourage epibiota and benthic invertebrates that turtles feed on. In addition, cumulative impacts from multiple inshore and offshore energy facilities in NW Atlantic waters could have a significant range-wide impact on sea turtles which should be taken into account during the siting and design phases. The Regional Wildlife Science Collaborative for Offshore Wind (RWSC) has developed a Science Plan which describes recommendations for data collection, research, and coordination for environmental monitoring of OSW following more than a year of information gathering and discussion with subject matter experts (RWSC 2024). The RWSC sea turtle recommendations included a need for increased baseline data collection and collaborative investigations into shelf-wide sea turtle distribution and abundance, and to investigate behavioral responses to construction (*e.g.*, pile driving, vessel activity) and operational activities (*e.g.*, electromagnetic

fields from cabling, vessel activity, and reef effects from biofouling on turbine supports). The Sea Turtle Chapter of the Science Plan also called attention to the lack of state funding for states such as the Commonwealth of Virginia which do not have state utilities which own and manage the transmission grid and thus have no ability to negotiate powersharing agreements that could provide funding for offshore wind research. The Plan encouraged federal funders to bridge the funding gap among states without these lucrative powersharing funds. Dominion Power began installation of a 179 turbine Coastal Virginia Offshore Wind (CVOW) development in May 2024 which is expected to be completed in 2026. In spring 2024, Dominion Power acquired development rights for a second lease area off Virginia for future development and acquired a northern North Carolina wind lease area, Kitty Hawk Wind, the onshore cabling for which will make landfall in southern Virginia Beach. Of the three projects, only CVOW has an approved Construction and Operation Plan and Final Environmental Impact statement. There are no mitigation requirements for sea turtles in the plans, but CVOW is expected to monitor for sea turtles during vessel and construction operations.

Navigational channel and beach replenishment dredging

Hopper dredging is a major source of mortality for sea turtles in channels along the southeast coast of the U.S. (Joyce 1982; Dickerson *et al*. 1991; Dickerson *et al*. 2004). Harbor and channel dredging can directly affect sea turtles by either entraining sea turtles in the dredge's draghead as it moves across the seabed or by support vessels striking turtles. Indirect effects of hopper dredging include degrading habitat by altering benthic foraging areas, decreasing the number and abundance of prey species, and/or reducing water quality by increasing turbidity and releasing potential contaminants into the water column (Dickerson *et al.* 2004; Ramirez *et al.* 2017). The most documented effects of dredging involve direct injury to and mortality of turtles, and this threat is discussed more extensively under the second factor.

When sand is dredged for beach renourishment, it is sometimes collected as part of existing dredging projects and other times mined for the sole purpose of renourishment. The risks associated with hopper dredging apply to sand mining and are similarly regulated. There are a number of beaches in South Hampton Roads that have and will continue to request renourishment. Some areas are renourished as needed and as funding allows, and others are renourished on a regular schedule based on special taxes.

In Virginia, most navigational dredging using hopper dredges is initiated as a federal action through the Army Corps of Engineers (ACOE). These large projects are permitted and reviewed by federal agencies, and the state has the ability to comment. Municipalities can initiate dredging in smaller water bodies and, depending on the location and water body these are regulated by state agencies.

Noise pollution from sources other than military activities

In-water noise pollution from sources other than military activities (*e.g.,* vessels, marine construction, offshore energy development and operation) may have negative non-lethal effects on sea turtles of all life stages such as alteration of migration routes and avoidance of foraging areas (Lavender *et al*. 2012, 2014; Piniak *et al.* 2012; NMFS and USFWS 2020, 2023;). A study on ambient noise levels near the mouth of the Chesapeake Bay and surrounding waters showed that sea turtles are dealing with very high levels of ambient noise in many of their prime mid-Atlantic estuarine habitats (Bort and Barco 2014). Moreover, noise levels increased with the amount of human activity during certain times of year, particularly at the height of the summer recreational boating season. The addition of anthropogenic noise in sub-surface waters, on top of natural levels to which sea turtles have likely adapted, may automatically push ambient levels to the point where they may actively select quieter habitats over ones that may be better suited to their ecological needs (Samuel *et al.* 2005; Bort and Barco 2014). As marine construction associated with OSW increases, use of mitigation measures during the noisiest phases of construction will be employed as part of the federal permitting process. Effects of OSW operational noise on sea turtles is unknown (RWSC 2024).

2) Excessive mortality or serious injury from commercial, recreational, scientific, or educational activities

In contrast to the previous factor which focused on change in habitat, this factor addresses activities that can directly harm sea turtles. It is inevitable that some sea turtles will be affected by the human use of habitats on which they depend. Some of the highest priority threats that directly affect sea turtles include commercial and recreational fishery bycatch, vessel strikes, hopper dredging, light pollution, marine debris ingestion, and oil pollution (Gleason *et al.* 2020; Lutcavage *et al.* 2017; Pham *et al.* 2017). More recent threats likely to directly affect sea turtles include inshore and offshore energy development and effects of climate change that directly impact animals as opposed to climate change effects on sea turtle habitat (Patricio *et al.* 2021; Hawkes *et al.* 2007; Hays *et al.* 2003).

In this section, we discuss takes of sea turtles in relation to human activities. The ESA defines a take as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Under the ESA, a take has the same meaning whether the turtle is discovered alive and apparently unharmed, alive and injured, or dead. Certain federal actions are legally allowed to take turtles under Section 7 of the ESA, and Biological Opinions are issued specifying the number and type of takes allowed under the provisions of the Opinion. Some activities require independent Protected Species Observers (PSO) to document and report takes. Shifts in both turtle behavior and distribution (*e.g.,* recent nesting activity in the Chesapeake

Bay, turtles occurring in Virginia waters earlier and leaving later in the year, *etc*.) combined with changes in human activities that likely affect sea turtles (*e.g.,* the deployment of new fishing gear or gear configurations, changes in dredging locations, gear or techniques, emerging forms of energy development, new vessel sizes and design, *etc*.) requires careful surveillance of how these co-occurring alterations are affecting the overall recovery of sea turtle populations.

Documenting non-anthropogenic mortalities, injuries and, in some cases takes, is one form of surveillance that has been on-going in Virginia since 1979 by way of the Virginia Sea Turtle Salvage and Stranding Network (VSTSSN). From 2008 to 2022, the VSTSSN responded to an average of 250 (range 173 – 325) sea turtle strandings per year (VAQS *unpublished data,* May 2023).

Two threats, fishery and vessel interactions, may have been responsible for at least 41% (221 of 538) of sea turtle strandings in 2021 and 2022. In Virginia, turtles that died from acute vessel or fishery interaction were more likely to be healthy and in better body condition than those that died from other causes, suggesting that these types of interactions are removing otherwise healthy turtles from the population (Barco *et al.* 2016). Lastly, recent work on identifying mortality from decompression sickness, which occurs when turtles captured in deep water nets are pulled up too fast, released immediately, and die 24 to 48 hours later, suggests that fishery-related mortality associated with gear set in deeper water (>30m) may be considerably higher than previously observed (Garcia-Párraga *et al.* 2014).

Commercial fisheries

Historic stranding, entanglement, and observer data from Virginia indicate that sea turtles may experience serious injury and/or mortality through encounters with the following gear types: gillnet, pound net, longline, crab and whelk pot, and trawl gear (VAQS *unpublished data,* May 2023; MRC *unpublished data,* September 2024). Although both recreational and commercial crab pot and gillnet gear are deployed in Virginia, net and pot gear recovered with identifying buoys from stranded and entangled turtles was exclusively identified as commercial gear. There is also potential for interactions with other net gear, including purse seines and haul seines, as well as dredge gear for mollusks and crustaceans. Structures associated with aquaculture could also cause entanglement or entrapment.

From 2008 to 2022 fishery interactions were reported with several gear types including pound nets (all turtle species), commercial crab and whelk pots (loggerhead and leatherbacks), hooks (J-hooks, circle hooks, and treble hooks) consistent with both recreational angler (all hard-shelled species) and commercial long line gear (loggerhead), gill net (all hard-shelled species). In 2021 and 2022 reporting protocols and human interaction categories for sea turtle strandings changed. Thus, the discussion of stranding data below applies to 2021 and 2022 data. In 2021 and 2022, 38% (n=207) of strandings in Virginia showed obvious signs of human interaction thought to have contributed to the stranding event (*i.e.,* not healed vessel and fishery interaction

scars or incidental debris ingestion), primarily fishery interactions (n-110) and vessel strikes (n=95; Table 1).

Table 1. Human interaction categories for stranded sea turtles in Virginia in 2021 and 2022. All fishery interactions were reported by recreational anglers, most of which (n=90) occurred on commercial fishing piers.

Human interaction category	Green	Kemp's ridley	Leatherback	Loggerhead	Unidentified	Totals
Caught on hook/line by recreational angler	3	79	0	9	18	**109**
Found in dredge equipment	0	2	0	9	0	**11**
Vessel strike (probable & suspect)	4	33	1	57	0	**95**
Unidentified trauma (vessel or dredge)	1	2	0	4	0	**7**
Entangled (monofilament twine)	0	1	0	0	0	**1**
Other	1[1]	0	0	1[2]	0	**2**
Totals	**9**	**117**	**1**	**80**	**18**	***207***

[1]The green turtle was netted by a recreational angler for personal consumption.
[2]The loggerhead turtle was entrapped in a marine construction project that escaped unharmed.

Among the 538 total strandings reported in Virginia in 2021 and 2022, nine loggerheads, 80 Kemp's ridleys, and three green turtles had ligature marks on their bodies, attached or ingested gear, or other evidence of interactions with recreational fishing gear (Table 1; Costidis *et al.* 2022; Epple *et al.* 2023). It should be noted that estimating the frequency of fishery interactions by way of the stranding record is complicated by the fact that ligature marks and other evidence of entanglement are not always discernible on the thick skin of sea turtles. As such, determining the root sources of fishery interactions continues to elude state and federal management agencies.

The picture of fishery interaction with sea turtles from the state-run observer program differs from stranding data. The observer program was developed in 2016 to monitor Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). During the 620 observed trips conducted by the MRC Protected Species Observer Program from 2016 to August 2024, the program recorded a total of 13 sea turtle takes. Six takes occurred on the ocean side of the Eastern Shore in gill nets, four occurred on the ocean side of Virginia Beach in beam trawls, two were observed in gill nets in the Chesapeake Bay, and one in a gill net in the James River. The takes included six loggerhead, six green, and one Kemp's ridley turtle (MRC *unpublished data,* September 2024). Although the overall take rate appears to be low, seven takes occurred in gill nets observed off the eastern shore of Virginia in May 2024 and four in beam trawls targeting shrimp during a three-week

period from late October to early November of 2023. This significant increase in takes is concerning and warrants closer examination and analysis.

All federally managed fisheries are monitored by federal fishery observers who document catch of targeted species as well bycatch of protected species and other non-target species. Federal fishery observers are assigned to vessels operating in either state or federal waters. The level of coverage is based on gear type, region, and mesh size (*e.g.*, anchored gillnet with >7 inch stretch mesh, fishing in the Mid-Atlantic). From 2013 - 2022, there were at least 28 sea turtle takes recorded by federal observers in state and federal waters from Cape Lookout, North Carolina to the Virginia/Maryland border (NOAA Fisheries Northeast Fisheries Observer Program, *unpublished data,* April 2023). The takes included all sea turtle species that occur in Virginia. Most of the takes (n=23) occurred in the first five years while the remaining five occurred in the second five-year period. Takes were documented in all months except April, July, and August with most observed from November through January, suggesting they may have occurred in the southern region of the coverage area. Murray (2023) reported that from 2017 to 2021, a total of 44 loggerhead, 46 Kemp's ridley and 15 leatherback takes were observed in small mesh gillnet gear in the Southern Mid-Atlantic Management area which extends from Delaware through North Carolina. This level of take was a significant decline from the previous five-year period but no cause of the decline was suggested (Murray 2018). There were also an estimated 155 sea turtle takes in the Mid-Atlantic sea scallop fishery from 2001-2019 with 53 takes confirmed as mortalities (Murray 2021).

Recreational fisheries

While federal and state regulations address some concerns posed by commercial fishing, interactions with recreational fisheries, especially the hook and line fishery, remain largely unreported, unregulated, and unaddressed. Rose *et al.* (2022) characterized recreational hook and line sea turtle bycatch in Virginia between 2014 and 2018. During that time, 250 turtles (162 Kemp's ridley, 45 loggerhead, 4 green, 39 unidentified turtle species) were reported caught on hook and line gear, of which 94% were hooked by anglers fishing from commercial piers. Most turtles interacted with baited hooks that were either bitten or swallowed. The remaining 25% of turtles were hooked externally in the flippers, neck or carapace or were entangled in fishing twine without being hooked. Many turtles recovered during the study either had multiple hooks from different interactions or were recovered more than once in the same year or in subsequent years suggesting seasonal residency near piers or habituation to feeding from baited hooks. The monitoring of take by recreational anglers along with outreach efforts that instruct anglers how to respond to and report hook and line captures that started in 2014 are still on-going in Virginia (Barco *et al.* 2015; Rose *et al.* 2022).

Other recreational gear, such as recreational crab pots, may also negatively affect sea turtles. Because recreational crab pots are often tied to docks and bulkheads or deployed in smaller and shallower waterways than commercial pots, incidental take may be nominal. In Virginia,

commercial crab pot gear must be marked with the fisher's permit number, whereas recreational gear requires no such marking. This allows investigators to assign Virginia pot interactions to either the commercial or recreational fishery with some degree of accuracy. To date, no crab pot buoys recovered from sea turtles in Virginia were identified as recreational gear.

