Climate Change *and* Conservation *in the* Southeast:

A Review *of* State Wildlife Action Plans

Final Report
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Kirsten Lackstrom,
Patty Glick,
Kirstin Dow,
Bruce A. Stein,
M. Nils Peterson,
Erika Chin,
and Kaly Clark

Developed as part of the Vital Futures Project, a collaboration of the National Wildlife Federation, North Carolina State University, and University of South Carolina

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Executive Summary

The Southeast is experiencing high rates of population growth, urbanization, and land use change, which, along with climate change, present considerable challenges to the health and sustainability of the region's fish and wildlife populations and their habitats. The project documented here was designed to support the Southeast Conservation Adaptation Strategy (SECAS) and its efforts to develop a regional conservation vision in light of these challenges. SECAS consists of diverse state, federal, non-profit, and private organizations, working together to identify and coordinate shared conservation goals and actions for the southeastern United States and Caribbean.

The federally-funded State Wildlife Grant (SWG) Program, and required State Wildlife Action Plans (SWAPs), are important resources that help states identify and protect declining species and their habitats. State Wildlife Action Plans also provide a framework and opportunity to foster the proactive strategies necessary to achieve the vision established under SECAS, and to help ensure that ongoing and future conservation efforts across the region will be as effective as possible. To help set the stage for this continuing work, the Vital Futures Project — a collaboration among the National Wildlife Federation, North Carolina State University, and University of South Carolina — assessed how states have addressed current and projected climate change in their recently-updated Wildlife Action Plans. The project team examined SWAPs from 15 southeastern states and Puerto Rico in order to: 1) identify the various approaches used to address climate change in the recent SWAP updates, 2) highlight key commonalities and differences among the states, and 3) improve understanding of the challenges and opportunities that state agencies face as they address climate change risks. Methods included detailed review of the SWAPs and follow-up interviews with SWAP coordinators. An adapted version of the "climate-smart conservation cycle" [11] provided the conceptual framework for the data analysis. This examination is intended to illuminate elements of success in these plans and facilitate further progress in both state and regional conservation efforts. Key findings include the following:

- While all states recognize the climate change threat, they exhibited a diversity of planning approaches. Factors such as staff capacity and expertise and consistency with other planning processes influenced the methods and extent to which the SWAPs incorporated climate change.

- Few states conducted climate change vulnerability assessments expressly to inform their SWAPs. Many interviewees suggested that an increase in interstate collaboration and resources to conduct regional-scale assessments would enhance the current, relatively-limited use of impact and vulnerability assessments.

- Climate adaptation strategies tend to be stated in general terms and few examples of implemented actions exist thus far. Acting with intentionality (i.e., linking specific strategies to climate impacts) and developing Southeast-specific resources for monitoring change and the effectiveness of conservation actions could increase the uptake of novel management strategies.

- Overarching conservation goals, as articulated in the SWAPs, tend to be persistence-oriented, although some internal conversations are considering how climate change will affect the future feasibility of existing conservation goals and strategies that were designed with stable climatic conditions in mind.

Based on the project findings and observations, the project team developed a set of recommendations intended to enhance existing opportunities and further advance the incorporation of climate change into wildlife conservation planning in the Southeast. While most recommendations are envisioned for action by state fish and wildlife agencies, collaboration among all governmental and non-governmental partners will be necessary to achieve a regionwide conservation vision. We suggest the following:

- *Enhance collaborative planning and implementation efforts* by capitalizing and building on existing regional activities, networks, resources, and expertise.

- *Advance the application of both state and regional climate change impact and vulnerability assessments* by making use of existing assessments, clearly identifying information needs, dedicating sufficient time and funding to employ vulnerability assessments in adaptation planning, and participating in efforts to promote planning under uncertainty and over long time periods.

- *Facilitate the development and implementation of climate adaptation strategies and actions* by being as explicit as possible in linking adaptation needs and actions, taking an active role in managing for ecological transitions, and considering innovative approaches when developing adaptation strategies and pursuing funding.

- *Foster the adoption of climate-informed conservation goals* by exploring how climate change may affect the feasibility of existing goals, influencing which species, habitats, and areas should be targeted for conservation action and the resulting societal benefits provided by wildlife and their habitats.

- *Enhance monitoring and evaluation efforts* by engaging and collaborating with scientists and other groups to identify indicators of climate change, track ecological thresholds and tipping points, address data and information needs, and assess the effectiveness of adaptation strategies and actions.

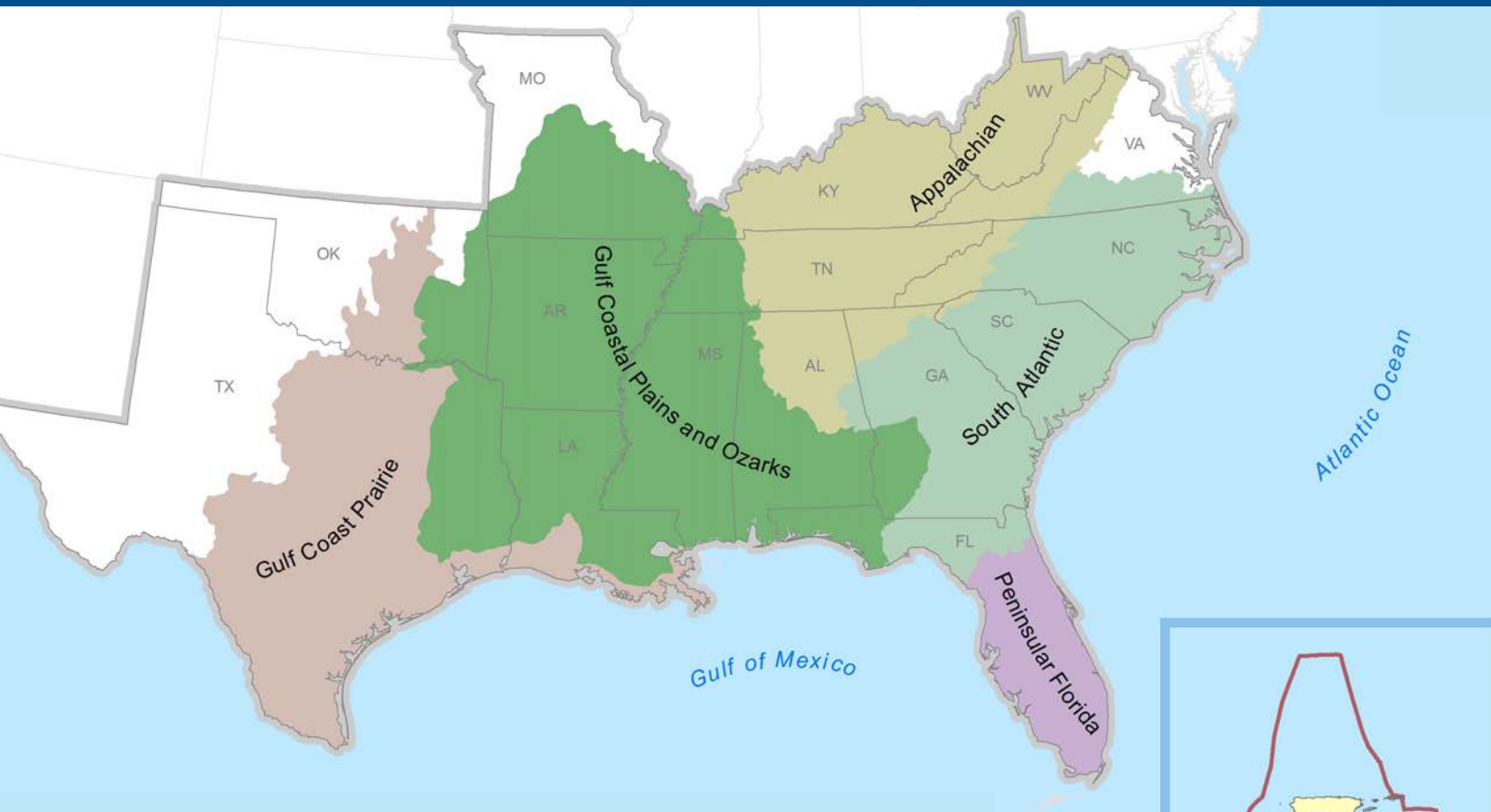
Collaboration among all governmental and non-governmental partners will be necessary to achieve a regionwide conservation vision.

Least Sandpiper (M.J. Sandoz)

1 Introduction

The southeastern United States supports a tremendous diversity of fish and wildlife. Habitats range from sandy beaches, mangroves, and coastal wetlands on the shores of the Atlantic Ocean and Gulf of Mexico, to unique long-leaf pine ecosystems along the region's coastal plains; from desert ecosystems and grasslands in Texas and Oklahoma, to bogs, meadows, and temperate forests in the Appalachians. The Southeast's freshwater habitats host more species of fish and other aquatic animals than any other region in the country [1, 2]. At the same time, the Southeast is undergoing high rates of population growth, urbanization, and land use changes, and is expected to experience changes in climate that will place significant additional stress on fish and wildlife populations and their habitats [3-5]. Social, economic, and environmental impacts associated with rising temperatures, shifts in precipitation patterns, stronger storms, sea level rise, and other climatic changes are already evident throughout the Southeast and Caribbean [6].

FIGURE 1 Geographic boundary for SECAS



This map outlines the 15 states (in gray), the Virgin Islands, and Puerto Rico that make up the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) and the six Landscape Conservation Cooperatives (LCCs) located in the region. These entities, with other conservation partners, are working to develop the Southeastern Conservation Adaptation Strategy. (Credit: secassoutheast.org.)