Vessel strikes

Propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 15% of all stranded loggerheads in the US Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post- or ante-mortem (NMFS and USFWS 2020, 2023). Recent research in Florida dispels the likelihood that vessel strike injuries among decomposed turtles are mostly post-mortem (Foley *et al.* 2019). In Virginia, evidence of vessel interactions has been observed among all species of sea turtles, and the number of stranded turtles diagnosed with injuries consistent with vessel strike remains high. In 2021 and 2022 alone, 108 strandings (68 loggerheads, 35 Kemp's ridleys, four green turtles and one leatherback) showed evidence of vessel strikes (Costidis *et al.* 2022; Epple *et al.* 2023). Twenty percent of all reported strandings in Virginia exhibited injures consistent with vessel strikes and it is the second most commonly assigned cause of stranding behind fishery interactions (VAQS *unpublished data,* May 2023). The number of post-mortem strikes in the Virginia stranding record is unknown, but gross necropsy and histopathology conducted on carcasses have confirmed pre- and peri-mortem strikes in all of the 22 samples analyzed as of September 2024 (VAQS *unpublished data*, September 2024; B. Stacy *pers. comm*.).

Santos *et al.* (2018) identified the lower Chesapeake Bay as a hot spot for vessel strike mortality during the month of June when high turtle presence and high levels of recreational boat traffic coincide. In 2021 and 2022, seasonal patterns of vessel interactions among stranded turtles in Virginia exhibited the typical spring peaks in May and June and remained elevated August through October with a surprisingly low number in July. Although the exact size of a propellor that hits a turtle is difficult to identify, marks on carcasses that range from several centimeters in length to complete bisection of large individuals suggest that both large and small propellors on vessels of varying sizes have caused serious injury and mortality in the region (VAQS *unpublished data,* May 2023). Virginia has high numbers of recreational vessel registrations in coastal and bayfront counties, with more than 33,000 vessels greater than 20 feet in length registered in 2024 as of November (DWR *unpublished data*, November 2024). The number of recreational vessels in these counties show an increasing trend since 2016, in all length categories with 99% of vessels (32,973) between 20 and 49 feet in length.

Because some debilitated turtles become abnormally buoyant and may have trouble diving, there has been some speculation that vessel-struck turtles are often compromised prior to the strike. Analysis of body condition and pathology reports from fresh dead turtles stranded in Virginia indicates that turtles with acute vessel strike injuries are significantly less likely to have

underlying health conditions and are in similar body condition to those considered healthy in the wild population (Barco *et al.* 2016).

Use of hopper dredges for channel maintenance and beach replenishment

Hopper dredges, which are known to take sea turtles, are used for large scale and deep water dredging which includes most federally permitted navigational channel dredging in Chesapeake Bay and the ocean waters of Virginia as well as sand mining for beach renourishment. According to the US Army Corps of Engineers' (USACOE) Operations and Dredging Endangered Species System (ODESS, accessed May 15, 2024), at least 78 lethal dredge-related sea turtle takes occurred in Virginia from 2000 through 2023, 88% of which were loggerheads. According to ODESS, most of the dredge takes observed in Virginia occurred in Chesapeake Bay navigational channels where the majority of dredging has occurred. Annual lethal takes since 2000 along the Atlantic US coast reported in ODESS vary widely from one take in 2010 to 41 takes in 2017 with a mean of 21 per year for the 24-year period. Numbers of takes are affected by dredging effort, location, and time of year. Comparing dredge takes in Virginia since 2000 to other Atlantic coast states with greater than 100,000 cubic yards of material removed by hopper dredge, Virginia had a relatively low number of takes but had the second highest rate of take based on dredge effort measured as cubic yards of material removed (Table 2; calculated from ODESS, accessed May 15, 2024). ODESS is a relatively new system and not all data have been entered and verified for accuracy. Number of takes is likely to be accurate since it is entered by PSOs, but the total amount of material removed may have been estimated by dredge companies or the USACOE. In analysis that resulted in the data presented in Table 2, lethal takes from projects with zero or null entered in the material removed field were not included in the take rate calculations (*e.g.*, take per 100,000 cubic yards of material) and instead were listed as additional takes in the final column. Regarding the calculations for the high take rates in Virginia, it is important to note: 1) Chesapeake Bay takes that occurred in shipping channels are often assigned only to Virginia despite some occurring in Maryland waters possibly inflating the rate for Virginia; and 2) No Virginia projects from 2015-2023 had information on project effort (*i.e.*, cubic yards of material removed) entered into the ODESS database and thus were not included in the calculations. If rates have been reduced by increasing the efficiency of dredge operations in recent years, that would not be reflected in the Virginia data (S. Reinheimer, Norfolk Division USACOE *Pers. Comm*., Nov. 22, 2023). A more thorough examination of hopper dredge-related take and effort data in Virginia is warranted. If the take rate from ODESS data are accurate, then Virginia's take rate in a temperate climate where sea turtles are not present year-round may rise even higher given the substantial volume of navigational channel widening and deepening planned through the remainder of this decade (NMFS 2018). The ACOE has self-imposed restrictions from September 1 through November 14 for avoiding times of year when takes are thought to be most likely. These restrictions were imposed following dive behavior studies in the early 2000s which found that in the Chesapeake Bay, turtles spent more time below the surface and near the bottom of the water column in the fall than at other times of the year potentially increasing the risk of dredge takes at a time when they were likely to be moving toward the

mouth of the Bay for fall migration (Mansfield and Musick 2004; Mansfield *et al.* 2009). Of the 78 lethal sea turtle takes reported in Table 2, take details were provided for 47 takes (41 loggerheads, and 5 Kemp's ridley and 1 green turtle; Table 2). The green turtle take was in February and may have been carried on the dredge from its previous job in South Carolina (S. Reinheimer, *pers comm.*). Of the remaining 46 takes, 85% (n=40) occurred from May through August with July having the highest number (n=14; Figure 13). Without data on dredge effort during these months, it is difficult to interpret the differences in monthly takes, but further analysis may provide possible mitigation measures.

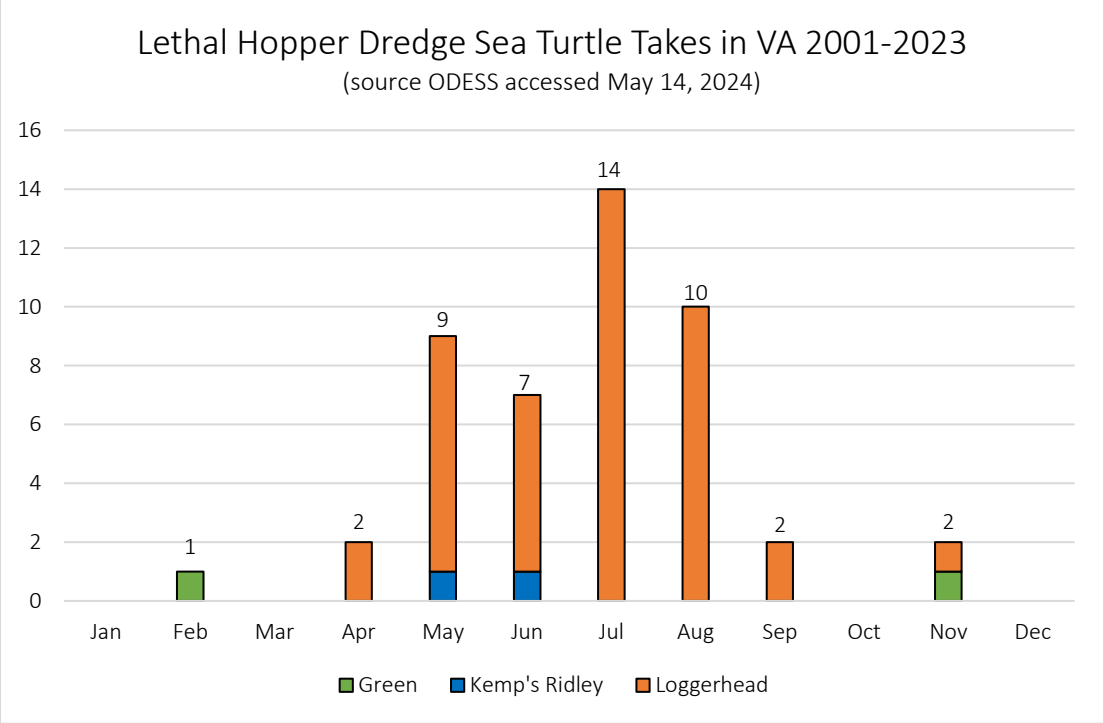


Figure 13. Monthly frequency of lethal sea turtle takes in Virginia by hopper dredge from 2001-2023 for 47 of 78 reported takes for which take details were available. The information in this table was downloaded from the US Army Corps of Engineers' Operations and Dredging Endangered Species System (ODESS) on May 14, 2024.

In most cases, a NOAA Fisheries approved PSO must be on board a hopper dredge any time it is operating to detect interactions with sea turtles. While it is likely that not all sea turtles killed by dredges are detected by onboard PSOs, onboard monitoring is considered the best method for estimating the level of dredge-related takes. In Virginia, however, there is a threat of unexploded ordinance (UXO) in the substrate which poses a human safety concern if suctioned into the draghead and/or deposited in the hopper. To keep UXO from being entrained, small mesh UXO screening is placed on the underside of the draghead where it makes contact with the substrate. The screening only allows small sized material to pass through the screen meaning that lethal takes must be identified from small turtle parts such as soft tissue (*e.g.*, intestine, muscle, *etc.*) or small, fragmented pieces of shell or bone, making detection by an observer less likely if the screen is installed properly (Ramirez *et al.* 2017). Under these circumstances, the volume of

material removed from the action area serves as a proxy for monitoring actual take (*i.e.,* an estimate of one sea turtle entrained for every 320,000 cubic yards of material dredged; NMFS 2012, 2018). This estimate provides a proxy for monitoring the number of incidental takes during hopper dredging operations when UXO screening is in place because the UXO screen at the bottom of the draghead precludes direct observations of impingements. Dredges working in most of the commercial shipping lanes of Chesapeake Bay and in the ocean approach to the Bay use UXO screening, making accurate take estimates using PSOs difficult. For projects using UXO screening, NOAA Fisheries does not require PSOs. Regardless of NOAA requirements, the

Table 2. Total number of lethal sea turtle takes reported during hopper dredging operations from Atlantic Florida to Virginia, 2000-2023. No Takes were recorded in Maryland, New York and Maine, less than 5 takes were recorded in Delaware and New Jersey. The information in this table is from the dredge project summary data from the US Army Corps of Engineers' Operations and Dredging Endangered Species System (ODESS) and was, accessed on May 14, 2024. Note that ODESS is a relatively new system and historic accuracy of Total Cubic yards of material has not been verified for all states including Virginia.

State	Lk	Cc	Cm	Dc	All turtle takes	Cubic yds material removed	Takes/100k cu yd	Additional lethal turtle takes [1]
FL[2]	4	145	53	0	202	82,495,664	0.24	8
GA	74	190	42	0	306	102,750,681	0.30	38
SC	7	38	2	0	47	50,122,059	0.09	19
NC	14	49	11	1	75	80,032,575	0.09	4
VA	5	41	1	0	47	18,866,978	0.25	46
Total	**104**	**463**	**109**	**1**	**677**	**334,267,957**		**115**

[1]Projects for which no data was entered in the cubic yards of material removed field (47% of VA projects, 17 of 36, were missing material removed data)
[2]Atlantic coast only

Norfolk District of USACOE requires PSOs for other types of data collection. Thus, despite the use of UXO screens and use of cubic yards of material moved being used a proxy for observed takes, PSOs have recovered and reported sea turtle takes on projects where UXO screens were in use (S. Reinheimer, USACOE *pers comm*.). The number of observed takes for projects where takes were theoretically difficult to detect raises questions about the proper use of UXO screening, its effect on the ability for takes to be observed, and on how the total number of takes should be calculated (observed and unobserved).

Marine debris

Sea turtles, especially those inhabiting oceanic habitats during the early stages of their lives, ingest a wide variety of debris items, such as plastic bags, raw plastic pellets, plastic and Styrofoam pieces, tar balls, balloons and monofilament line (Witherington 2002; Barco *et al.* 2015; Kühn *et al.* 2020; Warner *et al.* 2020; NMFS and USFWS 2023). In addition to marine debris ingestion, animals can become entangled in debris (Kühn *et al.* 2020; Warner *et al.* 2020).

At least one live stranded green turtle in Virginia suffered from an esophageal blockage caused by numerous pieces of debris including fragments of hard and soft plastic pieces, Styrofoam, and latex balloon (Walton *et al*. 2009). The ingestion of balloons with ribbon attached caused the death of at least one loggerhead and one Kemp's ridley turtle. A live Kemp's ridley was found severely entangled in a woven Tyvek seafood bag and had to undergo flipper amputation to remove the bag, and single use weather balloons entangled and killed at least two Kemp's ridleys (VAQS *unpublished data,* May 2023; Daniel *et al*. 2023). In many cases, however, debris ingestion is not the primary cause of a stranding. This is because effects of debris ingestion can be either lethal (*e.g*., direct obstruction of the gastrointestinal [GI] tract) or sublethal (*e.g*., absorption of toxic byproducts, reduced absorption of nutrients across the GI wall because the amount or size of plastic, especially plastic film such as thin bags and wrappers, blocks absorption; Balazs 1985). While small pieces of ingested plastic may pass through the digestive system without creating an obstruction, sublethal effects are currently unknown. Leatherbacks appear to be especially susceptible to GI tract blockage resulting from ingested plastic bags or plastic film because they may resemble jellyfish, a favorite prey item, when floating in the water. The ingestion of plastic or similar debris by other sea turtle species inhabiting the neritic zone is relatively rare but has been documented in the stranding record at a low level of regularity (Warner *et al.* 2020). Out of 278 GI samples collected from stranded loggerheads in Virginia, nine (3%) contained visible plastic debris (>0.5 cm), and of the 81 Kemp's ridley GI tracts sampled, six (7%) contained plastic or latex debris (Seney *et al.* 2014; VAQS *unpublished data,* May 2023). Presence of microplastics was not determined. Persistent marine debris in convergence zones and drift lines where young sea turtles congregate may expose them to debris ingestion and entanglement (Witherington 2002). Hatchlings emerging from their nests may become entangled in marine debris washed up on nesting beaches, which can prevent them from reaching the ocean (NMFS and USFWS 2020, 2023).