The Vital Futures project was designed to support the development of the Southeast Conservation Adaptation Strategy (SECAS), a broad collaboration intended to create a new vision for sustaining fish, wildlife, and natural resources in a changing future landscape [7, 8]. The primary emphasis of SECAS is to develop a collaborative network of conservation partners, shared conservation goals, and regional strategies to manage fish, wildlife, and other natural resources into the future across 15 southeastern states, the Virgin Islands, and Puerto Rico (see Figure 1). One component of the Vital Futures project included an examination of existing conservation plans to determine how they address the growing challenges the SECAS region faces and identify opportunities for further action.

This report focuses specifically on an analysis of State Wildlife Action Plans (SWAPs). In order to be eligible for grants through the State Wildlife Grant (SWG) Program, state and territory fish and wildlife agencies must develop and submit a SWAP to the U.S. Fish & Wildlife Service (USFWS) for approval [9]. This program has been critical in helping states across the country proactively protect all fish and wildlife, not just game species and those already listed as threatened or endangered. Original editions of the plans, first due in 2005, addressed climate change only cursorily, if at all. Increasingly, state fish and wildlife agencies have recognized that they must prepare for and adjust to changing, landscape-scale conditions to enhance the success and durability of conservation plans over the long term. States are required to review and update their SWAPs every ten years, and the 2015 updates demonstrate an expanded consideration and inclusion of climate change.

The purpose of this review was to: 1) identify the various approaches used to address climate change in the SWAP updates, 2) highlight key commonalities and differences among the states, and 3) improve understanding of the challenges and opportunities that state fish and wildlife agencies face as they address climate change risks. While this review focused largely on climate adaptation (i.e., efforts to cope with or adjust to changing climate conditions), we noted several examples of strategies focused on climate mitigation (i.e., actions to reduce greenhouse gas emissions or enhance carbon sequestration). To conclude, we provide insights into shared priorities and offer suggestions to enhance agency capacity, planning and management approaches, and regional collaboration in order to support ongoing SECAS efforts.

Okracoke, N.C. (Jason A.G.)

2 Overview and Methods

2.1 Fish and Wildlife Conservation in an Era of Climate Change

Existing fish and wildlife conservation efforts, such as those through the SWG Program, have proven invaluable [10]. However, they have largely focused on protecting and managing systems to maintain current conditions or return to a desired historical state. With large, landscape-scale transformations occurring, adaptive, forward-looking conservation strategies are needed that can account for changing climate conditions – a field of practice known as *climate adaptation* [11].

Indeed, interest in and attention to climate adaptation has grown considerably over the past decade, including among state fish and wildlife agencies. For instance, a companion study to this analysis that looked specifically at longleaf pine (LLP) management plans found that newer and state-based plans (including both SWAPs and dedicated state forest plans) placed greater emphasis on climate change concerns than older plans and those conducted by federal agencies, non-governmental organizations (NGOs), or Joint Venture partnerships [12]. Attention to climate adaptation by state wildlife agencies was spurred, in part, by the incorporation of a natural resource adaptation title in climate legislation (H.R. 2454) that passed the U.S. House of Representatives in 2009 [13]. That legislation would have provided significant new funding for wildlife conservation tied to the adoption of state adaptation plans, including climate-related elements of SWAPs. Although companion legislation did not pass in the U.S. Senate, the bill was seen as helping to incentivize adaptation planning among states across the country.

In 2009, the Association of Fish & Wildlife Agencies (AFWA) developed voluntary guidance for integrating climate change into SWAPs [14]. The Association's subsequent *Best Practices for State Wildlife Action Plans*, published in 2012, provides additional suggestions for incorporating climate considerations into SWAPs, highlighting connections to the "eight elements" required by Congress for inclusion in the plans [15] (see Box 1, page 7). The *National Fish, Wildlife and Plants Climate Adaptation Strategy*, a federal, state, and tribal collaboration, was also published in 2012 and offers examples and information about general strategies and actions that can be used to reduce the impact of climate change on the nation's ecosystems and natural resources [16]. More detailed guidance on adaptation planning for fish and wildlife managers is offered in *Climate-Smart Conservation: Putting Adaptation Principles into Practice*, which was published in 2014 based on the work of a federal, state, and NGO workgroup led by the National Wildlife Federation [11]. These documents, among others, have been cited extensively by the fish and wildlife agencies featured in this study as being valuable for informing their updated Wildlife Action Plans.

2.1.1 Principles for Effective Adaptation Planning

As the field of climate adaptation for fish and wildlife conservation has progressed in recent years, the following overarching principles for climate-smart conservation have emerged as important for achieving successful adaptation outcomes [11]:

Act with intentionality; link actions to climate impacts. To be effective, climate adaptation must be conducted in an intentional and deliberate manner that explicitly considers the effects of climate change. Linking conservation actions to climate impacts distinguishes well-conceived and thoughtful adaptation from "business as usual" conservation, which may or may not continue to be appropriate in light of those impacts. In AFWA's *Best Practices for State Wildlife Action Plans*, states are also urged to avoid "unspecified generalities," which can leave the door open for ineffective strategies [15]. Adapting to climate change may alter the location, timing, or way in which traditional management tools are applied; it also may require novel approaches and innovation as states face unique and unprecedented management and conservation challenges. Going through an explicit process to link actions to current and projected future conditions and trends will help states determine which conservation actions will maximize their investments.

Manage for change, not just persistence. Protecting America's biodiversity for current and future generations is fundamental to the mission of state fish and wildlife agencies. State Wildlife Action Plans have been a critical tool for conserving wildlife and habitat and helping prevent species from becoming threatened by extinction. Managing for *persistence* of species and habitats will continue to be a priority in many cases. However, the risks from climate change will increasingly challenge our ability to preserve species and habitats in their historical and current conditions. Managers will also need to consider when and how to prepare for eventual *transformation* of ecological systems and the species they support (i.e., manage for change).

Reconsider conservation goals, not just strategies and actions. As climate change continues to unfold, some existing conservation goals may no longer be feasible. Consequently, successful climate adaptation will require reevaluation of those goals from a climate perspective. Such a reevaluation may either validate the continued relevance of existing goals or indicate the need for modifications. Climate-informed goals will need to strike a balance between traditional aspirations and the emerging realities that are shaping what can be regarded as "achievable future conditions" [17].

Integrate adaptation into existing planning and management processes. Climate adaptation should not be viewed as a separate planning endeavor or necessarily addressed in a stand-alone plan. To be most effective, climate considerations should be routinely incorporated into the full spectrum of conservation planning and wildlife management efforts.

2.2 Conceptual Framework: The Climate-Smart Conservation Cycle

While states used a variety of planning approaches to update their Wildlife Action Plans, we organized our research design and analysis around key steps of the "climate-smart conservation cycle" (see Figure 2, page 8) to provide a consistent framework for reviewing and comparing how the states considered and incorporated climate change. This framework reflects an iterative method to adaptation planning and implementation, which is consistent with the approach recommended by AFWA in its *Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans* [14].

The following is a brief overview of the climate-smart conservation cycle steps, including ways in which they apply to the eight required elements for SWAPs (Box 1) [18]. While these elements are intended to provide a general framework for the SWAP planning process, each state decides how to organize and conduct the tasks necessary to develop its plan. As such, plans exhibit considerable diversity in the approaches they take to identify and assess Species of Greatest Conservation Need (SGCN), key habitats, conservation threats, and conservation actions. This diversity in planning approaches is also reflected in how states in the region addressed climate change.

BOX 1

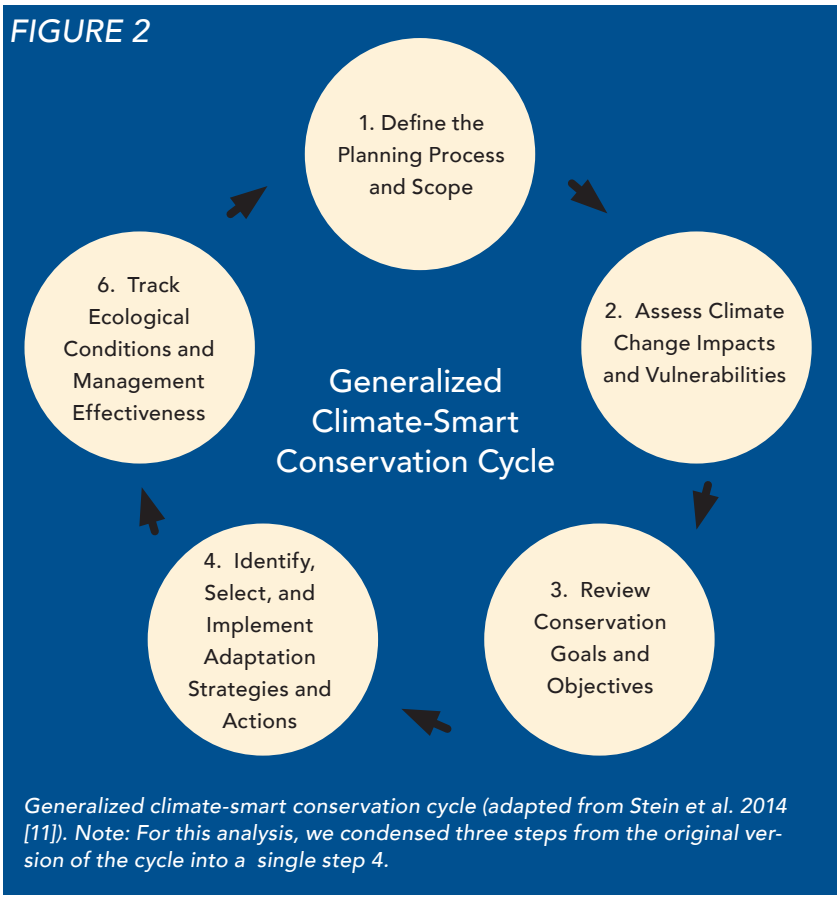
Eight Required Elements for State Wildlife Action Plans

1. ***SPECIES:*** 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 the State's Species of Greatest Conservation Need (SGCN);
2. ***HABITATS:*** The location and relative condition of key habitats and community types essential to the conservation of each State's SGCN;
3. ***THREATS/STRESSORS:*** The problems that may adversely affect SGCN or their habitats, and priority research and surveys needed to identify factors that may assist in restoration and improved conservation of SGCN and their habitats;
4. ***ACTIONS:*** The actions necessary to conserve SGCN and their habitats and the priorities for implementing such conservation actions;
5. ***MONITORING:*** The provisions for periodic monitoring of SGCN and their habitats, for monitoring the effectiveness of conservation actions, and for adapting conservation actions as appropriate to respond to new information or changing conditions;
6. ***REVIEW AND REVISION:*** Each State's provisions to review its Plan at intervals not to exceed 10 years;
7. ***PARTNER INVOLVEMENT:*** Each State's provisions for coordination during the development, implementation, review, and revision of its Plan with Federal, State, and local agencies and Indian tribes that manage significant areas of land or water within the State, or administer programs that significantly affect the conservation of species or their habitats; and
8. ***PUBLIC INVOLVEMENT:*** Each State's provisions to provide the necessary public participation in the development, revision, and implementation of the Plan.