Microplastics are an emerging concern for all marine species but can seriously affect post-hatchling sea turtles. Eastman *et al.* (2020) described microplastics found in the GI contents of post-hatchling loggerhead turtles that stranded in Florida. Of the 42 GI tracts examined, over 90% (n=39) contained plastic fragments less than 5 mm in length (*i.e.,* microplastics), and the number of microplastics found in a single turtle ranged from one to over 250. The ingested microplastics were mixed in with natural prey items indicating they were likely floating in the surface biofilm where neonatal turtles are known to feed. A global study of stranded sea turtles from different regions, including North Carolina, revealed all GI tracts examined had microplastics present (Ducan *et al.* 2019). Considering the results in these studies, it is likely that microplastics are a concern for turtles in Virginia although no specific studies have been conducted.

3) Predation and disease

Natural predation and disease are expected in any wild animal population but occurrences of harmful algal blooms, invasive species, range expansion due to climate change, and the occurrence of marine viruses, bacteria, parasites, and other disease-causing agents are increasing worldwide. Human exploitation of terrestrial and marine resources has greatly changed the food chain and predator/prey relationships are continually in flux. This factor addresses how these changes may affect turtles in Virginia.

Predation

Sea turtle nest predation in Virginia appears to be minimal compared to levels observed in states to the south where nesting occurrences are considerably higher. Over 230 nests have been documented in Virginia, and, of those, only five showed evidence of fox predation (unknown species), two were partially depredated by Atlantic ghost crabs (*Ocypode quadrata*) and one nest was partially depredated by a raccoon (*Procyon lotor*; DWR, *unpublished data*). This may be due in part to the fact that there are so few sea turtle nests present at any given time and naive predators have not learned the cues needed to find the eggs. Moreover, every nest that is discovered is either covered by a 2 in. x 4 in. wire mesh screen or a partially buried 5-sided cage made of the same material to deter ground predators from digging into the nest. On-going predator management efforts on the barrier islands, specifically on Assateague Island where most of the nesting activity occurs along the island chain, may also be contributing to the lack of predation by mammalian predators. Placing screens or cages over nests are not effective deterrents against ghost crabs which can access the nest cavity by burrowing under the screen or cage. Despite the lack of any protection against ghost crabs, they mostly seem to ignore the few nests that are laid on Virginia's beaches. This may be attributed to the fact that there is plenty of other food the crabs can locate without much difficulty.

Raccoons, foxes, ghost crabs, and various species of gulls are all known predators of sea turtle hatchlings on land. Nests hatching on the southern mainland beaches often have volunteer nest sitters present who count the number of hatchlings that emerge from the nest cavity, keep the public a safe distance from the nest and hatchlings, and make sure the hatchlings find their way to the ocean safely without inference from potential predators. Nests that hatch on the barrier islands typically do not have nest sitters present; as such, hatchlings are exposed to various levels of predation as they crawl towards the ocean. Once hatchlings enter the ocean, they are extremely vulnerable to predatory fish as they swim towards the north Atlantic gyre (Witherington and Salmon 1992).

Disease and parasites

Sea turtles suffer from a variety of health problems including infections caused by bacterial, viral, parasitic, and fungal agents (George 2017; Innis and Staggs 2017; Manire *et al.* 2017; NMFS and USFWS 2020, 2023), as well as loggerhead turtle chronic debilitation syndrome,

which is characterized by emaciation, lethargy and heavy barnacle load (Stacy *et al.* 2018). Sea turtle fibropapillomatosis, a disease which, in advanced stages, causes cauliflower-like tumors on sea turtles, sometimes severe enough to affect the turtles' ability to see, eat, and swim, reached epidemic proportions in some wild green turtle populations (Patrício *et al.* 2012; Seminoff *et al.* 2015; Manes *et al.* 2022) and has now been documented in loggerheads and Kemp's ridleys as far north as Massachusetts, including cases in North Carolina where loggerheads tested positive for the virus but were tumor-free (Page-Karjian *et al.* 2015, 2021). Diseases documented in turtles that stranded in Virginia from 2017 to 2023 have been dominated by lung disease from a variety of causes (VAQS *unpublished data,* May 2023*;* A. McNaughton, DVM *pers. comm* July 2023). While neither loggerhead turtle chronic debilitation nor fibropapillomatosis have been definitively detected in Virginia, live, debilitated loggerheads have become more prevalent in the Virginia stranding record since the mid-2010s (McNaughton *et al.* 2022), and there had been very little surveillance for fibropapillomatosis of turtles stranded in Virginia and cryptic cases such as those in North Carolina could have occurred.

Harmful algal blooms (HABs)

Harmful algal blooms (HABs) in the US are becoming more toxic and are expanding into new areas of the country. Moreover, the number of toxic species and toxins are increasing as well (Anderson *et al.* 2021). Green, Kemp's ridley and loggerhead turtles have all been affected by brevetoxin from HABs on the gulf coast of Florida (Capper *et al.* 2013; Fauquier *et al.* 2013; Perrault *et al.* 2014). Although the organism that produces brevetoxin, *Karenia brevis*, has not been documented in Virginia HABs, increasing presence of other toxic algal species have been documented in the lower Chesapeake Bay (Li *et al.* 2020; Lin *et al.* 2018). Toxins produced during HAB events affect animals through respiration, ingestion, or absorption and can affect breathing, digestion, or cognition depending on the neurotoxin, pathway into the body, and level of exposure. HABs have caused debilitation and death in green and olive ridley turtles off the Pacific coast of El Salvador (Amaya *et al.* 2018). Extensive, persistent HAB events that produce toxins can cause mass sickness and mortality in a number of marine species similar to those generated by chemical and fossil fuel spill events and require preparedness and training for appropriate, safe response.

Even when toxins produced during a HAB event do not directly affect turtles, the blooming algae can cause the water to become anoxic by robbing it of oxygen when it dies and decomposes. As air breathers, sea turtle respiration is not directly affected by anoxic conditions, but low dissolved oxygen levels in the water have a significant impact on fish and lungless marine organisms, including many of the lower trophic species on which sea turtles feed (Jackson *et al.* 2001; NMFS and USFWS 2023). Moreover, HABs increase water turbidity and block sunlight which can result in seagrass die-offs. Seagrasses are a food resource for the herbivorous green turtle, provide habitat for other sea turtle prey species, absorb wave energy and nutrients, produce oxygen, and improve water clarity. The loss of submerged aquatic vegetation can lead to altered

ecosystem functions, which in turn can affect sea turtles, but to what degree remains unknown (Jackson *et al.* 2001; Milton and Lutz 2003).

In Virginia, VIMS researchers are addressing HABs in Chesapeake Bay by investigating the toxicity of various HAB organisms and their effects on local shellfish, submerged aquatic vegetation and specific estuarine habitats.

4) Other natural or human-induced factors affecting sea turtles

These factors include more subtle, often indirect threats to sea turtles and their habitats. For example, cumulative impacts from low levels of contaminants such as heavy metals, fossil fuels, fire retardants, polyfluoroalkyls (PFAs), and chemicals found in prescription drugs, dyes, and optical brighteners may not directly kill, injure, or sicken animals but can affect overall fitness by interfering with reproduction, immunity, and/or growth and development. Moreover, when combined with other stressors such as low dissolved oxygen, increased background noise, and low prey abundance or poor prey quality, the presence of contaminants can have compounding effects on local populations. The Chesapeake Bay Preservation Act of 1988 is a critical element in the fight to mitigate nonpoint source pollution and improve water quality in Chesapeake Bay. Under the Bay Act framework, the Chesapeake Bay Preservation Area Designation and Management Regulations provide the required elements and criteria that local governments must adopt and implement in administering their Bay Act programs. These include designating Chesapeake Bay Preservation areas; zoning and ordinance measures to protect the quality of state waters; assessment and limitation of development impacts on Bay waters. The Chesapeake Bay Preservation Program is administered by the Virginia Department of Environmental Quality.

Climate change

Climate change impacts on sea turtles, specifically ocean warming and sea level rise, are likely to become more apparent in future years (Hawkes *et al*. 2007, 2009; NMFS and USFWS 2020, 2023; Van Houtan and Halley 2011; Patrício *et al*. 2021). There is substantial new evidence that suggests observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, ocean acidification, and circulation. These changes include shifts in the range, distribution, and abundance of submerged aquatic vegetation, plankton including gelatinous macroplankton, invertebrates and other marine organisms (IPCC 2007; Orth *et al.* 2017; Hammer *et al.* 2018) which, in turn, will affect the distribution and abundance of sea turtles and their prey (NMFS and USFWS 2020 2023). The Virginia strandings data already reflect changes in the timing of the annual arrival and departure of loggerhead and Kemp's ridley turtles. Comparing the first springtime dates of sea turtle strandings for five-year increments from 2003 -2022, the first seasonal strandings of both species in the most recent five-year period (2018-2022) occurred an average of approximately 12 days earlier in the spring than 20 years ago (2003-2007; VAQS *unpublished data,* May 2023).

Extended fall occurrence exhibits more interannual variability than spring arrival and may be more impacted by annual weather and storm patterns than long term climactic changes, but the fall weather variability such as warm fall water temperatures (*e.g.*, >60 °F) into November punctuated by significant cooling events is correlated with increasingly consistent strandings of cold stunned sea turtles over the past 20 years (VAQS *unpublished data,* May 2023). In the early and mid-2000s cold stun events occurred every two to five years, but in the past five years, one or more cold stunned turtles stranded in Virginia each year.

In addition to in-water changes associated with climate change, the demand for sand replenishment and the placement of hardened structures on sea turtle nesting beaches to counter the effects of beach erosion are likely to increase in the face of projected sea level rise and more intense storm activity associated with global climate change (Conant *et al*. 2009; Hamann *et al.* 2013; Hawkes *et al.* 2007, 2009; Pike 2013; Patrício *et al.* 2021). See Category 1 "Human caused destruction, modification or curtailment of habitat or range" of this section for further discussion of the impacts of beach renourishment, beach hardening, and dredging. Moreover, sea level rise and the increase in frequency and severity of storm events are significant climate change related threats to sea turtle nesting habitat and nests. In Virginia, the cause of most nest losses and poor hatch success has been attributed to severe storms and frequent and prolonged tidal inundation (DWR, *unpublished data*).

The Commonwealth of Virginia Priority Climate Action Plan (VDEQ 2024) focuses on strategies to: reduce greenhouse gas emissions in transportation sectors; increase energy efficiency in homes, businesses, and institutions; reduce production of greenhouse gasses in agriculture, industry, and energy sectors; and protect and restore high-carbon habitats in Virginia. Various coastal bird species, terrestrial reptile and amphibian species were the focus of Virginia's strategy for safeguarding species of greatest conservation need from the effects of climate change (VDGIF *et al.* 2009). Although sea turtles were not listed in the plan, strategies to preserve ocean beach nesting habitat for shore and waterbirds will positively affect sea turtle nesting habitat as well.

Eutrophication in Chesapeake Bay

Eutrophication in aquatic ecosystems occurs when excessive concentrations of minerals and nutrients, particularly nitrogen and phosphorus become present, which stimulates excessive plant and/or algal growth that can result in harmful algal blooms as discussed above and general habitat degradation such as low dissolved oxygen, increased turbidity, algal overgrowth, *etc.* (NMFS and USFWS 2023). Human activities and population growth are known to accelerate eutrophication by increasing the rate at which nutrients and organic substances enter aquatic ecosystems. Agricultural runoff, urban runoff, failing septic systems, and sewage discharges are common sources of excessive nutrient pollution in the Chesapeake Bay and have resulted in hypoxic (dissolved oxygen concentrations <0.2 mg/L) and anoxic (no measurable dissolved oxygen) conditions (Kemp *et al.* 2005). Chesapeake Bay hypoxia has been linked to bacterial disease in fishes, changes in copepod vertical distribution (to avoid hypoxic water masses which

led to increase predation), and increased mortality of macrobenthic invertebrate communities (Elliott *et al.* 2013; Sturdivant *et al*. 2013; LaPointe *et al.* 2014). Hypoxia in Chesapeake Bay is so pervasive in deeper waters that there is an established dead zone which has precipitated "Daily Dead Zone Forecasts" and an annual "Dead Zone Report Card" (https://www.vims.edu/research/topics/dead_zones/forecasts/report_card/index.php; accessed Sep 5, 2023). Loggerhead turtles, which tend to forage in the deeper waters of the Bay (DiMatteo *et al.* 2022), have likely been affected by changes in the distribution of prey generated by the dead zone. The consequences of persistent eutrophication and the resulting hypoxia in the Bay may represent a growing threat to sea turtles and warrants further investigation.