Step 1: Define the Planning Process and Scope. Initiating climate change adaptation planning largely mirrors the first steps of conventional conservation planning processes. However, several specific climate change considerations may come into play. For instance, at this initial stage, states may decide whether to present relevant climate information as a stand-alone chapter, a separate report, and/or integrated throughout their updated action

The risks from climate change will increasingly challenge our ability to preserve species and habitats in their historical and current conditions.

FIGURE 2



Generalized climate-smart conservation cycle (adapted from Stein et al. 2014 [11]). Note: For this analysis, we condensed three steps from the original version of the cycle into a single step 4.

plans. Addressing climate change also may necessitate involving climate scientists and other experts that might not have been otherwise considered in the planning process, as well as planning for longer time frames and across broader geographic scales (e.g., across multiple jurisdictions). Section 3.1 of this report highlights the various tools, approaches, and guidance that states used to incorporate climate change into their updated plans. It also identifies whether and how climate considerations influenced collaboration among diverse partners both within the state and across the region, which is key to ***Element 7***.

Step 2: Assess Climate Change Impacts and Vulnerabilities. Understanding how, where, and when climatic changes may affect species and ecosystems is essential for developing meaningful adaptation strategies [19]. Thus, assessing climate impacts and vulnerability, even at a very general level, is a fundamental step for addressing climate change in SWAPs [14]. Climate change can have direct and indirect effects on species and habitats. Further, because climate events and impacts interact with, and often exacerbate, many other stressors affecting species and habitats across the region (e.g., land use change, invasive species, and pollution), they are also considered to be "threat multipliers" [20].

In the context of SWAP planning, states may apply vulnerability assessments to inform a range of decisions. Under ***Element 1***, for instance, states must identify SGCN, based on a range of criteria and approaches. The 2009 AFWA voluntary guidance suggests a number of ways in which states could consider climate change in reexamining their SGCN. These include identifying potential changes in species abundance and geographical ranges; defining what constitutes native, exotic, and invasive species; and adding new groups of species (e.g., marine species, plants) that were not included in initial SGCN lists [14]. Similarly, addressing climate change necessitates consideration of a variety of implications for key habitats and community types under ***Element 2***, such as shifts in climatic suitability of existing and potential habitat areas and identification of opportunities to connect habitats based on projected movements of associated species. ***Element 3*** requires that states identify the problems that may affect important species and their habitats. Section 3.2 of this report identifies a variety of approaches that states used to assess the vulnerability of both species and habitats and highlights some of the key challenges and information needs identified by planners.

Step 3: Review Conservation Goals and Objectives. Assessing the climate change vulnerability of species and habitats may lead to a reexamination of the problems in need of attention, as well as raise questions about the continued relevance and feasibility of existing conservation goals and objectives. Such a considered review may result in the validation of existing goals and objectives, or point to the need for modifications, which is consistent with the importance of periodic revisions to the action plans reflected by ***Element 6***. Increasingly, state fish and wildlife agencies will need to respond to and manage inevitable changes (i.e., adopt goals that envision desired future conditions, including possible ecological transformation), rather than assume current species and habitats can forever be maintained or restored to historical conditions (i.e., adhere strictly to persistence-oriented goals). Section 3.3 of this report provides an overview of general conservation goals under the action plans and notes ways in which states are considering them in the context of climate change.

Step 4: Identify, Select, and Implement Adaptation Strategies and Actions. Identifying conservation strategies and actions to address threats to SGCN and their habitats is the heart of SWAPs, as reflected in ***Element 4***. Stein

et al. (2014) parse the identification, selection, and implementation of adaptation actions into three discrete steps of the climate-smart cycle [11]. We have condensed them into a single step here, as this more closely aligns with the ***Element 4*** requirement. As noted in Section 2.1.1 of this report (Principles for Effective Adaptation Planning), the key to developing successful adaptation strategies is to explicitly link those actions to climate change impacts (i.e., act with intentionality). Armed with an understanding of climate vulnerabilities in the context of climate-informed goals, states have the information necessary to address climate change as part of that process. In some cases, existing conservation and management approaches may still be appropriate – in others, actions may need to be modified or new and novel approaches may be warranted. Section 3.4 focuses on the various climate change adaptation strategies and actions identified in the plans and which actions have been prioritized and implemented by the states. The section also highlights the degree to which those actions are clearly tied to climate change impacts and notes a few examples of states specifically managing for change.

Little Brown Bat (USFWS, Ann Froschauer)

Step 5: Track Ecological Conditions and Management Effectiveness. Monitoring and evaluation are well established in fish and wildlife management, and SWAPs are required to include strategies for monitoring the condition of species and habitats as well as evaluating the effectiveness of management actions (***Element 5***). Given the ongoing shifts associated with climate change and that climate adaptation is in part about planning for an uncertain future, well-conceived and executed monitoring and evaluation are a means for determining how well plans align with conditions as they actually develop. In particular, effective monitoring and evaluation are essential for adaptive management, which has, in principle, been part of SWAPs since their inception [21]. Section 3.5 discusses how states in the region are considering monitoring and evaluation in the context of climate change.

2.3 Research Methods: Document Analysis and Interviews

At the time the Vital Futures project was initiated, all states and territories in the region were at various stages of updating their original Wildlife Action Plans to meet the 2015 deadline for submission to the USFWS. We reviewed all available plans – 16 in total. The U.S. Virgin Islands did not have a 2015 SWAP update available and therefore was not included in this review. Most plans were in final draft form or published in 2015, with the exceptions of Florida (2012), Kentucky (2013), and Texas (2012). We also reviewed supplemental material, where close integration with the plan made these especially relevant. For example, Texas and Virginia had state overview documents as well as regional and local plans [22, 23]. In addition, a number of states published results of climate change vulnerability assessments and adaptation planning efforts separately from the official action plans. We considered these to be relevant to the project if the states used them to inform the SWAP process. Most plans and supplemental reports were available online. If not, we contacted the SWAP coordinator or other agency official to obtain those documents.

Several aspects of the plans were evaluated through a systematic content analysis. We developed a codebook with the specific questions and criteria to identify and document how states incorporated climate change into the SWAPs. Questions fell into three general areas:

- *Consideration or inclusion of climate change, and long-term challenges associated with climate change, in conservation goals and objectives*
- *Consideration of climate change as a conservation threat, including the known/potential effects on species and habitats*
- *Integration of climate into conservation strategies and actions*

For many questions, we developed criteria to indicate the extent to which a state considered or included climate in a particular component of the SWAP. For example, in reviewing how states assessed or determined climate threats, some states primarily drew from existing literature and national-level reports, while others conducted more detailed, state-specific analyses for the SWAP process. We independently read through the documents to identify the extent to which certain criteria were met (e.g., whether states relied on existing climate change vulnerability assessments or conducted new, dedicated assessments; whether states explicitly linked conservation actions to climatic changes or related impacts). For some questions and issues, the initial review entailed searching the document for key words (e.g., connectivity, corridors, and resilience); this often required additional follow-up to see how the terms were used in context due to the varying uses of terminology and underlying definitions. We also regularly discussed coding results and interpretations in order to resolve any inconsistencies. This approach allowed for a relatively straightforward comparison among the states in terms of their planning approaches. Appendix A lists the main questions and guidance used in the document review and coding process.

The key to developing successful climate adaptation strategies is to explicitly link those actions to climate change impacts.