Trophic changes from fishery harvest and benthic alteration

Selective and intense harvest of marine species by fisheries, coupled with declining water quality due to eutrophication, and changing temperature and salinity associated with climate change may result in significant changes to trophic interactions within an ecosystem. These changes may affect availability of prey for higher trophic species such as sea turtles, and sea turtles may undergo increasing stress due to food-web alterations. Lutcavage and Musick (1985) found that Atlantic horseshoe crabs (*Limulus polyphemus*) were the predominant prey item of juvenile loggerheads in the Chesapeake Bay from 1980-1981. Subsequently, the harvest of Atlantic horseshoe crabs over the next 17 years increased significantly with a peak of nearly 6 million pounds reportedly taken in 1997 (ASMFC 1998). The over-harvest of horseshoe crabs may have led to diet shifts among juvenile loggerheads, from predominantly horseshoe crabs to blue crabs (*Callinectes sapidus*) in the late 1980s and early 1990s, to mostly finfish in the late 1990s and early 2000s (Seney and Musick 2007). The latter data suggest that turtles began foraging in greater numbers in or around fishing gear and/or on discarded bycatch in response to local declines in Atlantic horseshoe crab and blue crab populations (Seney and Musick 2007). The implementation of reduced Atlantic horseshoe crab and blue crab catch limits in the last decade may may have enabled their populations to increase in Virginia to the point where loggerheads are able to return to a more traditional diet. Analyses of GI tract contents collected from 192 stranded loggerheads in Virginia from 2008 to 2012 revealed that over 59% of the turtles foraged on blue crabs and 45% consumed Atlantic horseshoe crabs (Barco *et al.* 2015). Thirty-nine percent of the turtles sampled had large gastropods remains in their GI tracts followed by 32% with fish remains and 5% with elasmobranch (shark, ray or skate) remains. Novel species including several insects were identified in the GI tracts of 81 Kemp's ridley turtles that stranded in Virginia from 2010 through 2013. Blue crab was present in 19% of the samples and constituted 50% of the observed diet within the dataset. When prey presence, number and weight of prey were combined into an index of prey importance, the highest diet importance after blue crabs were for mud snails (20%), spider crabs (14%), bony fishes (5%), hermit crabs (4%), and horseshoe crabs (3%). Mud snail and other small gastropod shells found in GI tracts were counted as gastropods but may have contained hermit crabs when ingested by the turtles (Seney *et al.* 2014; Barco *et al.* 2015). Thus, hermit crabs may be a more important prey item than indicated by the index of importance values. Diet of green turtles stranded in Virginia has not

been studied very intensively but among twelve green turtle GI tracts that underwent examination, a variety of vegetation along with one observation of crab parts was found in their GI tracts (VAQS *unpublished data,* May 2023). Given the rapidity of the observed shifts in diet and the compounding effects of climate change and eutrophication in Virginia's coastal waters, intensive diet studies that incorporate fishery harvest data in the analyses should be conducted at least every 5 to 10 years.

Shoreline development and coastal armoring result in benthic habitat alteration including reduction in quantity and quality of saltmarsh and shallow water habitats that support submerged aquatic vegetation and shellfish (Seitz *et al*. 2006; Gittman *et al.* 2016). Likewise, disturbance by shellfish and finfish aquaculture, stationary and mobile fishing gear, and nearshore breakwaters may have significant effects on marine biodiversity and habitat quality, with the effect of marine biodiversity being generally positive and the effects on habitat quality being negative (Dauer *et al.* 2000). The effects of these potential changes on turtle populations, and specifically on prey abundance and distribution, have not been determined, but are of concern (NMFS and USFWS 2023). Mobile bottom net gear for commercial fishing (*e.g.*, trawls) are banned in Virginia's Chesapeake Bay to preserve bottom habitat, and increased use of bottom lands for clam and oyster aquaculture and improving hard bottom for oyster habitat appear to have improved water clarity and quality over time in the region (Murphy *et al.* 2016; Turner *et al.* 2019).

Contaminants

Field and laboratory studies to determine the effects of petroleum on the development and survival of sea turtle embryos indicate that an oil spill resulting in the contamination of nesting beaches before the nesting season may affect nesting success for a short period, if at all. On the other hand, a spill that occurs during the nesting season may result in extremely low hatch success or cause the abnormal development of hatchlings if washed-up surface oil makes contact with eggs or pools on the top of nests (NMFS and USFWS 2020, 2023). Oil cleanup activities can also be harmful. Earth-moving equipment can destroy nests, containment booms can entrap hatchlings, and lighting from nighttime activities can misdirect turtles and dissuade females from coming ashore to nest (Shigenaka *et al.* 2021).

In-water exposure to petroleum products can be fatal to all life stages of sea turtles. Surface oil and tar balls that collect in oceanic drift lines and in mats of free-floating *Sargassum* are especially dangerous for young, oceanic stage sea turtles actively select and use these convergence areas as developmental habitats (Lutcavage *et al*. 1997; Witherington 2002). Prolonged physical contact with floating oil can occur when turtles become entrained in oil slicks (NMFS and USFWS 2008). This contact can cause significant changes in respiration, diving patterns, energy metabolism, and blood chemistry. Sea turtles may also suffer from esophageal impactions and lesions, inflammatory dermatitis, salt gland dysfunction or failure, red blood cell disturbances, compromised immune response, and digestive disorders (Lutz and Lutcavage 1989; Lutcavage *et al*. 1995; NMFS and USFWS 2020, 2023). The 2010 Deepwater Horizon oil spill

and the subsequent use of dispersants and burning of surface oil impacted all sea turtle species and age classes that occur in the Gulf of Mexico (Frasier *et al.* 2020).

Like with many other species including human beings, contaminants can enter an organism's system in a variety of ways (*e.g.,* external contact, ingestion, inhalation). Little is known about the compounding and confounding effects of non-lethal exposure to a variety of contaminants on sea turtle immune systems, growth and development, reproduction, foraging behavior and other critical functions. Chemical contaminants that may affect sea turtles includes persistent organic pollutants such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), polychlorinated hydrocarbons (PCHs), along with numerous metals, and other chemical classes such as per- and polyfluoroalkyls (PFAs) also known as "forever chemicals" (NMFSUSFWS 2020, 2023). There are emerging concerns about contamination from ingested anthropogenic debris, especially those leached from macro- and microplastics. Long-lived carnivorous species, such as sea turtles, tend to bioaccumulate some of these compounds (Lutcavage *et al*. 1997; Keller 2013). However, I-60 organochlorine concentrations found in sea turtles have been much lower than those found in marine mammals and birds (George 2017), probably due to the much lower metabolic rates of sea turtles. Keller *et al*. (2004) found significant correlations between contaminant levels and a wide variety of biological functions, suggesting, for example, changes in the immune system, liver function, and alterations in protein and carbohydrate regulation could be affected by contaminants in sea turtles. However, the authors cautioned that the correlations suggest, but do not prove, a cause-and-effect link.

Perfluorinated compounds (PFCs) are persistent environmental contaminants. O'Connell *et al.* (2010) examined concentrations of PFCs in juvenile loggerheads from Florida Bay, Florida to the Chesapeake Bay, Maryland. PFC concentrations varied significantly by site, with Maryland and Florida Bay turtles having the highest values. One of the most common PFCs found was perfluorooctane sulfonate (PFOS) despite a decrease in its production and regulatory restrictions that were imposed in the early 2000's. Loggerheads in Maryland had the highest concentrations of PFOS; thus, the Chesapeake Bay is considered a good study area for assessing PFOS health effects on sea turtles, which are largely unknown (O'Connell *et al.* 2010). Using a combination of satellite tracks and contaminant levels in eggs and blood, levels of persistent organic pollutants increase in loggerhead populations as post-nesting females (Alava et al. 2011; Keller 2013) and adult males (Ragland et al. 2011; Keller 2013) move north to forage in mid-Atlantic waters. Differences in contaminant levels in between southern and mid-Atlantic foraging areas was speculated as the cause of this result.

Sea Turtle Conservation Strategy

Sea turtles that occur in the Mid-Atlantic waters of the US are highly migratory and belong to widely distributed populations with complex life histories. As such, policies and protections

provided by any one state should ideally reflect larger, regional collaborative conservation efforts and support, extend, and enhance federal conservation and management The DWR Board adopts federal ESA status and population unit designations via regulatory action on a periodic basis. The DWR follows national sea turtle nest monitoring and management guidelines that are appropriate for Virginia (DWR *unpublished report*s 2017, 2020; September 2024). In addition, the state provides support through grants for a scientifically based Sea Turtle Stranding and Salvage Network administered through the Virginia Aquarium & Marine Science Center Foundation (VAQF) and applies for competitive grant funds to support the Network and sea turtle conservation efforts more broadly. Finally, Virginia's on-going ocean planning efforts and history of regional partnership with the Mid-Atlantic Regional Council on the Ocean (MARCO) provide a foundation for regional cooperation on many of the threats facing sea turtles in the state, such as changing water temperatures, shifting prey distributions, increasingly volatile weather events, habitat degradation, energy development, marine debris, and other sources of pollution.

Below is a conservation outline listing this plan's goals and strategies, followed by the conservation narrative which adds details to the listed strategies, a list of actions that address the strategies, the entity assigned to take the lead on each action in **bold** lettering along with supporting organizations, timelines (where appropriate), and affected habitats. Timelines were classified into three categories: near-term (to be implemented within three years of Plan publication), longer-term (to be implemented between three and eight years of Plan publication), and on-going (regardless of implementation timeline).

Finally, the Conservation Outline includes reference to similar federal conservation and recovery recommendations from the four US sea turtle recovery plans. Note that the format of the plans for the Kemp's ridley, leatherback and green turtles were similar and actions are listed together. Actions in the Loggerhead plan followed a different format and are listed separately.

Conservation Outline

The overarching goal of this plan is to enhance the survival and conserve the habitats of sea turtles in Virginia.

Conservation Goal 1: Maintain a permanent and effective Sea Turtle Stranding and Salvage Network in Virginia

Strategy 1.1. – Establish one or more consistent funding sources to sustain a permanent and effective VSTSSN.

Strategy 1.2. – Establish an Interagency Stranding Event Network (ISEN).

Strategy 1.3. – Establish one or more consistent funding sources to support the operation and maintenance of the Darden Marine Animal Conservation Center (DMACC).

Strategy 1.4. – Integrate Virginia's historical stranding records into the national stranding database.

Actions listed in the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle that align with the Virginia Plan (NMFS and USFWS 2008):

1. Determine demographic parameters, refine population genetic structure, and monitor distribution, abundance, and trends.
   17. Maintain and improve the Sea Turtle Stranding and Salvage Network.

While not directly addressing the actions below, a strong, science-based stranding network provides monitoring and assessment of the following actions:

6. Minimize other causes of disturbance, harassment, injury, and mortality.
   62. Minimize loggerhead bycatch in domestic fisheries using a gear-based strategy.
   64. Develop and implement a strategy to assess, monitor, and minimize effects of trophic changes on loggerheads from fishing and habitat alteration.
   65. Develop and implement a strategy to minimize the effects of marine debris ingestion and entanglement.
   66. Develop and implement a strategy to reduce vessel strikes.
   67. Monitor and minimize mortality from channel dredging activities.

Actions listed in step down outline of the Kemp's ridley (NMFS *et al.* 2011), Leatherback (NMFS and USFWS 1992) and Green turtle (NMFS and USFWS 1991) recovery plans that align with the Virginia Plan:

2. Protect and manage population
   23. Maintain a stranding network

Conservation Goal 2: Identify and mitigate risks to sea turtle populations and habitats in Virginia through cost-effective monitoring, research, and best practices.

Strategy 2.1. – Collect, analyze and compare commercial fishery effort, observed sea turtle takes, and stranding data for state managed fisheries known to or likely to interact with sea turtles.

Strategy 2.2. – Continue to assess trends in sea turtle population demographics in Virginia over time and compare them to trends observed throughout the mid-Atlantic region.

Strategy 2.3. – **Continue to monitor the health, diet, and nutritional status of sea turtles in Virginia.**

Strategy 2.4. – **Continue to monitor sea turtle nesting activity in Virginia.**

Strategy 2.5. –Assess, protect, and/or enhance sea turtle nesting and in-water habitats through engagement with state and regional initiatives and partnerships.

Strategy 2.6. – Incorporate the foraging and habitat needs of sea turtles in the development of or revisions to relevant fishery management plans, regulations, and best practices.

Actions listed in the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle that align with the Virginia Plan (NMFS and USFWS 2008):

1. Determine demographic parameters, refine population genetic structure, and monitor distribution, abundance, and trends.
   12. Monitor nesting abundance and trends by recovery unit.
   13. Monitor in-water population abundance and trends.
2. Assess, monitor, and protect habitats.
   21. Ensure beach sand placement projects are conducted in a manner that accommodates loggerhead needs and does not degrade or eliminate nesting habitat.
   27. Inventory and protect neritic habitats used by loggerheads
   28. Inventory and protect oceanic habitats used by loggerheads.
3. Prevent overutilization for commercial, scientific, or educational purposes.
4. Assess and manage disease and predation.
   41. Reduce nest predation.
   42. Develop diagnostic health assessment protocols and establish baselines for wild populations.
   48. Develop a strategy to recognize, respond to, and investigate mass strandings, disease episodes, or unusual mortality events.
6. Minimize other causes of disturbance, harassment, injury, and mortality.
   62. Minimize loggerhead bycatch in domestic fisheries using a gear-based strategy.
   64. Develop and implement a strategy to assess, monitor, and minimize effects of trophic changes on loggerheads from fishing and habitat alteration.
   65. Develop and implement a strategy to minimize the effects of marine debris ingestion and entanglement.
   66. Develop and implement a strategy to reduce vessel strikes.
   67. Monitor and minimize mortality from channel dredging activities.

Actions listed in step down outline of the Kemp's ridley (NMFS *et al.* 2011), Leatherback (NMFS and USFWS 1992) and Green turtle (NMFS and USFWS 1991) recovery plans that align with the Virginia Plan:

1. Protect and manage habitats

11. Protect and manage nesting habitat
12.Protect marine habitat

2. Protect and manage population
21. Protect and manage nesting population
22. Protect and manage populations in the marine environment

Conservation Goal 3. Promote sea turtle conservation in Virginia through social marketing and information dissemination.

Strategy 3.1. – Promote sea turtle conservation in Virginia through effective social marketing.

Strategy 3.2. – Develop sea turtle educational materials for a variety of audiences.

Strategy 3.3. – Prepare and regularly update permitting guidance documents to assist with the review of proposed human activities that may negatively affect sea turtles in Virginia.

Actions listed in the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle that align with the Virginia Plan (NMFS and USFWS 2008):

7. Facilitate recovery through public awareness, education, and information transfer.
71. Develop and distribute educational materials.