TABLE 1 Questions addressed in the document analysis and interviews

Document Analysis	*Interviews*
Step 1: Define Planning Purpose and Scope	
> How was climate change addressed and included in the SWAP (e.g., was it integrated throughout the report or provided as a stand-alone section or chapter? > What planning tools and resources were used?	> What factors guided the approach to addressing climate change? > What was more (or less) challenging about addressing climate change than expected? > To what extent has your state coordinated with other states? > To what extent has the state coordinated with other partners (intrastate, interstate) on climate change issues?
Step 2: Assess Climate Change Impacts and Vulnerabilities	
> How were climate threats identified and assessed? *(Element 3)* > How was climate considered in the identification and prioritization of SGCN? *(Element 1)* > How was climate considered in the identification and assessment of key habitats? *(Element 2)*	> How did your team decide on your approach to assessing vulnerability? > What information sources and/or tools were most (or least) useful? > What was more (or less) challenging about assessing vulnerability?
Step 3: Review Conservation Goals and Objectives	
> How do SWAPs articulate overarching goals and objectives? > To what extent are goals specifically associated with addressing climate change or other future threats?	> Did considering climate change influence thinking about what goals might be achievable? *(Element 6)* > Did consideration of "resilience" factor into thinking about achieving goals in light of climate change? > Are any of the conservation goals focused on managing for change (vs. maintaining current, or restoring historical, conditions)?
Step 4: Identify, Select, and Implement Adaptation Strategies and Actions	
> Does the plan include climate adaptation actions? *(Element 4)* > To what extent are conservation actions explicitly linked to climate change impacts? ("intentionality") > Did the plan prioritize conservation actions based on climate change?	> Did consideration of climate change inform the development of conservation actions? > Has your state implemented any climate adaptation actions? Are there adaptation actions you expect to implement?
Step 5: Track Ecological Conditions and Management Effectiveness	
> To what extent do monitoring, or similar, sections include or address climate change? *(Element 5)*	> No specific questions asked

The document analysis entailed a comprehensive assessment of the plans and supplemental documents. However, while we were able to document which states used different approaches, the review did not provide a complete picture as to the reasons *why* states chose certain approaches, nor did it fully capture the nuances of how the plans followed some of the above-mentioned adaptation principles (e.g., reevaluation of conservation goals). Consequently, we conducted a series of phone interviews with the SWAP coordinators and/or other staff associated with development of the updated plans to "ground truth" our interpretations during the document review process and to glean additional information. We interviewed at least one representative from 15 states in the southeastern region.[1] Appendix B lists the interview questions. Prior to each call, interviewees were provided with a summary document for their state containing our interpretation of their approaches to integrating climate change and their use of certain terminology. During our interviews, we verified that the information provided from our analyses was accurate and sought additional context on their SWAP revision process.

Table 1 shows the key questions addressed in the document analysis and in the interviews, organized according to the climate-smart planning steps. Also noted are questions that pertain to the required elements for SWAPs (shown in italics).

[1] We were unable to arrange an interview regarding Puerto Rico's plan.

Bullfrog Creek Wildlife Environmental Area (Florida Fish and Wildlife Conservation Commission)

3 Results

This section presents results from the review of the SWAPs, relevant supplemental documents, and interviews. It is organized according to the five steps of the conservation cycle. For each "step" we include summary information from both the document and interview analyses to highlight insights regarding the SWAP process and the challenges and opportunities related to incorporating climate change into the SWAPs. Throughout this section we use specific examples provided by the states to illustrate prevalent themes or key points. In the interest of space, these examples are usually limited to one or two states. We have included examples from all states throughout the report to demonstrate the broad progress toward incorporation of climate change into conservation plans.

3.1 Step 1: Define the Planning Process and Scope

Our assessment for this step focused on the following questions and topics:

- How was climate change addressed and included in the SWAP?
- What factors guided the state's approach to addressing climate change?
- What planning tools and resources were used?
- To what extent has the state coordinated with other partners (intrastate, interstate) on climate change-related issues?
- What was more (or less) challenging about addressing climate change than expected?

3.1.1 Integrated vs. "Stand-Alone" Climate Change Considerations

As a manifestation of the considerable flexibility given to states for the planning process in general, SWAPs tend to be highly diverse. That diversity is also reflected in how southeastern states addressed climate change, from the choice of planning tools and approaches to where and how climate change was integrated into the plans. Factors such as staff capacity, ease, and consistency with other planning approaches helped determine both the methods and extent to which climate change was integrated into the action plans.

Fourteen states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Missouri, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, and Texas) highlighted climate change in a separate chapter or, in the cases of Kentucky [24] and Puerto Rico [25] a separate report, reflecting a more "stand-alone" approach [11]. During the interviews, many of these states acknowledged that the choice to address climate change as a somewhat separate issue was due to ease and limited staff capacity. Delegating the task to one or several internal and/or external experts was considered more feasible than increasing the climate-related capacities of multiple team members. The Oklahoma interviewee also suggested that it was a useful way to introduce a "new" issue into the planning process.

While Alabama, Arkansas, Oklahoma, and Kentucky treated climate change exclusively as a stand-alone issue, ten states (Florida, Georgia, Louisiana, Missouri, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, and Texas) also integrated at least some discussion of climate change into other sections of their plans. Virginia and West Virginia integrated climate change throughout their plans without a dedicated climate chapter, although both states, along with North Carolina and Tennessee, also published results of climate change vulnerability assessments as separate documents (see Section 3.2).

3.1.2 Planning Tools and Resources

A considerable number of tools, frameworks, trainings, and guidance documents exist to assist conservation practitioners in planning for climate change. As illuminated during the document reviews and interviews, SWAP planners relied on a variety of existing resources, many of which were common across the region (see Table 2, page 10). In addition, many agencies noted that leadership and assistance from key climate science and adaptation experts from both within and outside of their agencies proved to be invaluable. Several interview participants acknowledged the usefulness of coordinating with other states' SWAP coordinators to share experiences and gain insights on alternative approaches to address climate change. For example, planning teams from Louisiana, Arkansas, and Georgia built upon Tennessee's methodologies for

Many agencies noted that leadership and assistance from key climate science and adaptation experts from both within and outside of their agencies proved to be invaluable.

TABLE 2 Examples of climate adaptation planning tools, approaches, and resources referenced in documents and interviews

	AL	AR	FL	GA	KY	LA	MS	MO	NC	OK	PR	SC	TN	TX	VA	WV
AFWA Voluntary Guidance/ Best Practices Reports [14, 15]	X		X	X		X	X		X				X	X		X
NWF Climate-Smart Conservation [11]	X	X		X								X	X		X	
US Forest Service resources (e.g., TACCIMO [26])						X		X	X							
US Fish & Wildlife Service Climate Academy	X	X														
Climate Science Centers		X		X		X			X	X	X	X	X		X	
Landscape Conservation Cooperatives	X	X	X	X		X	X		X	X	X	X	X	X	X	X
National Fish, Wildlife, and Plants Climate Adaptation Strategy [16]	X	X		X		X	X					X	X			
State Natural Heritage Programs									X					X		X
Other (e.g., NGOs, consultants)	X		X		X	X			X				X		X	X

assessing species and habitat vulnerability. A few interviewees also indicated that their approaches evolved over time as they became more engaged in climate change discussions. North Carolina, Texas, and West Virginia, for instance, coordinated with their respective state natural heritage programs to enhance capacity after realizing early in their planning process that such expertise was needed.

3.1.3. Observations on Collaboration

Intrastate collaboration. ***Element 7*** requires state fish and wildlife agencies to coordinate across other state agencies, local and federal agencies, and Indian Tribes in the development, implementation, review, and revision of their conservation strategies. While each state has a designated agency, team, and/or coordinator to lead the SWAP process, many different entities within any given state will be involved in resource management and/or conservation activities. Supporting within-state partnerships can be an important mechanism for addressing climate risks and vulnerabilities. For instance, the Florida interviewees acknowledged several factors that have fostered intrastate collaboration, including:

- Robust funding sources for aquatic restoration projects that have provided opportunities to coordinate across the freshwater and estuarine environments;
- Presence of university-based researchers who work on climate change issues; and
- Local efforts (such as the Southeast Florida Regional Climate Change Compact) that have taken the initiative to convene different constituencies on climate change issues.

Many interview participants noted institutional challenges within and among their government agencies, or between the agencies and other local organizations, as potential barriers to collaboration. On the other hand, the interviewee from Texas noted that improving communication across divisions and between different departments has helped increase capacity and enhance opportunities to accomplish larger conservation goals, such as those intended to address climate change.

Interstate and regional collaboration. Given the SECAS interest in facilitating regional collaboration on conservation priorities, one of the key issues we wanted to illuminate was the degree to which states have worked, or hope to work, with other states in both planning and implementation of climate adaptation strategies. Although neither interstate nor regional coordination is a required element of the SWAPs, nearly every state in the region recognized the importance of working on a larger landscape scale and longer timeframe than they may have done traditionally in order to address broad challenges such as climate change. However, there was virtually across-the-board acknowledgement among interview participants that aspirations about regional collaboration in the development and implementation of SWAPs often fell short. The interviews revealed several reasons for this disconnect, ranging from the existence of different priorities among states to genuine feelings of myopia and competition for federal conservation funding. From a planning perspective, states were at different stages of their processes at any given time. In addition, they often used dissimilar spatial and temporal scales in their studies, making cross-state planning more difficult.

TABLE 3 Examples of planning challenges and opportunities identified by interview participants

Challenges	Opportunities
Lack of information for some state-specific habitats and species of concern	Availability of information for some topics and species
Lack of resources to conduct more research	Availability of trainings (e.g., Climate Academy on-line training) to increase familiarity with the issue
Limited staff	Assistance from the LCCs, the Southeast CSC, and other outside experts
Lack of expertise within the agency	Ability to engage staff when they realized that addressing climate change could be linked with other ongoing activities
Lack of information on impacts, which reduced the sense of urgency to address the issue	
Difficulty planning on long time frames	
Long-term climate change considered less urgent than other threats (e.g., land conversion, urbanization)	

On the positive side, interviewees acknowledged that important opportunities exist for multi-state collaboration on climate adaptation. Both in the plans and interviews, states specifically highlighted the important roles of the regional Landscape Conservation Cooperatives (LCCs) and the Southeast Climate Science Center (CSC)[2] had played in facilitating collaboration on climate change and other long-term challenges. Several interview participants also referenced regionally-focused efforts as being important foundations and catalysts for collaborative conservation efforts (e.g., SECAS, the Southeast Aquatic Resources Partnership [SARP], and the Joint Ventures). Most of the discussion on collaboration involved species of concern or habitat types common across state borders.

Participants from Virginia and West Virginia, which are members of both the Northeast Association of Fish and Wildlife Agencies (NEAFWA) and the Southeastern Association of Fish and Wildlife Agencies (SEAFWA), pointed to recent NEAFWA collaboration on climate change adaptation efforts as a useful model for similar collaboration in the Southeast [27]. The interviewee from Alabama suggested that there may be "common threads" that can be capitalized on, such as the existence of similar SGCN in neighboring states. The Tennessee participant suggested that, with sufficient funding, states across the region have significant opportunities to facilitate adaptation among migratory birds, perhaps focusing on urban areas as stepping stones.

Interview participants from Mississippi, Tennessee, and Virginia underscored the importance of SARP and other efforts to help advance aquatic habitat connectivity throughout the region and to facilitate fish passage as habitat conditions change. Participants from coastal states emphasized the need for a consistent framework for regional strategies to address sea level rise and more intense coastal storms.

3.1.4. Planning Challenges and Opportunities

During the interviews, participants were asked to identify what, if anything, was more or less challenging about addressing climate change than they had expected. Some responses were more relevant to subsequent planning steps (e.g., assessing vulnerability) and are therefore discussed elsewhere in this report. Here, we highlight challenges and opportunities most relevant to climate change adaptation planning in general. Table 3 highlights a range of issues noted by participants. Three prevalent themes center on *data and information*, the availability of *resources and expertise*, and *institutional support for climate action*.

Data and information. Overall, interviews revealed that agencies had varying experiences and perspectives on the availability and use of climate data and information, specifically as it pertained to impacts on habitats and species of concern. Some participants indicated that they had access to the necessary climate information and resources to inform their plans. Others reported challenges in covering the vast amount of available climate information in a manner that would make the plan useful and efficient. Still others noted that a lack of information regarding specific climate impacts to individual states, habitats, and species of concern hindered the development of strategies and actions to address those impacts. These differing experiences suggest that future planning efforts may benefit from opportunities for states to discuss and develop shared approaches.

Resources and expertise. Many interview participants expressed concern about a lack of resources (e.g., staff and funding) to develop their updated SWAPs in general, let alone address climate change. Due to limited time and available staff, delegating the adaptation planning elements to one or more internal and/or external experts was considered more feasible than increasing the capacity of multiple staff members. Several interviewees also

[2] In 2018 the Southeast Climate Science Center was renamed the Southeast Climate Adaptation Science Center.

acknowledged that limited funds hindered their ability to build state-specific climate change knowledge and expertise, such as through participation in trainings. On the other hand, agencies whose staff were able to participate in trainings found them to be useful.

Institutional support for climate-related activities. In a few cases, interview participants suggested that climate change may not be prioritized for action due to many other significant stressors such as human population increases, urbanization, and agricultural development. Because climate change is often perceived as a distant and somewhat uncertain threat, their sense of urgency to act on climate is less compared to more immediate threats. Additionally, for states that have not seen much empirical evidence of climate change, the timeline for addressing the effects of climate change appeared beyond the scope of the current 10-year SWAP planning cycle. Interviewees from several states suggested that their ability to address climate change was somewhat limited given existing "political sensitivities" and level of support from elected officials as well as within their agencies, though most also expressed confidence that opportunities for further work on climate change are likely to increase. In contrast, several participants remarked that politics proved less challenging than they had thought in terms of their ability to address climate change.

3.2 Step 2: Assess Climate Change Impacts and Vulnerabilities

Our assessment for this step focused on the following questions and topics:

- How were climate change threats identified and assessed?
- How was climate change considered in the identification and prioritization of SGCN?
- How was climate change considered in the identification and assessment of key habitats?
- How did your team decide on your approach to (species, habitat) vulnerability assessment?
- What information sources and/or tools were most (or least) useful?

3.2.1 Climate Change as Conservation Threat

All SWAPs evaluated for this study acknowledge climate change as one of the problems of concern for target species and/or habitats, consistent with required ***Element 3***. Each plan (or relevant companion document) provides at least a basic discussion of climate change trends and projections for the region and general impacts and ecological responses. The documents reviewed exhibit a high degree of consistency regarding the overarching climatic variables and impacts of concern, though the level of detail of the discussions varies. Every plan/document notes higher air temperatures, shifts in precipitation and drought patterns, and shifts in species and/or habitat ranges as likely for their state and region. All of the coastal states expressed concerns about sea level rise. Most states also acknowledge extreme precipitation events, storms, and flooding; higher stream temperatures; altered hydrology and water quality; expansion of invasive species; and altered species interactions as important.

Classification of threats. In developing their updated plans, most states generally followed the threat classification system developed by the International Union for Conservation of Nature (IUCN) and the Conservation Measures Partnership (CMP), which includes a category for climate change and severe weather, along with the definitions highlighted in *A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions* [28]. While West Virginia applied the IUCN-CMP system, they purposefully chose the term "stresses" over "threats," the distinction being that many of the problems that cause negative effects on habitats at any one time tend to be "more chronic than acute" [29]. This diverges somewhat from the aforementioned standard lexicon, which defines stress as a symptom, or outcome, of a direct threat (e.g., habitat destruction is a stress created by conversion to agriculture). The Oklahoma plan refers to threats as "conservation issues," with climate change considered separately as an emerging issue for long-term conservation planning [30]. Beyond the initial classification of climate as a threat, the plans and/or companion materials are highly varied in how they describe climate change. For instance, some documents focus more on the severe weather aspect of the climate threat, rather than on climate change explicitly.

Consideration of synergistic effects. Most plans and/or companion documents mention the synergies between climate change and other problems, such as urbanization, land use changes, and pollution, as especially challenging. Several states placed considerable emphasis on those interconnections in their planning processes. North Carolina's planning team conducted comparisons of climate change with other threats for all of its target natural community types to help them determine short-term and long-term conservation actions and recommendations [31]. For instance, team members did not consider climate change to be the most significant threat to its coldwater ecosystems, although concern about the synergistic effects between climate change and development and lack of forested corridors elevated the agency's level of concern about these systems' ability to support target SGCN in some areas. Louisiana used the NatureServe Conservation Status Assessments: Rank Calculator (Version 3.186), which includes a threats calculator that incorporates the IUCN-CMP lexicon, to prioritize threats for each habitat and basin treated in the 2015 plan [32]. This allowed for a direct comparison of the relative scope, severity, and impacts of general (1st level) threats, including climate change [33]. In the threat assessment for freshwater floating marsh, for example, the SWAP planning team rated Climate Change & Severe Weather as Pervasive in scope, Extreme in severity, and Very High for impact, while

Most interview participants expressed confidence that opportunities for further work on climate change are likely to increase.

Human Intrusion/Disturbance was rated as Small, Slight, and Low. In contrast, for lakes and reservoirs, Residential/Commercial Development was rated as Large, Serious, and High, while Climate Change & Severe Weather was Small, Slight, and Low.

Immediate v. longer-term threats. Plans from North Carolina and Oklahoma acknowledge that failure to think about long-term problems (e.g., land use change and climate change) may mean that important conservation opportunities would be foregone. For example, the North Carolina plan notes the importance of considering the potential for maritime forests to migrate inland, which could provide potential future habitat. It recommends making "remaining coastal maritime habitats a priority for land acquisition efforts," even though "…coastal uplands are the most costly areas to acquire in the state" [31]. Oklahoma's plan suggests that "[t]he concept of adjusting natural systems to moderate the harmful effects of changing conditions and to exploit the beneficial opportunities is a fundamental principle that applies to all long-term conservation planning," adding "[m]any of our commonly-implemented, short-term conservation actions can be strategically modified, coordinated, and expanded to address the long-term challenges brought about by changes in climate, human population growth, development pressure, or land use practices" [30].

Eastern Hemlock (Doug McAbee)

Interview participants from Alabama, Arkansas, and Tennessee indicated a relatively low sense of urgency about climate change given that many changes seem to be long term and gradual. Alabama's representative, for example, conceded that due to so many pressing issues, many people in the agency felt that "issues that could happen years down the road" would "have to be put aside" for now. The interviewee from Kentucky, on the other hand, expressed an alternate perspective in which, "the cloud of climate change hanging over everything really pushes that sense of urgency more."

Consideration of broader geographic scales. Although the region's habitats and species are highly diverse, certainly commonalities exist across neighboring states and along the coasts. Understanding vulnerabilities beyond state boundaries is essential for developing effective adaptation strategies, as both climatic changes and the responses of species and habitats occur at multiple spatial scales. While the discussion of impacts in the plans and/or companion materials largely focuses on the vulnerability of habitats or ecosystems within the particular state, broader assessments referenced by states could serve as foundations for future regional collaboration. For example, the Louisiana plan highlights both the local and broader regional vulnerabilities of coastal habitats and associated species, drawing from the Gulf Coast Vulnerability Assessment [34] and a Gulf-wide application of the Sea Level Affecting Marshes Model (SLAMM) [35].

3.2.2 Vulnerability Assessment Tools and Approaches

Two fundamental activities of the SWAP process are to provide information on 1) the distribution and abundance of wildlife species, including low and declining populations (***Element 1***) and 2) the location and relative conditions of key habitats essential to the conservation of each state's SGCN (***Element 2***). All plans and/or companion documents included in this study offered at least some discussion of the current and potential impacts of climate change on SGCN and associated habitats. Climate change vulnerability assessments – whether preexisting or conducted purposefully to inform the planning process – played an essential role in helping SWAP planning teams better understand climate-related impacts and risks.