Actions listed in step down outline of the Kemp's ridley (NMFS *et al.* 2011), Leatherback (NMFS and USFWS 1992) and Green turtle (NMFS and USFWS 1991) recovery plans that align with the Virginia Plan:

3. Sustain Education and Partnership Programs 31. Educate the public
32. Develop community partnerships
33. Maintain and develop local, state and national government partnerships

Conservation Narrative

The Conservation Narrative provides an implementation roadmap for the goals and strategies presented in the Conservation Outline. More precisely, the narrative identifies each strategy's (1) justification and need; (2) specific actions and corresponding lead agencies; (3) timeline for completion; and (4) additional resource requirements (*e.g.*, funding, extra staff), as needed. Many of the strategies in this plan rely on the willingness of conservation agencies, academia, and affected stakeholders to weigh actions that affect human beings, wildlife, and ecosystems equally. This approach will require a paradigm shift in management that acknowledges the connection between human and marine ecosystem concerns and emphasizes the need to advance sea turtle conservation and habitat protection while sustaining homeland security and human economic interests, safety, and recreation.

Conservation Goal 1: Maintain a permanent and effective Sea Turtle Stranding and Salvage Network in Virginia

In 1979, VIMS established the Virginia Sea Turtle Stranding and Salvage Network (VSTSSN or Network) to assess and monitor trends in sea turtle mortality within the Chesapeake Bay and coastal waters of Virginia. For over 20 years, VIMS coordinated and managed the VSTSSN and served as the primary repository for Virginia's sea turtle stranding data. In 2002, VIMS began sharing VSTSSN coordination responsibilities with VAQS and by 2009, VAQS assumed the role of VSTSSN coordinator.

Sea turtle stranding and incidental take data from permitted activities such as dredging, marine construction and fishing activities provide the only available index of sea turtle mortality and morbidity available to resource management agencies. All data collected by the VSTSSN are entered into a national stranding database maintained by NOAA Fisheries. That agency has assisted state and federal conservation agencies with the implementation and evaluation of regulations and management strategies for sea turtles along the eastern seaboard.

Maintaining an effective VSTSSN allows for the collection of other types of information that are critical to the management and recovery of sea turtles. For example, health, diet, and nutrition indices are important tools for monitoring the overall health of sea turtle populations and assessing the quality of the sea turtle foraging habitat and food resources in Virginia. Most health and diet data collected in Virginia have been obtained largely by way of the recovery of live turtles incidentally captured in recreational hook and line gear and presumed healthy turtles that recently died from acute trauma or underwater entrapment.

Stranding data also provide an opportunity to monitor changes in sea turtle demographics in state waters. Evaluation of Virginia data have revealed shifts in size and age class proportions, sex ratios, and seasonal occurrences over time. Warming temperatures are likely to produce higher frequencies of female hatchlings due to temperature dependent sex determination during incubation. Increasing numbers of nesting females in slow-to-mature species such as loggerhead and green turtles will not appear on nesting beaches until 30 or more years after hatching but may be observed in stranded and bycaught juvenile turtles much sooner. Likewise, changes in distribution and population size may first be detected as trends observed in stranding data.

Lastly, the effectiveness of a single state stranding network is greatly enhanced when contact with other state sea turtle stranding networks and the national STSSN is maintained over the long term. This involves attending relevant meetings and conferences for the purpose of remaining current with stranding data collection techniques, data reporting and management protocols, and collaborative research and monitoring opportunities.

Strategy 1.1. – Establish one or more consistent funding sources to sustain a permanent and effective VSTSSN.

Despite its importance to sea turtle management in the Commonwealth and the mid-Atlantic region, there has never been sustained, sufficient support for the VSTSSN. The Network has had to rely on small on-going grants from the CZM, periodic funding from the DWR (including State Wildlife Grant funds), and small project funding and supplies as well as competitive grants from the NOAA Species Recovery Grants to States Program. Collectively, these funds have supported stranding data management, volunteer training, carcass recovery, live stranding response and rehabilitation, and several short-term health, diet, and mortality studies to determine cause of stranding and mortality, including potential sublethal causes such as debris and fishing gear ingestion, abnormal parasites, and evidence of disease or infection. This approach, however, is untenable over the long term, especially as administrative, operating and staff costs and needs continue to increase. The VSTSSN funding needs extend beyond basic administrative and operational costs and include expenditures associated with conducting detailed necropsies on fresh carcasses and collecting biological samples from live and fresh dead turtles to determine cause of death or morbidity. Presently, cause of death or morbidity is unknown for the majority of strandings in Virginia and represents a significant data gap in the development of management strategies designed to reduce sea turtle mortality.

VAQS, the current administrator of the VSTSSN, is part of the Virginia Aquarium & Marine Science Center's (VAMSC) Veterinary Science and Research Division. VAMSC is a collaboration between the City of Virginia Beach and the Virginia Aquarium & Marine Science Center Foundation (VAQF), a non-profit 501 (c3) organization. VAQF is responsible for maintaining VAQS along with other VAMSC-sponsored conservation and scientific research efforts. Because the VSTSSN is led and managed by a non-profit organization and is almost entirely reliant on soft money, it is vulnerable to economic vagaries that may result in inconsistent stranding response or at worst, the collapse of the Network. It is for these reasons that one of the actions under this strategy involves exploring the feasibility of establishing a state supported position within the VSTSSN (see action 1.1.2). Such an action will reinforce the state's support for the VSTSSN and help ensure its permanency.

Action 1.1.1. -Identify all existing and potential revenue streams to permanently fund the operation of the VSTSSN (Entities: **DWR**, CZM, MRC, VAQS and NOAA Fisheries).

Action 1.1.2. -Develop the justification for and explore the feasibility of establishing a state supported position within the VSTSSN. This position will also oversee Virginia's sea turtle nesting monitoring programs (see Strategy 2.3 under Conservation Goal 2). (Entities: **DWR**, VAQS and CZM).

Action 1.1.3. -Assemble a temporary working group tasked with recommending and/or establishing one or more revenue streams that will permanently sustain operational funding and establishment of a permanent state position to sustain the VSTSSN. The working group should include representatives from government agencies, non-profit organizations, and other partners with a vested interest in sea turtle conservation and/or stranding (Entities: **DWR**, CZM, VAQS, MRC, NOAA Fisheries).

Action 1.1.4. – Seek the necessary support from the Virginia General Assembly and/or the Virginia Secretary of Natural and Historic Resources to safeguard the permanency of the VSTSSN (Entities: **DWR**, MRC, CZM).

Action 1.1.5. – Develop a Cooperative Agreement among the DWR and the City of Virginia Beach, the VAMSC, and/or the VAQF which clearly defines VSTSSN-related roles and responsibilities of the state supported position and includes a contingency plan should VAQS lose its capacity to manage the day-to-day operations of the VSTSSN (Entities: **DWR**, and City of Virginia Beach, VAQS, VAMSC, VAQF).

Action 1.1.6. – Support maintaining contact with other state sea turtle stranding networks, the national STSSN, and entities conducting relevant sea turtle research and management by attending meetings and conferences to remain current with data collection techniques, reporting and management protocols and collaborative research and monitoring opportunities (Entities: **DWR**, VAQS).

Strategy Timeline: Actions 1.1.1 through 1.1.5 will be near-term. Action 1.1.6 is ongoing.

Strategy 1.2. – Establish an Interagency Stranding Event Network (ISEN).

Currently, there is no institutional framework in place for detecting and responding to unusual sea turtle stranding events that require resources and staff beyond capacity of the VSTSSN, VAQS, or any single agency. These events may involve large numbers of sick, injured or dead turtles washing ashore on publicly- and privately-owned shorelines, in marinas, waterfront communities, military installations, or other heavily populated areas over a short or extended period of time. A very likely scenario that could occur in Virginia is a mass cold-stunning event involving hundreds of turtles becoming hypothermic due to exposure to sudden and substantial drops in water temperature. Cold-stunned turtles can develop a number of health conditions such as lung, intestinal, skin and eye disorders that may result in death if not addressed immediately. Other potential causes of mass mortality/morbidity events include disease outbreaks, interactions with fishing gear, harmful agal blooms, oil/hazardous material spills, and sustained declines in food resources.

Unusual stranding events do not always involve large numbers of turtles but may only involve one or several individuals that become entrained or trapped within the footprint

of a marine construction project, a nuclear power plant, or some other infrastructure or human activity that necessitates their immediate capture and removal. In-water recovery of live and dead turtles can be logistically difficult and often require resources and authorizations not afforded to the VSTSSN. Dealing with these kinds of unusual stranding events compels the cooperation, coordination and sharing of resources among federal, state, and local agencies as well as non-governmental stakeholders that are impacted by these occurrences.

Action 1.2.1. - Identify and contact stakeholders that may be willing and able to participate in an ISEN and determine the extent to which each stakeholder can: (1) contribute funds, staff, equipment, or other resources; (2) assist with stranded turtle searches, transport or disposal during unusual stranding events; (3) provide expertise to help identify cause or direct response efforts (*e.g.*, pathologists, veterinarians, fishery gear experts, marine construction companies) and/or (4) provide the necessary authorizations to establish working relationships, necessary training, and points of contact (Entities: **DWR**, CZM, VAQS, MRC and NOAA Fisheries).

Action 1.2.2. – Convene regular meetings with stakeholders who have committed to being part of the ISEN to develop response plans, a communication plan, task and resource assignments, and a post-event evaluation process (Entities: **DWR**, MRC, VAQS).

Action 1.2.3. – Develop a sea turtle stranding response Memorandum of Understanding between DWR and MRC to outline expectations for state assistance with unusual sea turtle stranding events (Entities: **DWR**, MRC).

Action 1.2.4. – Convene annual ISEN meetings to update plans and task and resource assignments (Entities: **DWR**, MRC, VAQS).

Strategy Timeline: Actions 1.2.1 – 1.2.3 will be near-term. Action 1.2.4 will be ongoing.

Strategy 1.3. – Establish one or more consistent funding sources to support the operation and maintenance of the Darden Marine Animal Conservation Center (DMACC).

One of the most costly and public-facing functions of the VSTSSN is the recovery, treatment and care of sick or injured sea turtles. In 2021, the Virginia Aquarium and Marine Science Center opened the DMACC, a state-of-the-art facility that provides holding pools and animal care space for sea turtle and seal rehabilitation as well as examination rooms and laboratory space for diagnostic and forensic investigations of stranded animals. The location of the facility provides direct access to a natural seawater supply for aquarium systems and vessel access to the Atlantic Ocean. Currently, all DMACC expenditures are covered by the City of Virginia Beach and the Virginia Aquarium & Marine Science Center Foundation (Foundation). Given the uncertainties

and financial pressures surrounding municipal and non-profit organization budgets and the high costs associated with maintaining saltwater plumbing and filtration systems, there is a need for a secondary revenue stream dedicated to the operation and maintenance of the DMACC to ensure it remains functional over the long term.

Action 1.3.1. – Assemble a temporary working group tasked with identifying and establishing one or more revenue streams to help cover expenditures associated with the operation and maintenance of the DMACC. The working group should include representatives from the City of Virginia Beach Budget and Management Services, Virginia Senate District 6, 100th District of Virginia House of Delegates, non-profit organizations, and other partners with a vested interest in sea turtle conservation (Entities: **DWR**, VAQF).

Strategy Timeline: Action 1.3.1 will be longer-term.

Strategy 1.4. – Integrate Virginia's historical stranding records into the national stranding database.

Sea turtle stranding data are currently entered into the NOAA Fisheries STSSN Database which came online in 2021. NOAA Fisheries plans to upload historic stranding data, however, the VSTSSN has over 10,000 historic stranding records that will require considerable verification and no resources are currently available to complete the necessary one-time review and editing.

Action 1.4.1. – Seek CZM or other funding to support the verification of historic stranding data and ensure it is in the correct format for uploading into the national stranding database (Entity: DWR).

Action 1.4.2. – Identify (and hire as appropriate) a qualified individual with the necessary knowledge base, computing skills and tools to prepare the historic stranding data for uploading into the national stranding database under the guidance of the VSTSSN and NOAA Fisheries database managers (Entities: **DWR**, VAQS).

Action 1.4.3. – Upload verified and reformatted historic stranding data into the national stranding database (Entity: VAQS).

Action 1.4.4. –Maintain contact with other state sea turtle stranding networks and the national STSSN by attending relevant meetings and conferences for the purpose of remaining current with stranding data collection techniques, reporting and management protocols and collaborative research and monitoring opportunities (Entities: **VAQS**, DWR).

Strategy Timeline: Actions 1.4.1 and 1.4.2 will be near-term, Action 1.4.3 will be longer-term, and Action 1.4.4 is ongoing.

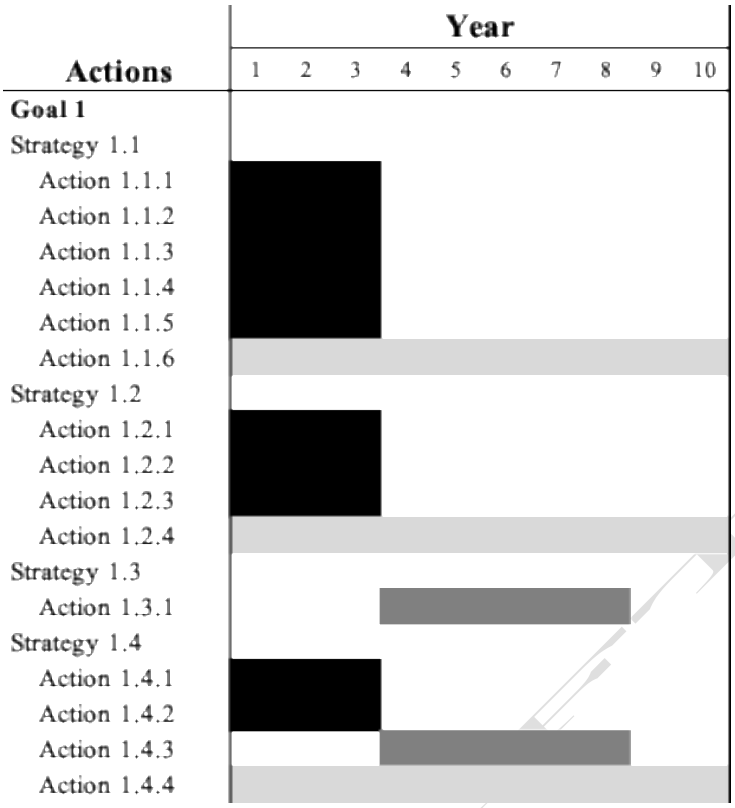


Figure 14. Implementation timelines of actions under Goal 1 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing.