States used a wide range of methods and tools to assess vulnerability of species and/or habitats, including literature reviews, indices, model-based assessments, expert opinion (e.g., in taxa teams or work groups), or a combination of these. The choice of assessment methods depended on a variety of factors, including the management questions of concern, the types of conservation targets (e.g., species, habitats, ecosystems, etc.), the geographic scope, institutional capacity (e.g., time, funding, and expertise), and the availability (perceived or real) of relevant information. Table 4 (page 14) highlights some of the tools and resources used by the states in their vulnerability assessments. Some tools and resources focus on the exposure (climate) component of vulnerability (e.g., Climate Wizard [36]), while other approaches integrate exposure, sensitivity, and adaptive capacity components (e.g., NatureServe's Climate Change Vulnerability Index [37]).[3]

[3] Vulnerability to climate change is generally characterized as having three components: sensitivity, exposure, and adaptive capacity, whereby: 1) sensitivity is the degree to which a species or habitat will be affected by and respond to a given change in climate or related effect; 2) exposure is the degree to which a system (i.e., species or habitat) is subjected to a given change; and 3) adaptive capacity is the system's ability to accommodate or cope with the climate-related change.

TABLE 4 Examples of vulnerability assessment tools and resources used or referenced in the SWAPs

	AL	AR	FL	GA	KY	LA	MS	MO	NC	OK	PR	SC	TN	TX	VA	WV
Literature review/ previous assessments	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Climate Wizard		X	X		X	X			X	X	X		X			
Climate Change Vulnerability Index (CCVI)			X			X							X			X
TNC Resilient Sites	X			X					X				X		X	
Sea Level Affecting Marshes Model (SLAMM)			X	X		X			X			X				
Other model-based approaches			X										X		X	
Expert opinion/consultants			X			X			X			X	X		X	X

At the most general level, states typically relied on reviews of existing literature to highlight vulnerabilities among individual species and/or habitats. Summaries of those reviews ranged from very general discussions in the action plans themselves (e.g., Missouri and Mississippi) to dedicated, stand-alone documents (e.g., North Carolina [38], Puerto Rico [25], South Carolina [39], and Tennessee [40]). Six states in the region (Florida, Louisiana, North Carolina, Tennessee, Virginia, and West Virginia) conducted dedicated species and/or habitat assessments with the intent to inform the SWAP process. We highlight these states' approaches and results for species and habitats/ecosystems below.

Index-based assessments. Four states (Florida, Louisiana, Tennessee, and West Virginia) applied NatureServe's Climate Change Vulnerability Index (CCVI). The CCVI is a worksheet-based tool designed to facilitate relatively rapid assessments of the potential vulnerability of plant and animal species to climate change within a defined geographic area [37]. In addition to providing relative rankings for vulnerability among individual species and taxa, which can be used for prioritization, the CCVI allows for detailed narratives describing underlying assumptions, scientific references, and other sources underlying the ratings. Because the CCVI is useful for assessing a large number of species, it has emerged as one of the most popular tools among states across the country to assess climate vulnerability of SGCN [41].

Given the large number of SGCN, each planning team chose a subset of species for assessment based on factors such as: their perceived vulnerability; their role as indicators of ecosystem health; their range within the state and/or region; and the availability of information. Florida assessed 26 of its 1,036 SGCN [42]; Tennessee assessed 189 of more than 1,400 [43]; and West Virginia assessed 185 of 517 [44]. Louisiana initially applied the CCVI to 70 of 308 non-marine species (CCVI is not applicable to marine species), then relied on input from agency experts to conduct similar scoring for the remaining species [33]. For details on the CCVI and results of these assessments, we refer readers to the original study documents cited in the references.

Modeling and spatial analysis. Much of the scientific literature on species and habitat vulnerabilities referenced by states in the region focuses on model-based assessments, which often entail spatially explicit analyses and/or application of detailed physical or population models. These can involve a variety of approaches, including general characterization models, habitat and occupancy models (including bioclimatic envelope models), vegetation/habitat response models, physiologically based models, and ecological models [19]. Three states (Florida, Tennessee, and Virginia) conducted model-based assessments specifically to inform their SWAP updates. Below are brief descriptions of their efforts. Again, we refer readers to the cited studies for details on approaches and results.

The Florida team worked with the Massachusetts Institute of Technology (MIT) to conduct "spatial resilience planning," a multiple scenario-based approach that evaluated the vulnerability of species of concern across a range of socioeconomic and biophysical changes, over a 50-year time horizon [45].

Tennessee and its partners conducted a spatial analysis of climate change vulnerability across terrestrial habitats to help inform land management efforts [43]. The study included comparisons between Terrestrial Habitat Priority areas identified for the 2015 SWAP and several established indices of potential climate stress and resilience, including the Terrestrial Climate Stress Index (TCSI) developed by the U.S. Forest Service and areas identified as

Resilient Sites for Terrestrial Conservation by The Nature Conservancy (TNC) [46].

Virginia worked with the National Wildlife Federation (NWF) and the Conservation Management Institute at Virginia Tech to downscale climate data for the state and apply a bioclimatic envelope model to assess vulnerability of 20 SGCN [47].

Expert opinion. Engaging scientific experts in the vulnerability assessment process can be useful on its own or as a supplement to other assessment approaches. This can be done formally (e.g., through a facilitated "expert elicitation" process [48]) or informally (e.g., through work groups or other means), and participants can be from within and/or outside of the agency. While many of the states in the region engaged experts in one form or another, North Carolina's approach was notable. Specifically, the state conducted an assessment of ecosystem responses to climate change with input by scientific staff of other conservation agencies [49]. Using projections for key climate change variables, expert panels identified potential impacts for 42 ecosystems and associated species and habitats.

3.2.3 Vulnerability Assessment Challenges and Opportunities

Interview participants noted aspects of vulnerability assessment that they found more (or less) challenging and identified resources that they found especially helpful (see Table 5). Again, availability of *resources and expertise* was identified as a significant factor in determining how states approached vulnerability assessment. Considerable discussion also focused on the availability of and confidence in relevant *data and information* to inform the process.

Resources and expertise. Many interviewees identified limited staff, expertise, and funding as barriers to assessing vulnerability of species and habitats, with some notable exceptions. The Florida participant, for example, acknowledged that their high capacity and access to a plethora of information about climate change impacts and vulnerabilities in the state has been a significant asset and enabled the state to be "steps ahead" of many other states in adaptation planning. Nevertheless, the state grapples with what additional vulnerability assessment approaches and tools will be most useful as it continues to build on its plan, acknowledging that there are "too many species of concern to assess them all."

Participants from nearly every state acknowledged that engaging experts, including those from the regional CSCs, LCCs, academic institutions, and NGOs, helped them navigate the sea of climate change information and make that information relevant for their particular planning needs. Conversely, among states that applied the CCVI, having internal taxa experts review and/or apply the CCVI (as opposed to relying exclusively on outside consultants or other partners) gave agency staff greater confidence in and a sense of ownership of the results. The exercise was also useful in that it helped the agencies' wildlife experts better understand the specific ways in which climate change might affect species of concern.

Data and information. Interview results suggested a dichotomy of perspectives on the availability and relevance of data and information on species' sensitivities and adaptive capacity to inform vulnerability assessments. Participants from Alabama, Oklahoma, and Texas suggested that a lack of specific information about the vulnerability of SGCN was a reason for not including it in the species selection or prioritization process for the current SWAP update. On the other hand, interviewees from Georgia, North Carolina, Texas, and Tennessee noted that

TABLE 5 **Examples of vulnerability assessment challenges and opportunities identified by interview participants**

Challenges	*Opportunities*
▸ Lack of information about many species (distribution, occurrence, life history, ecology) ▸ Ability to assess large number of species ▸ Ability to keep up with new information and resources ▸ Applying broad-scale information to local contexts ▸ Climate change models and impacts – Lower confidence in projections for precipitation than temperature – Lack of consistency in climate projections – Ability to assess confidence in models – Ability to determine when climate change is a driver	▸ Availability of good data and information ▸ Availability of guidance and support from external sources ▸ Engaging internal staff in conducting vulnerability assessments improved knowledge and confidence in results

deciding how to assess vulnerability was initially very difficult given the "overwhelming" amount of general climate change information available.

Overall, participants acknowledged greater availability and higher degrees of confidence in climate models than in the past. As noted above, the vast amount of valuable climate data available, in contrast with lack of state-specific data on local habitats and species of concern, was discussed as a significant challenge when attempting to apply climate information to their assessments and goals. However, several interviewees noted that further improvements in the "consistency" and "accuracy" of climate change projections were necessary to enhance future adaptation planning efforts. Interview participants from Arkansas, Missouri, Texas, and Tennessee expressed particular concern about the uncertainties in model projections for precipitation. Several other states (e.g., Florida [50], South Carolina [51]) have already conducted or are planning to conduct scenario planning to address inherent uncertainty in climate projections and associated impacts.

3.3 Step 3: Review Conservation Goals and Objectives

This section highlights results for the following questions and topics:

- How do SWAPs articulate overarching conservation goals and objectives?
- To what extent are goals specifically associated with addressing climate change or other future threats?
- Did consideration of climate change influence thinking about what goals might be achievable or not?

TABLE 6 Examples of conservation goals articulated in the SWAPs

State/ Territory	Example Goal Statement
Alabama	"Conserve our rich natural heritage, for future generations to experience the biodiversity and beauty we enjoy" [53]
Arkansas	"Keep common species common for the benefit of all" [54]
Florida	"Facilitate habitat conservation efforts on the high-priority habitat categories to improve their health and resiliency and to achieve their long-term ecological sustainability statewide" [50]
Georgia	"Maintain Georgia's diversity of native species and natural habitats" [55]
Kentucky	"Manage for the perpetuation of [fish and wildlife resources and their habitats] and their use by present and future generations" [56]
Louisiana	"Provide the habitat and ecosystem functions that support healthy and viable populations of all species, avoiding the need to list additional species under the ESA while insuring that commonly occurring species do not experience declines" [33]
Mississippi	"Protect and improve Mississippi's diversity of native species and habitats" [57]
Missouri	"Support Missouri's full diversity of fish, wildlife, and plants for future generations of Missourians to enjoy" [58]
North Carolina	"Conserve and enhance the state's full array of fish and wildlife species and their habitats" [31]
Oklahoma	"Conserve our rare and declining wildlife species and in doing so maintain Oklahoma's rich biological heritage for present and future generations" [30]
Puerto Rico	"Conserve Puerto Rico's wildlife and natural areas for future generations" [59]
South Carolina	"Sustain South Carolina's diverse wildlife resources" [51]
Tennessee	"Preserve, conserve, protect, and enhance the fish and wildlife of the state and their habitats for the use, benefit, and enjoyment of the citizens of Tennessee and its visitors" [60]
Texas	"Continue to protect lands and water for future generations of people, fish and wildlife" [61]
Virginia	"Benefit a diversity of species and habitats" [62]
West Virginia	"Conserve the full array of habitat types and biological diversity in the state" [29]

- Did consideration of "resilience" factor into thinking about achieving goals in light of climate change?
- To what degree are goals focused on maintaining persistence vs. facilitating change?