Conservation Goal 2: Identify and mitigate risks to sea turtle populations and habitats in Virginia through cost-effective monitoring, research, and best practices.

Most sea turtles that occur in Virginia are juveniles that spend their time feeding and resting in the Commonwealth's polyhaline and mesohaline waters. Virginia also supports a small breeding population of primarily loggerhead turtles that has been monitored annually since 1970 (DWR, *unpublished data*, September 2024). Sea turtles typically begin arriving in Virginia in May and remain until cooling water temperatures trigger their southward migration sometime in mid to late fall. Rising ambient and sea temperatures will likely prolong their length of stay and may even lead to an increase in future nesting activity. These possibilities combined with unknown impacts of sea level rise, increased weather variability, shifting prey distribution, invasive species and pathogen introduction, offshore wind energy development, fishery interactions, and eutrophication in the Chesapeake Bay makes the identification, evaluation and mitigation of these and other risks an immediate need in Virginia. The most effective approaches for addressing this goal are to (1) support existing sea turtle research and monitoring efforts; (2) collaborate with experts specializing in climate change, harmful algal blooms (HAB), forage fish ecology, commercial and recreational fisheries, marine contaminants and other risk categories to ensure sea turtle concerns and research needs are addressed in each of these disciplines; and (3)

support the development and implementation of science-based best management practices and to provide science-based regulatory and enforcement recommendations, as needed.

Strategy 2.1. – Collect, analyze and compare commercial fishery effort, observed sea turtle takes, and stranding data for state managed fisheries known to or likely to interact with sea turtles.

One of the most scientifically rigorous and effective ways to quantitatively understand fishery interactions with protected species is through a fishery observer program. Federally managed fisheries in Virginia that are likely to interact with protected species receive limited observer coverage by the Northeast Fisheries Observer Program (NEFOP) which is administered by NOAA Fisheries for the purpose of quantifying bycatch rates. Fisheries operating in state waters and/or managed solely by state agencies are usually not covered by the NEFOP. Developing and maintaining a state fishery observer program that collects rigorous data on harvested target species, non-target bycatch and fishing effort will inform fishery management decisions and help with the development of gear modifications and other best practices designed to avoid or minimize fishery interactions with protected species.

Action 2.1.1 – Develop and submit application and maintain the proper federal agreements and permits to operate a state observer program for protected species including sea turtles (Entities: **MRC**, DWR)

Action 2.1.2 - Provide guidance and training for observers to handle, resuscitate, collect data and samples from turtle takes (Entities: **MRC**, DWR, VAQS)

Action 2.1.3 - Calculate and compare bycatch rates, by fishery and with similar gear in federal waters or in other states, and share sea turtle take details, effort data, and bycatch rates with other agencies in the Commonwealth and other stakeholders (Entity: MRC)

Action 2.1.4 - Review takes regularly to assess trends and needs for management actions (Entities: **MRC**, DWR)

Strategy Timeline: Actions 2.1.1 and 2.1.2 are near-term. Actions 2.1.3 and 2.1.4 will be ongoing and implemented after Actions 2.1.1 and 2.1.2 are completed. Completion of Action 2.1.1 is dependent on staff availability, and, more importantly, NOAA Fisheries' Protected Resources review and approval. Action 2.1.2 should be completed before the next NOAA Fisheries approved training course becomes available.

Additional Resource Requirements: Actions 2.1.2 and 2.1.3 will require additional staff time for data analysis.

Strategy 2.2. – Continue to assess trends in sea turtle population demographics in Virginia over time and compare them to trends observed throughout the mid-Atlantic region.

Long-term stranding data provide an opportunity to monitor changes in sea turtle demographics in state waters and allow for comparisons to be made with regional trends. Previous evaluation of Virginia data has revealed species-specific shifts in size/age class proportions, sex ratios, and seasonal occurrences over time (Barco *et al.* 2015). Limited capture-release (Barco *et al.* 2016; VIMS and VAQS, *unpublished data*, May 2023) and observed dredge and fishery incidental take data (USACOE and NOAA Fisheries, *unpublished data,* May 2023) collected in the Commonwealth and the mid-Atlantic region are also available for future analyses. Lastly, incorporating relevant environmental co-variates and predictive modeling in the recurring sea turtle population trend analyses of existing data is a cost-effective way to detect and interpret state and regional demographic shifts over time and inform future management decisions.

Action 2.2.1. – Conduct a comprehensive population trend analysis every 10 years using Virginia and mid-Atlantic stranding and incidental take data and incorporating environmental co-variates and predictive modeling in the recurring sea turtle population trend analyses. (Entities: **DWR**, VAQS, VIMS, CZM, NOAA Fisheries, USACOE, USFWS-VFO).

Action 2.2.2. – Foster collaborations with academic institutions and other entities with expertise in time series and/or climactic trend analysis/modeling to assist with Action 2.2.1 (Entities: **DWR**, VAQS, VIMS, NOAA Fisheries).

Action 2.2.3.– Identify and secure funding for recurring sea turtle population trend data collection and analyses including aerial surveys, satellite tagging and research described in Actions 2.2.1 and 2.2.2 (Entities: **DWR**, CZM, NOAA Fisheries).

Strategy Timeline: Action 2.2.1 will be near-term. Actions 2.2.2 and 2.2.3 will be longer-term but should be implemented as soon as feasible after the completion of Action 2.2.1.

Strategy 2.3. – Continue to monitor sea turtle demographics, health, diet, distribution, and nutritional status in Virginia

Demographic data as well as health, diet, and nutritional indices are important indicators of the overall status of sea turtle populations; however, collecting samples from turtles in the wild is expensive and logistically challenging. Live turtles incidentally captured via recreational hook and line gear and subsequently examined for ingestion of secondary

hooks and other undetected anomalies were shown to have blood and body condition values similar to those obtained from presumed healthy turtles in the wild population (Rose *et al.* 2022). This confirmed the notion that incidentally captured turtles without secondary injury can contribute baseline demographic research and health values that accurately reflect those found in the wild population. Similarly, presumed healthy turtles that recently died from acute trauma or underwater entrapment can be used as a proxy for healthy wild turtles for diagnostic tests that are able to be conducted post-mortem (Barco *et al.* 2016).

The most recent long-term analysis of sea turtle health, diet, and nutrition in Virginia was completed in 2015 using live and fresh dead stranded turtles recovered by the VSTSSN from as far back as the 1980s. Findings from this work revealed that springtime blood and body condition values acquired from wild turtles incidentally captured in pound nets and trawl operations conducted during dredge projects as well as those captured independent of other gear were considerably different from published values obtained from turtles incidentally captured in Virginia pound nets in late summer and fall (Davis *et al.* 2010; Barco *et al.* 2015). This result suggests that turtles arriving in the spring appear to be more nutritionally compromised than those that have spent the summer foraging in Virginia waters (George *et al.* 1997; Barco *et al.* 2015).

Another example of management information that can be gleaned from stranded sea turtles is variations in prey consumed over time. Diet analyses based on gastrointestinal (GI) contents collected from loggerhead and Kemp's ridley turtles revealed a shift from decapod crustaceans to fish discarded from fishing gear in the early 2000s (Seney and Musick 2005, 2007) followed by a return to a more traditional diet of primarily blue crabs for Kemp's ridleys and horseshoe crabs for loggerheads that closely mimicked data collected from turtles in the 1980s and 1990s (Seney *et al.* 2014; Barco *et al.* 2015).

New techniques have been developed (*e.g.*, microbiome analysis) to assess diet and nutritional status of turtles and baseline health index protocols have changed since the completion of the 2015 study. As such, there is a need to determine the most appropriate methodology that is comparable to previous work and one that will generate the most accurate baselines for future trend analyses. Once baselines are established, subsequent monitoring of these parameters through continued sampling of live and fresh dead strandings will provide the information needed to detect shifts in health status, diet and food availability over time, and to assess the quality of the foraging habitats within and outside of Virginia's waters.

Action 2.3.1. – Convene a temporary working group with subject matter experts to (1) determine the most appropriate methodologies for establishing accurate health, diet and nutritional baseline indices; (2) develop sampling protocols designed to generate health and diet data for trend analyses, and (3) identify the lead entity for this project (Entities: **DWR**, VAQS).

Action 2.3.2. – Identify and secure funding for (1) hiring a project lead; (2) establishing accurate health, diet and nutritional baseline indices; (3) subsequent collection and monitoring of key health and diet parameters; and (4) and conducting health and diet trend analyses every five years (Entity: DWR).

Action 2.3.3. – Establish accurate health, diet and nutritional baseline indices and initiate the collection of health and diet data (including plastics/microplastics) following the methodologies developed under Action 2.2.1 (Entity: **To be determined [TBD]**)

Action 2.3.4. – Conduct a health and diet trend analysis every 5 years (Entities: **TBD**, DWR, VAQS).

Strategy Timeline: Actions 2.3.1 through 2.3.4 will be longer-term with the goal that the results of analyses be available two years prior to Plan revision deadline (*e.g.* eight years from completion of this Plan).

Strategy 2.4. – Continue to monitor sea turtle nesting activity in Virginia.

Although Virginia's loggerhead turtle nesting population is small (see Loggerhead Reproductive Activity and Virginia Sea Turtle Nest Monitoring sections), it does present unique opportunities to detect and monitor changes in nesting demographics within the NRU. When habitat and physiological stressors emerge from phenomena such as rising sea surface temperatures, sea level rise, shifting prey distribution, invasive species and the introduction of pathogens, phenological changes are often greatest and first to occur at the fringes of the range. The timely detection of and management responses to these changes requires sound monitoring, data gathering, and protection of nests, hatchlings and post-hatch outcomes. This in turn requires coordination and oversight of Virginia's sea turtle nest monitoring programs. Currently, the DWR coastal nongame biologist assumes this role. However, this position encompasses a number of other responsibilities and as such, does not have the capacity to adequately manage the nest monitoring programs. Therefore, there is a need for an additional state-supported staff to assume these responsibilities which will go a long way towards ensuring that the monitoring programs deploy standardized monitoring and reporting protocols over the long term.

Action 2.4.1. – Develop the justification for and explore the feasibility of establishing a state supported position within the VSTSSN (see strategy 1.2 under Conservation Goal 1) and assign the management and coordination of Virginia's sea turtle nest monitoring programs to this position. (Entity: DWR).

Action 2.4.2. – Review and assess the current level of sea turtle nest monitoring effort on the southern mainland beaches and barrier islands, to establish best practices and participating/lead agencies for each segment. (Entities: **DWR**, BBNWR, VAQS, DNNB, JEB-FS, CNWR, ESNWR, NASA Wallops).

Action 2.4.3. – Reconvene annual meetings with agencies engaged in monitoring sea turtle nesting activity in Virginia to debrief concerns from the previous season, plan for the upcoming season, and discuss emerging monitoring needs and research opportunities (Entity: DWR).

Action 2.4.4. – Enter all Virginia sea turtle nesting data in the current sea turtle nest data portal (Entity: DWR).

Action 2.4.5. – Establish and maintain contact with other states in the Loggerhead Turtle NRU by attending relevant meetings and conferences for the purpose of remaining current with (1) nest monitoring methods, data collection and reporting protocols; (2) nest and nesting habitat management strategies; and (3) collaborative research opportunities (Entity: DWR).

Action 2.4.6. – Adhere to sea turtle nest monitoring methods and data collection protocols established for the NRU to maintain consistency throughout the recovery unit and include protocol updates in the Virginia Sea Turtle Nesting Handbook to ensure their implementation (Entity: DWR).

Action 2.4.7. – Adopt sea turtle nesting habitat protection and management strategies established by other states within the NRU, when possible, to maintain consistency throughout the recovery unit (Entity: DWR).

Action 2.4.8. – Participate in regional research projects that will inform management decisions related to sea turtle nesting activity and the protection and enhancement of nesting habitat (Entities: **DWR**, BBNWR, VAQS, CNWR, USFWS-VFO).

Strategy Timeline: All actions except for 2.4.1 should commence in the near-term. The timeline for Action 2.4.1 is dependent on the approval and hiring of the state supported position but should be requested in the near-term.

Strategy 2.5. –Assess, protect, and/or enhance sea turtle nesting and in-water habitats through engagement with state and regional initiatives and partnerships.

There are a number of state and regional initiatives and partnerships that conduct and coordinate relevant monitoring and research of marine wildlife and ecosystems. Some focus on mitigating specific challenges such as offshore wind energy (*e.g.*, Regional Wildlife Science Collaborative) and marine debris (*e.g.*, VIMS Trap, Removal, Assessment, and Prevention Program (TRAP)) while others consolidate available data to help inform conservation planning and management decisions (*e.g.*, **Mid-Atlantic Regional Council on the Ocean** (MARCO). These types of initiatives often stem from or can result in the formation of effective partnerships that can yield cost-effective, broad scale conservation benefits that cannot be achieved by a single state or organization.

Action 2.5.1. – Identify, participate in and contribute data to state and regional initiatives and partnerships that promote the assessment, protection and/or enhancement of sea turtle nesting and in-water habitats (Entities: **DWR**, VAQS, CZM, MRC).

Action 2.5.2. – Support and promote strategies and actions in the Marine Debris Reduction Plan for Virginia (Register 2021) and the regional 2021 Mid-Atlantic Marine Debris Action plan (NOAA Marine Debris Program 2021) that will help reduce sea turtle mortality and entanglement and reduce the amount of marine debris on sea turtle nesting beaches and in-water habitats (Entities: **CZM**, DWR, Virginia Clean Waterways).

Action 2.5.3. – Enhance and restore green turtle foraging habitats by supporting ongoing efforts to reestablish submerged aquatic vegetation in the lower Chesapeake Bay and seaside lagoon system (Entities: **VIMS**, CZM, TNC, MRC, DWR).

Strategy Timeline: All actions will be ongoing.

Strategy 2.6. – Incorporate the foraging and habitat needs of sea turtles in the development of or revisions to relevant fishery management plans, regulations, and best practices.

Virginia waters provide important foraging habitat primarily for migratory juvenile loggerheads and Kemp's ridleys. In Virginia, loggerheads forage primarily on large whelks, horseshoe crabs and a variety of true benthic crabs, including blue crabs, whereas Kemp's ridleys feed mostly on blue crabs and spider crabs. Whelks, blue crabs and horseshoe crabs are commercially important species in the Commonwealth and are managed intensively for the purpose of maintaining commercially sustainable populations. Equally important, however, is the need to ensure that these harvested populations are viable enough to support sea turtles and other marine wildlife that prey on these species. There is also a need to minimize the bycatch of blue crabs, horseshoe crabs and other benthic organisms in pot and bottom fishing gear to help sustain diverse prey resources over the long term. While the impact of clam aquaculture on sea turtles is currently unknown, it is possible that the emerging modifications to the benthic environment to protect artificially seeded clams from predators may displace sea turtles or their prey. Additional research will be needed as new aquaculture sites are selected or considered.

Action 2.6.1. – Assess and incorporate the foraging needs of loggerhead and Kemp's ridley turtles in horseshoe crab, blue crab, whelk and other commercially important sea turtle prey species' management plans, harvest limits, regulations, and by-catch reduction measures (Entities: **MRC**, DWR).

Action 2.6.2. – Assess bycatch of important sea turtle prey species in commercial pot and bottom fishing gear and develop science-based by-catch reduction measures and best practices (Entities: **MRC**, VIMS).

Action 2.6.3. – Study the impacts of shellfish aquaculture on the use of benthic habitats by sea turtles (Entities: **DWR**, VIMS, MRC).

Action 2.6.4. – Develop science-based best practices for existing and new shellfish aquaculture leases based on results from Action 2.5.2 and 2.5.3 that reduce or mitigate impacts on sea turtle habitats (Entities: **DWR**, VIMS, MRC).

Action 2.6.5. –Assess potential effects of emerging aquaculture and commercial fisheries on sea turtle habitats and/or prey abundance and availability and develop science-based best practices, designed to avoid, or reduce identified risk factors (Entities: **MRC**, DWR, VIMS).

Strategy Timeline: Actions 2.6.1 and 2.6.2 will be near-term; Actions 2.6.3 and 2.6.4 will be longer-term; and Action 2.6.5 will be developed in the near-term and implemented whenever changes in aquaculture and fisheries are being proposed.

Additional Resource Requirements: The impact assessments and/or development of best practices described in each of the actions will require additional funding from sources such as Virginia Sea Grant, NOAA Fisheries and the National Fish and Wildlife Foundation (Entities: **DWR**, VIMS, MRC, CZM).

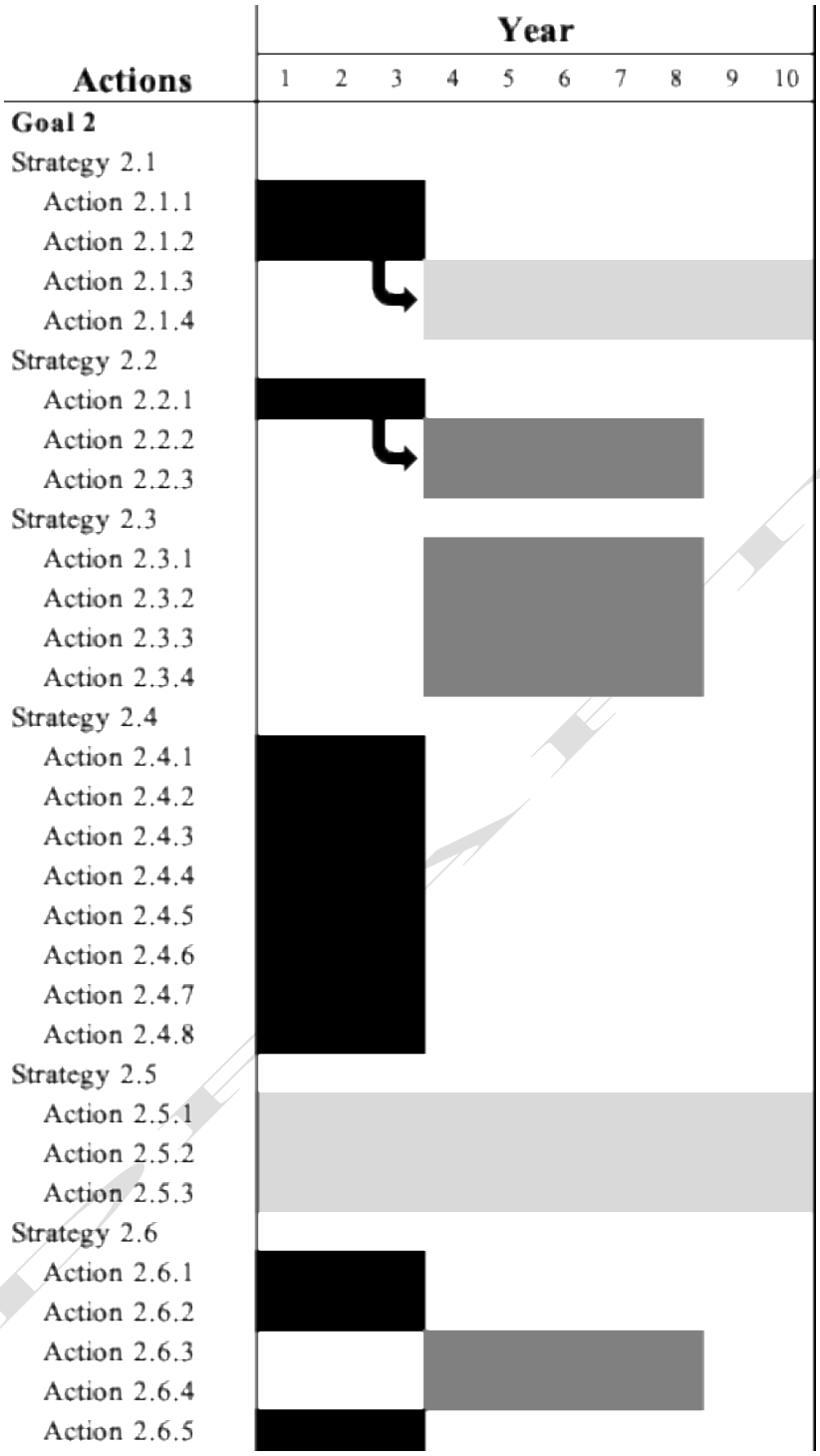


Figure 15. Implementation timelines of actions under Goal 2 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing.

Conservation Goal 3. Promote sea turtle conservation in Virginia through social marketing and information dissemination.

Sea turtle conservation fundamentally includes human beings, and the most successful conservation actions are those aligned with the values, wellbeing, and perspectives of people. When conservationists work to address the needs of threatened or endangered species, they are often trying to change or reinforce human behavior that will benefit the targeted species.

Because of their empathy and curiosity, children are often the most effective promoters of behavioral change making them excellent endangered species ambassadors, especially for highly charismatic species such as sea turtles (Young *et al*. 2018). Getting children engaged in sea turtle conservation at an early age can result in lasting and cascading conservation behaviors that often touch and influence parents, siblings, and other family members.

Another important component of effective sea turtle conservation and management is to ensure that regulatory agencies receive accurate up-to-date information on the biology, distribution, behavior, and habitat use of marine turtles in Virginia to inform project reviews, Environmental Assessments, Environmental Impact Statements, Biological Opinions, and other related documents.

Strategy 3.1. – Promote sea turtle conservation in Virginia through effective social marketing techniques

Because sea turtle nesting activity is rare in Virginia, especially on municipally owned beaches, beachfront communities and commercial stakeholders are reluctant to adopt restriction on artificial lighting or large nighttime public events such as concerts, festivals, and sports competitions during the nesting season. Strategic use of social marketing can increase the adoption of evidence-based conservation practices and behaviors through effective messaging that targets beachgoers and owners/managers of beachfront businesses, hotels, vacation rentals and private residences.

Similar social marketing techniques can also be used to change the behavior of recreational boaters, anglers and other water enthusiasts in ways that reduces human-sea turtle interactions on the water. Creative, and targeted messaging can persuade and educate the public how to properly report sea turtle strandings, hook and line captures and other situations that require an immediate response by the VSTSSN, law enforcement or some other entity.

Action 3.1.1. – Convene a temporary working group made up of sea turtle biologists, education/outreach staff, and social marketing experts to: (1) review existing materials, and identify those that warrant updating and public dissemination; (2) update existing education/outreach materials and tools where needed; (3) identify specific audiences, messages, and information dissemination pathways and platforms (*e.g.*, public service announcements, websites, social media, blogs, fishing club newsletters and other outlets);

and (4) develop new messaging materials, tools and outlets (Entities: **DWR**, CZM, BBNWR, CNWR, ESNWR, TNC, VIMS, VAQS).

Action 3.1.2. – Contract with a marketing organization to develop, test, and implement a social marketing campaign to promote human behaviors (including safe boating practices) and conservation practices that minimize disturbance and injury/mortality to nesting females, nests, and hatchlings and to sea turtles in the water and document recreational bycatch, harassment, and other concerns affecting sea turtles (Entity: DWR).

Action 3.1.3. – Launch and periodically update state social marketing campaigns (Entities: **DWR**, CZM, CZM, BBNWR, CNWR, ESNWR, TNC, VAQS).

Strategy Timeline: Actions 3.1.1 - 3.1.2 will be near-term; Action 3.1.3 will be ongoing and implemented as soon as feasible following completion of previous actions.

Additional Resource Requirements: Additional funding will be needed to engage a social marketing company and to develop, disseminate and evaluate all forms of outreach materials (Entities: CZM, DWR).

Strategy 3.2. – Develop sea turtle educational materials for a variety of audiences and messages.

Sea turtles are highly charismatic and well loved by people of all ages. The most effective means of ensuring the adoption of relevant conservation practices and behaviors is through the early exposure to a well-developed educational curriculum about sea turtle conservation, demography and ecological roles.

Action 3.2.1. – Identify and review existing sea turtle curricula for K-12 schools and update as needed or develop a new one(s) that includes information on the important roles sea turtles play in marine ecosystems, such as controlling prey species or providing food to larger predators, and the possible effects of the disappearance of sea turtles from the marine environment (Entity: **DWR**).

Action 3.2.2. – Identify and review existing sea turtle curricula for K-12 schools and update as needed or develop a new one(s) that includes information on the important roles sea turtles play in marine ecosystems, such as controlling prey species or providing food to larger predators, and the possible effects of the disappearance of sea turtles from the marine environment (Entity: **DWR**).

Action 3.2.3. – Identify and review other existing sea turtle educational materials and curricula that target adults, children, and underserved populations in a variety of settings and update, or develop new materials, as needed (Entity: **DWR**).

Strategy Timeline: All actions will be longer-term.

Additional Resource Requirements: Additional funding will be needed to contract with educational resource specialists to help develop educational curricula, *etc.* (Entity: DWR).

Strategy 3.3. – Prepare and regularly update permitting guidance documents to assist with the review of proposed human activities that may affect sea turtles in Virginia.

The accurate review of human activities and projects that may impact sea turtle nesting beaches, nesting females, nests, hatchlings, and in-water habitats requires accurate up-to-date information on sea turtle demographics, distribution and ecology that is specific to Virginia. This is especially true for beach renourishment projects in the City of Virginia Beach which are complex, involve multiple review agencies and require close monitoring of nesting activity and strict adherence to numerous environmental provisions. Similar sea turtle biological and ecological information is required for the development of NEPA documents, biological opinions, and project best practices. Providing regulatory agencies, developers, and action agencies with the necessary information upfront will help streamline and provide transparency in permitting process and promote consistency among regulatory agencies.

Action 3.3.1. –Develop an adaptive sea turtle guidance document for regulatory agency use specifically for ocean beach renourishment projects that includes science-based recommendations, information extracted from relevant Biological Opinions, protocols and provisions for the monitoring of nesting activity, nest protection, project lighting, equipment placement and mobilization, and other specifications designed to minimize impacts to nesting turtles and their habitat (Entities: **DWR**, USFWS, USACOE, MRC).

Action 3.3.2. - Develop a general adaptive guidance document that includes information on sea turtle biology and ecology, the distribution and number of nests in Virginia, known seasonal occurrences in state coastal waters, in-water habitat preferences, and other key pieces of information needed to develop environmental documents and inform project reviews. This guidance document will be updated periodically and undergo review by appropriate federal agencies to ensure consistency (Entity: DWR).

Action 3.3.3. - Upload and maintain the most current sea turtle-related permitting guidance documents compiled under actions 3.3.1 – 3.3.2 on the online DWR portal that is accessible to all state and federal regulatory agencies and permit applicants (Entity: DWR).

Action 3.3.4. - Conduct an information session with MRC Fisheries and Habitat divisions, DEQ, and CZM to reestablish baseline knowledge of each agency's roles and responsibilities concerning sea turtles (Entity: **DWR**).

Strategy Timeline: Actions 3.3.1 and 3.3.2 will be ongoing as documents are completed; Action 3.3.3will be longer-term, occurring as soon as feasible after completion of Actions 3.3.1 and 3.3.2. Action 3.3.4 will be near-term.