3.3.1 Overarching Conservation Goals

At their highest level, the conservation goals articulated in SWAPs largely focus on the persistence of the state's native fish and wildlife species and their habitats for current and future generations (Table 6). This finding was not unexpected, as it reflects the primary intent of the SWG Program to preserve our nation's ecological heritage, indeed, the primary mission of state fish and wildlife agencies. That said, the goals also tend to be highly general, which provides some flexibility for further refinement as warranted [52].

3.3.2 Consideration of Climate-Informed Goals

As introduced in Section 2.1.1 (Principles for Effective Adaptation Planning), confronting climate change and other broad-reaching, long-term threats necessitates planning for future, rather than past, conditions. This will entail adopting forward-looking goals and implementing management strategies specifically designed to adjust to current and future climatic, ecological, and social changes. It also involves managing for continual change, which may require reconsideration of underlying conservation goals [63].

Recognition of the challenge. Most plans and/or companion materials highlight the need to reconsider conservation *strategies* in light of climate change, building on the fundamentals of adaptive management. However, only a few documents explicitly acknowledge the need to reconsider or update conservation *goals* or *targets* (e.g., SGCN). For example, the South Carolina plan recognizes: "We will also need to constantly re-evaluate [the state's] priority species list as species may be added or removed as they adapt/react to climate changes" [51]. Kentucky notes in its climate change report: "[t]o effectively conserve [the state's] fish and wildlife resources amidst changing environmental, climatic, and social conditions, we must monitor the success of our conservation actions and create future goals based on these results" [24].

The interview process revealed more robust, behind-the-scenes discussions of the challenges that climate change brings to achieving some existing goals and the likely need for the evaluation and reevaluation of goals over time. The participant from Florida, for instance, noted that "hard conversations" will be necessary but have not been part of the SWAP process. Considering that places such as the Florida Keys "could be under 3 feet of water in 40 or 50 years, how does that change what we are doing now?" The state's fish and wildlife managers are grappling with how to monitor changes over time and identify "trigger points" that would indicate that priorities might need to change (see Section 3.5). The interviewee from Virginia acknowledged that identifying possible adaptation opportunities during the species prioritization process can help states decide how to spend valuable resources on actions that can achieve the most success for particular species or benefit many species. For some critically endangered species, however, several interview participants acknowledged that there may ultimately be little that an individual state can do as climate change continues to unfold.

National Fish, Wildlife, and Plants Climate Adaptation Strategy. Plans from five states (Arkansas, Georgia, Louisiana, Mississippi, and Tennessee) explicitly articulate "climate change adaptation" goals, drawing from and building on the goals included in the *National Fish, Wildlife, and Plants Climate Adaptation Strategy* (NFWPCAS) (see Box 2) [16].

The Arkansas planning team developed specific management objectives for the first four goals. Under Goal 1, the state's plan acknowledges, "[i]t may be possible to ameliorate the effects of climate change through direct management activities. For instance, restoring a natural fire regime to grasslands and open woodlands will reduce fuel loads and lessen the potential for catastrophic wildfires" [54].

Louisiana's team did a crosswalk between the each of the NFWPCAS goals and selected goals and objectives of their Wildlife Action Plan and developed specific, climate-informed objectives to achieve them. For example,

BOX 2

Goals in the *National Fish, Wildlife, and Plants Climate Adaptation Strategy*

- ***Goal 1:*** Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate
- ***Goal 2:*** Manage species and habitats to protect ecosystem functions and provide sustainable cultural, subsistence, recreational, and commercial use in a changing climate
- ***Goal 3:*** Enhance capacity for effective management in a changing climate
- ***Goal 4:*** Support adaptive management through integrated observation and monitoring and use of decision support tools
- ***Goal 5:*** Increase knowledge and information on impacts and responses of fish, wildlife, and plants to a changing climate
- ***Goal 6:*** Increase awareness and motivate action to safeguard fish, wildlife, and plants in a changing climate
- ***Goal 7:*** Reduce non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate

TABLE 7 Perspectives on resilience

General or Persistence-oriented Perspectives	
Arkansas	"Our overarching goal will be to implement the wildlife action plan, which will increase adaptive capacity and affords our best chance of reducing threats to species and ensuring healthy, stable populations of SGCN will be more resilient in the face of climate change" [54]
Kentucky	"If appropriately funded, Kentucky's Action Plan…would increase the resilience of our resident fish and wildlife populations in the face of climate change and will increase the likelihood of survival and recruitment of these populations" [24].
North Carolina	"Resilience: The ability to retain essential processes in the face of disturbances or expected shifts in ambient conditions; ecosystem resilience provides the ability to support native diversity" [31].
South Carolina	"We define resilience as the ability of a system to recover to a steady state; it's the baseball analogy – although the players may change, the game is still the same" [interview response].
Texas	"With our current levels of information, it is difficult to predict exact system changes; therefore, to the extent that we can reduce current adverse pressures and improve the resiliency of ecosystems, climate change's adverse impacts may be ameliorated" [61].
West Virginia	"Implement a comprehensive plan to enhance climate change resiliency through reducing other stressors (such as invasive species), identifying, maintaining, and creating key habitat cores and corridors, and protecting areas of high landscape complexity and integrity" [29].
Change-oriented Perspectives	
North Carolina	"A resilient network is a structurally intact geophysical setting that sustains a diversity of species and natural communities, maintains basic relationships among ecological features and key ecological processes, and allows for adaptive change in composition and structure" [31].
Oklahoma	"Resilience is the ability of a population or community, or an ecological process, to recover or maintain a new stable state after disturbance. Adaptability contains elements of resilience, but also includes the ability of species to change genetically, temporally, spatially, or behaviorally in response to environmental change" [30].

in support of Goal 6, the action plan acknowledges that "climate change adaptation efforts will be most successful with buy-in from conservation partners, landowners, and the general public. Therefore, it could prove advantageous to incorporate information about the potential impacts of climate change into current outreach efforts, or to develop entirely new outreach products or methods" [33].

Consideration of climate change in the selection and/or prioritization of SGCN. Plans from three states (Georgia, North Carolina, and West Virginia) explicitly acknowledge consideration of climate change as a factor in the *selection* of updated SGCN (i.e., additions and/or subtractions from the previous list of species). For example, Georgia added several species of birds (seaside sparrow, saltmarsh sparrow, and Nelson's sparrow) to its 2015 list of high priority species given their vulnerability to more extreme droughts and floods [55]. Several other states, including Louisiana, South Carolina, and Tennessee, used climate change vulnerability as a criterion for *prioritizing* SGCN in their plans (i.e., ranking them based on conservation need).

Perspectives on resilience. The concept of resilience featured prominently in the climate change discussions among states featured in this study, although the specific definitions and context in which it was used varied state-by-state. In general, a focus on resilience is not surprising, as it has frequently been viewed as synonymous with adaptation within the conservation field [64]. As such, it is often articulated in the plans as a goal itself rather than, more appropriately, as a means to achieve conservation goals. We therefore highlight how states addressed resilience in this section, as well as offer additional examples in Section 3.4 (Identify, Select, and Implement Adaptation Strategies and Actions).

Enhancing the resilience of species and ecosystems to climate change can be meaningful, as long as the concept is well defined. In general, definitions of resilience encompass the range of adaptation responses, from resistance to change (i.e., maintaining or returning to a particular functional state) to realignment in response to change (i.e., having the capacity to adapt and reorganize to be better

prepared for climate impacts). Often, however, the term resilience is ambiguous and is applied in a variety of ways, both across disciplines and within the conservation field itself [65]. Indeed, during the interviews, the Florida participant indicated that the agency purposefully avoided using the term in its action plan, acknowledging that it has become somewhat of a "buzzword." The interviewee from Texas suggested that ensuring the resilience of all species to climate change is likely "pie in the sky" – especially since there is still "so much that is unknown about the current status of many species." The Tennessee representative acknowledged that one of the problems with using resilience is that "we're not sure what it really means…we don't really have the institutional knowledge to say 'this is going to be a resilient landscape,' or know how to manage it." While the use of the term resilience in most of the review documents is highly general and persistence-oriented, several notable examples illustrate a more purposeful application of the concept as it relates to climate adaptation. Table 7 highlights excerpts and interview responses that reflect both perspectives.

Green Anole (Chaney Shultz)

Several plans also acknowledge the Resilient Sites for Terrestrial Conservation approach developed by TNC to identify potential priority areas for conservation [46]. The approach is intended to facilitate the identification of terrestrial areas that are expected to continue to support high levels of biodiversity under changing climate conditions given a variety of ecologically-relevant physical landscape features. While Tennessee was the only state to explicitly apply the concept for habitat prioritization in its action plan update, Alabama, Georgia, North Carolina, and Virginia highlighted it as a possible next step. That said, the interviewee from Georgia suggested that the approach was "a hypothesis to be tested."

Envisioning change. Aside from the application of resilience, few states articulated climate-related goals or targets that move beyond persistence and explicitly envision change. However, we did identify several examples that reflect at least some acknowledgement of inevitable system changes.