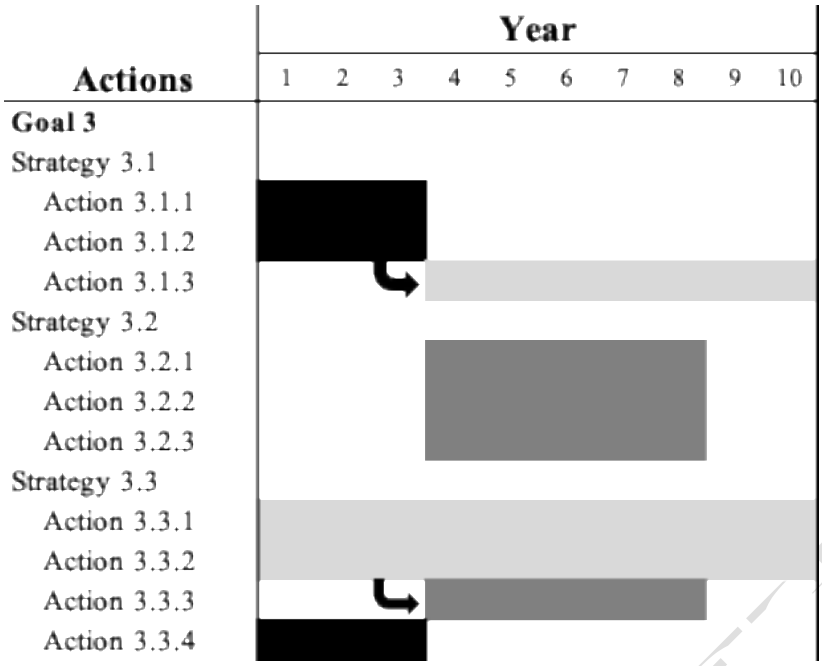


Figure 16. Implementation timelines of actions under Goal 3 pursuant to the publication of the Plan. Black represents near-term (within three years), medium gray represents longer-term (between three and eight years), and light gray represents ongoing.

Summary

Sea turtles are a natural resource shared across national and international borders. Their conservation requires coordinated efforts among many entities. Chesapeake Bay and Virginia coastal waters are an important habitat for U.S. Atlantic coast populations, especially for threatened loggerhead and endangered Kemp's ridley turtles.

Oversight and implementation of this Plan will be conducted by the DWR with assistance from other key state and federal partners. The DWR will also be managing the Virginia Marine Mammal Conservation Plan, which includes many strategies and actions similar to this Plan. Much of the work described in these Plans require new or redirected resources which will be critical in accomplishing the Actions listed in each Plan. Conservation plan updates are recommended every ten years, and interim assessment of progress toward achieving conservation goals and associated strategies and actions will be ongoing. Adoption and implementation of the Virginia Sea Turtle Conservation Plan will encourage inner-departmental coordination, align Virginia's conservation planning with regional and federal efforts, and promote efficient use of resources to provide sea turtles in Virginia with a sustainable future.

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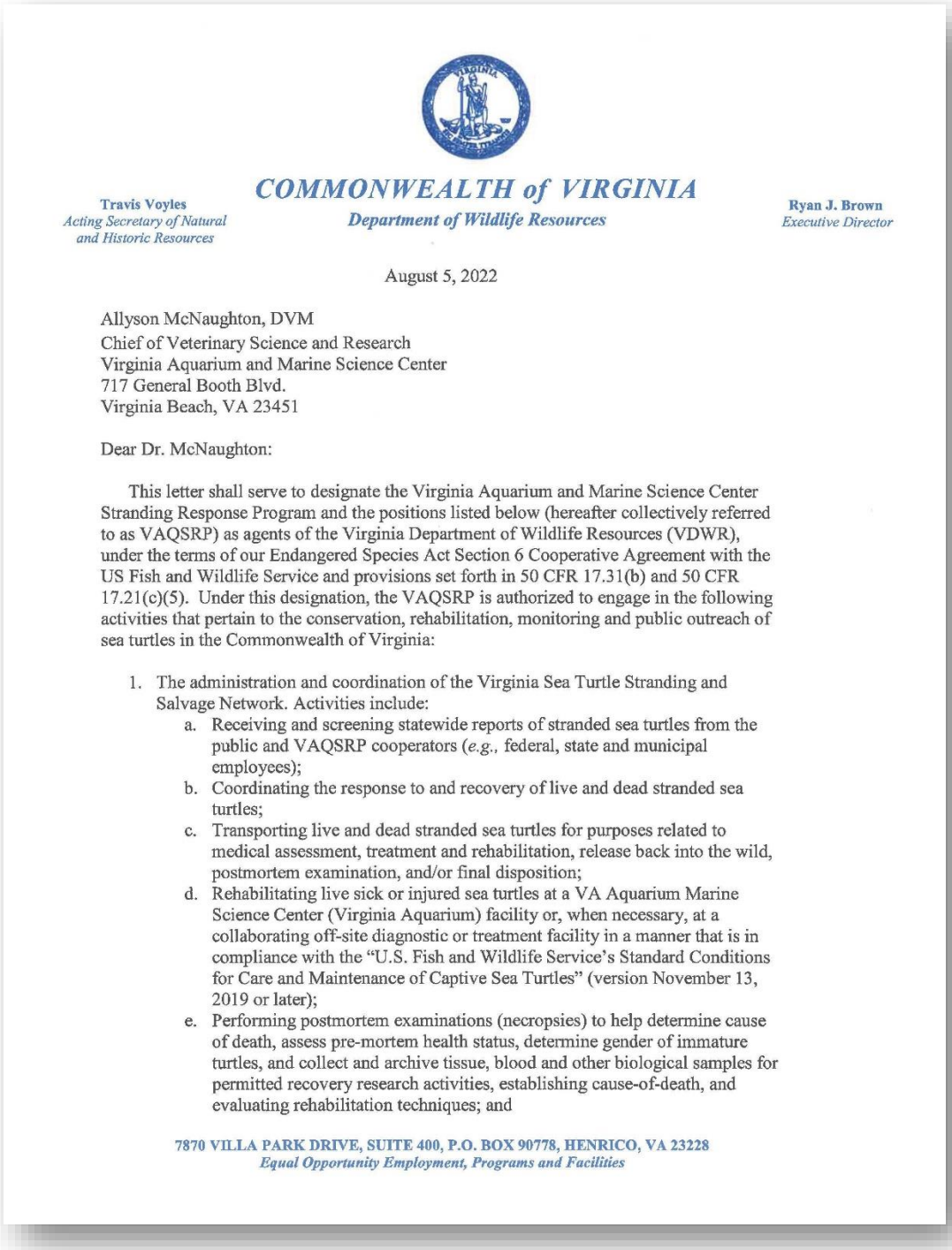
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Appendix – 2022-2027 Agent of State designation for VAQS



COMMONWEALTH of VIRGINIA

Department of Wildlife Resources

Travis Voyles
Acting Secretary of Natural and Historic Resources

Ryan J. Brown
Executive Director

August 5, 2022

Allyson McNaughton, DVM
Chief of Veterinary Science and Research
Virginia Aquarium and Marine Science Center
717 General Booth Blvd.
Virginia Beach, VA 23451

Dear Dr. McNaughton:

This letter shall serve to designate the Virginia Aquarium and Marine Science Center Stranding Response Program and the positions listed below (hereafter collectively referred to as VAQSRP) as agents of the Virginia Department of Wildlife Resources (VDWR), under the terms of our Endangered Species Act Section 6 Cooperative Agreement with the US Fish and Wildlife Service and provisions set forth in 50 CFR 17.31(b) and 50 CFR 17.21(c)(5). Under this designation, the VAQSRP is authorized to engage in the following activities that pertain to the conservation, rehabilitation, monitoring and public outreach of sea turtles in the Commonwealth of Virginia:

1. The administration and coordination of the Virginia Sea Turtle Stranding and Salvage Network. Activities include:
    a. Receiving and screening statewide reports of stranded sea turtles from the public and VAQSRP cooperators (*e.g.*, federal, state and municipal employees);
    b. Coordinating the response to and recovery of live and dead stranded sea turtles;
    c. Transporting live and dead stranded sea turtles for purposes related to medical assessment, treatment and rehabilitation, release back into the wild, postmortem examination, and/or final disposition;
    d. Rehabilitating live sick or injured sea turtles at a VA Aquarium Marine Science Center (Virginia Aquarium) facility or, when necessary, at a collaborating off-site diagnostic or treatment facility in a manner that is in compliance with the "U.S. Fish and Wildlife Service's Standard Conditions for Care and Maintenance of Captive Sea Turtles" (version November 13, 2019 or later);
    e. Performing postmortem examinations (necropsies) to help determine cause of death, assess pre-mortem health status, determine gender of immature turtles, and collect and archive tissue, blood and other biological samples for permitted recovery research activities, establishing cause-of-death, and evaluating rehabilitation techniques; and

7870 VILLA PARK DRIVE, SUITE 400, P.O. BOX 90778, HENRICO, VA 23228
Equal Opportunity Employment, Programs and Facilities

f. Euthanizing moribund stranded turtles that are deemed untreatable or unlikely to recuperate or survive in the wild, are carrying a transmissible disease that likely poses a threat to wild populations or captive turtles, or are undergoing severe pain and suffering for which euthanasia is the only humane option available.

The VAQSRP will enter all stranding records in the National Sea Turtle Stranding and Salvage Network database as required by the NOAA Fisheries Greater Atlantic Regional Fisheries Office (GAR). The VAQSRP's sea turtle stranding and salvage activities will be coordinated, as appropriate, with the GAR Sea Turtle Stranding and Disentanglement Coordinator.

2. Research on the rehabilitation and subsequent release of live-stranded sea turtles. Allowable actions under this activity include:
   a. Collecting and archiving blood and tissue samples for diagnostic and prognostic assessments, assessing efficacies of rehabilitation techniques and determining causation of strandings; and
   b. Applying external tags (flipper tags), internal tags (Passive Integrated Transponder or PIT tags) and telemetry tracking devices on rehabilitated sea turtles prior to release.

3. Implementation and administration of the Virginia Pier Partners Program developed by the VAQSRP to document, assess, remove embedded or ingested hooks, provide post-treatment care (when needed), and/or release of sea turtles incidentally captured by recreational pier fishers in the tidewater area. This program involves providing pier managers with the necessary equipment and information on how to report and safely recover and temporarily hold live, hooked turtles until they can be picked up and transported to a Virginia Aquarium facility by trained VAQSRP staff or volunteers.

4. Sea turtle nest monitoring and relocation along beaches owned by the City of Virginia Beach. All activities shall be carried out as described in the Virginia Sea Turtle Nesting Handbook and include:
   a. Conducting daily nest searches between sunrise and 0900;
   b. Confirming the presence of eggs;
   c. Relocating confirmed nests laid below the high tide line;
   d. Marking in situ and relocated nests;
   e. Conducting post-hatch nest excavations and quantifying hatching success; and
   f. Entering annual nesting data in the VDWR sea turtle nesting database.

   Communications regarding nest locations, monitoring and relocation (as needed) will follow the attached Communications Plan.

5. The Virginia Aquarium and Marine Science Center (Virginia Aquarium) will be permitted by the VDWR to continue displaying, for educational purposes only, those sea turtles already in possession and any sea turtles that are placed at the Virginia Aquarium by the U.S. Fish and Wildlife Service or that are determined, in consultation with NOAA and the U.S. Fish and Wildlife Service, to be non-releasable following rehabilitation. Animals will be held, displayed and reported on following the "U.S. Fish and Wildlife Service's Standard Conditions for Care and Maintenance of Captive Sea Turtles" (version 11/13/2019 or later). State authorization will continue as long as the Virginia Aquarium complies with all terms and conditions of its state-issued Exhibitor permits.

6. Reporting requirements.
    a. The VAQSRP will be required to submit an annual report to the VDWR by June 1 of each year covered under this letter. The report shall contained a detailed summary of activities 1 – 5 outlined above.
    b. The VAQSRP will be required to submit to the VDWR an annual report generated from its Sample Management Database list that (1) lists and tracks the purpose and disposition of sea turtle tissue, blood and other biological samples collected from live and dead stranded sea turtles requested by and sent to other researchers for scientific and conservation purposes and (2) lists and tracks the purpose and disposition of sea turtle tissue, blood and other biological samples archived in-house for establishing cause-of-death and evaluating rehabilitation techniques.

Location where authorized activities may be conducted:

Rehabilitation, necropsies and euthanasia: All Virginia Aquarium facilities.

Field-based stranding response, necropsies and euthanasia: Virginia Beach, Norfolk, Portsmouth, Chesapeake, Hampton, Suffolk, Newport News and Poquoson; Accomack, Northampton, Isle of Wight, York, Matthews, Surry, Gloucester, King and Queen, Lancaster, Middlesex, Northumberland, Westmoreland and all other counties east of the fall line.

Sea turtle nest confirmation, management and monitoring: Public beaches of the City of Virginia Beach and other locations upon the request or permission of the VDWR.

Authorized VAQSRP entities:

Chief of Veterinary Science and Research
Senior Scientist Stranding Response Program Coordinator
Stranding Response Program Rehabilitation Manager
Stranding Response Program Response Manager
Sea Turtle Nesting Coordinator
Associate Veterinarian

Veterinarian technician(s)
Trained VAQSRP staff, interns and volunteers
Staff from state-owned parks and natural area preserves under the direction of the VAQSRP

Term of this Agent of the State Designation: July 1, 2022 – June 31, 2027. Sixty days prior to the expiration of this term, the VDWR and the VAQSRP may consider the option of renewing this designation during which time, modifications to the existing authorized activities and terms and conditions contained herein shall be reviewed and amended, as needed. In addition, this letter may be reviewed and amended during the term as needed to ensure all authorized activities meet the most current conservation, management and monitoring needs of sea turtles in Virginia.

Consequences of non-compliance: The VAQSRP shall comply with all terms and conditions listed under each authorized activity. Failure to do so may render this letter null and void and rid the VAQSRP of its status as a designated agent of the state. Lastly, this letter does not support any activities outside of those contained herein.

I look forward to this unique and very important partnership and very much appreciate the VAQSRP willingness to continue carrying out these essential activities as a designated agent of the state. Please let me know if you have any questions or need more information (becky.gwynn@dwr.virginia.gov; 804.389.3953).

Sincerely,

Rebecca K. Gwynn
Deputy Director

Cc: Ruth Boettcher, Coastal Nongame Biologist
Martin Miller, USFWS, North Atlantic-Appalachian Region
Abby Gelb, USFWS, North Atlantic-Appalachian Region
Emily Argo, USFWS, Virginia Field Office