Alabama's SWAP notes that "[d]ecisions on how to manage public lands and waters should emphasize restoring and/or enhancing natural habitats to maximize ecological benefits and achieve desired future wildlife habitat conditions" [53].

The North Carolina plan recognizes that "[m]anatees, Roseate Spoonbills, and possibly other species may be able to persist in North Carolina in the future with warmer weather" [31].

South Carolina's plan suggests that, "[a]s climate changes, so too will species ranges, making it more difficult to determine what was introduced versus what arrived here on its own. The definition of 'exotic' may evolve over time to encompass these new arrivals as they become part of the local ecosystem" [51].

Importantly, these acknowledgements do not express whether or not such changes are "desirable"—ultimately, that will require discussions of values and trade-offs.

3.4 Step 4: Identify, Select, and Implement Adaptation Strategies and Actions

Under this step, we focused on several key questions and topics:

- To what extent does the plan include specific actions to address climate change?
- To what degree are adaptation actions explicitly linked to climate change impacts?
- Did the plan prioritize conservation actions based on climate change?
- In what ways, if any, did consideration of climate change contribute to new/different conservation actions or revisions to current actions?
- Have you and/or your partners implemented any adaptation actions since you finished the plan?

As noted under ***Element 4***, updated SWAPs are required to describe the conservation actions needed to address identified threats to SGCN and their habitats [14]. Collectively, the plans, companion documents, and interviews revealed a continuum of approaches in how the states integrated climate change into their conservation strategies and actions. We also note that any individual state may have demonstrated one or more of these approaches:

- No consideration of climate change
- Discussion of general climate change adaptation strategies
- Assumption that existing conservation best practices will be appropriate for climate change adaptation (i.e., that "business-as-usual" will be sufficient)
- Identification of co-benefits of conservation strategies for climate change (e.g., strategic land acquisition to enhance habitat as well as facilitate species' movements across the landscape)

Few states articulated climate-related goals or targets that move beyond persistence and explicitly envision change.

(continued on page 21)

TABLE 8 Examples of general adaptation strategies identified by states in the region

Reduce non-climate stressors: Minimize localized human stressors (e.g., pollution) that hinder the ability of species or ecosystems to withstand or adjust to climate events	
Louisiana. "The reduction of non-climate stressors is an important part of our approach to addressing the potential impacts of climate change, as this includes the conservation actions that LDWF and other conservation partners are currently undertaking in Louisiana to benefit SGCN and their habitats" [33].	**Texas**. Among "Guiding Principles and Actions Related to Climate Change Adaptation": "Review habitat management plans, species management plans, and other conservation management plans to ensure that non-climate stressors are identified; that mechanisms exist to address these factors in the future; that these are being addressed explicitly where possible; and encourage the formation of regional cooperatives to tackle these issues on a landscape scale" [61].
Protect key ecosystem features: Focus management on structural characteristics (e.g., geophysical state), organisms, or areas (e.g., spawning sites) that represent important "underpinnings" or "keystones" of the current or future system of interest	
Alabama. "By conserving all types of geophysical settings and using site resilience criteria to select places for conservation action, the variety of diversity conserved may be expanded with increased probability of persistence over time" [53].	**Virginia**. "Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change" [62].
Enhance connectivity: Protect, restore, and create landscape features (e.g., land corridors, stream connections) that facilitate movement of water, energy, nutrients, and organisms among resource patches	
Georgia. Under "Highest Priority Conservation Actions" for climate change: "Create a map to help guide land acquisition and identification of greenways and wildlife corridors" [55].	**Mississippi**. "Working with stakeholders such as local, state, or federal agencies, LCCs, Joint Venture Partnerships, NGO's identify and conserve tracts of land that would maintain or restore habitat connectivity (i.e. corridors) and allow for the shifting range of habitats due to climate change" [57].
Restore ecological structure and function: Rebuild, modify, or transform ecosystems that have been lost or compromised, in order to restore desired structures (e.g., habitat complexity) and functions (e.g., nutrient cycling)	
Kentucky. "By conserving and restoring functioning ecosystems, Kentucky will harbor healthier SGCN populations. In turn, these populations will be able to persist despite environmental threats resulting from climate change" [24].	**West Virginia**. "Manage for Ecosystem Function and Habitat Integrity. Healthy and biologically diverse ecosystems will be better able to withstand and recover from the impacts of climate change" [44].
Support evolutionary potential: Protect a variety of species, populations, and ecosystems in multiple places to bet-hedge against losses from climate disturbances	
Oklahoma. "Connectivity reduces the isolation of populations and helps to maintain the genetic diversity that helps populations adapt to change" [30].	**Texas**. "Conserve existing biodiversity by 1) conserving protected areas and other high quality habitats, 2) conserving the range and ecological variability of habitats and species, and 3) building replication within protected-area networks" [61].
Protect refugia: Protect areas less affected by climate change, as sources of "seed" for recovery (in the present) or as destinations for climate-sensitive migrants (in the future)	
Alabama. "Critical habitats—those areas in which targeted species can persist and/or relocate over time – may provide a refuge from climate change impacts and become high-priority candidates for acquisition and enhanced conservation efforts" [53].	**Arkansas**. Under "Adaptation Strategy": "Providing additional refugia for species will improve species' chances for survival" [54].
Relocate organisms: Engage in human-facilitated transplanting of organisms from one location to another in order to bypass a barrier (e.g., urban area)	
Florida. "Evaluate the feasibility of moving or relocating species that are threatened with extinction because of habitat loss due to sea level rise" [50].	**Tennessee**. Under "TN Adaptation Option": "When appropriate, facilitate species movement to new habitat locations" [60].

- Development of intentional actions to reduce climate impacts and vulnerabilities
- Development of intentional actions to "manage for change"

3.4.1 Climate Change-Related Management Strategies

The climate change-related management strategies identified in the review documents range from very general examples to those that show a high degree of intentionality, even within an individual plan or report. States paid considerable attention to "commonly known" general adaptation strategies, especially those that "promote connectivity," "protect refugia," and "reduce non-climate stressors" [11]. For this analysis, we determined "intentionality" as whether the plan made a direct reference to the specific climate change impact(s) being addressed. Several examples suggest "managing for change, not just persistence." We also highlight a few cases where states have considered climate mitigation in addition to adaptation.

General adaptation strategies. As consideration of climate change adaptation has increased in the field of fish and wildlife conservation, several general categories of management strategies have emerged as being especially relevant. Table 8 highlights examples of general adaptation strategies identified in the SWAPs and/or companion climate change documents, organized according to the categories frequently referenced in the adaptation literature [11].

"Business as usual" conservation characterized as "adaptation." Given that climate change adaptation is still somewhat new to conservation practitioners, it is not uncommon to see strategies framed as "climate adaptation" which reflect "business as usual" conservation. Here, we consider "business as usual" actions as those designed and implemented to achieve certain conservation outcomes (e.g., "restoring functioning ecosystems" and "conserving existing biodiversity"), but without explicit linkage to climate-related impacts. Adaptation strategies aimed at "reducing non-climate stressors," but which do not acknowledge climate change, fall into that category.

Yet, it is important to recognize that, although the general toolbox of conservation and management approaches may remain fairly constant for climate change efforts, it is not sufficient to simply apply the same practices only "better" (more effectively) or "more" (in a greater amount). For instance, even so-called "healthy" coastal wetland habitats in a wildlife refuge or park are at risk from accelerating sea level rise. Rather, the risks associated with climate change may require changes to some of the assumptions that go into management decisions, as well as how these approaches and strategies are used in given situations. It may be determined, in some cases, that addressing climate change may not require significantly different management approaches. Indeed, interview participants from both Oklahoma and Louisiana indicated that, once it was recognized that many existing conservation practices remain relevant even in the face of climate change, the idea of adaptation seemed more "accessible." In other cases, however, modified or entirely novel management approaches may be necessary to either complement or supplant current best practices.

Examples of intentionality: actions linked to climate impacts. Although many of the conservation actions articulated in the reviewed documents tend to be fairly broad and high level, planners in nearly every state expressly linked some actions to climate impacts, as illustrated in Table 9 (page 22). We added emphasis on the specific climate change-related connections in italicized text.

Several actions articulated in the Louisiana SWAP include characteristics of both generalization and intentionality. The following strategy, for example, initially reflects a more business-as-usual perspective: "By continuing efforts to address conservation issues such as habitat fragmentation, invasive species, and natural system modifications, the resiliency of SGCN and associated habitats can be increased, which in turn will decrease the potential negative impacts associated with changing climate conditions… [33]." However, the plan further acknowledges that "…[s]uch efforts may not be enough, as future conditions should also be considered when planning and implementing habitat conservation. For example, it might be beneficial to proactively protect forested lands inland of current migration stopover sites, to ensure the continued availability of such habitat when current stopover habitat is lost."

Examples of managing for change. As noted in Section 2.1.1, state fish and wildlife agencies will increasingly need to respond to and manage inevitable changes, rather than assume habitats and species assemblages can forever be maintained or restored to historical conditions. Approaches to managing for change can range from resisting changes, to actively or passively facilitating changes so that inevitable system transitions might retain desirable ecological attributes rather than result in a complete collapse of ecosystem functions and services. Although the review documents provided few specific examples, the following excerpts illustrate the concept.

The risks associated with climate change may require changes to some of the assumptions that go into management decisions.

For example, the Tennessee plan recommends "Monitor[ing] change in forest community in the field to assess if/how transitions are occurring; Use monitoring information to inform management decisions to facilitate transition or invest in persistence strategies" [60].

The West Virginia plan recommends "Increas[ing] Habitat Connectivity. Climate change is degrading current habitats and will likely create novel habitats as species with good dispersal mechanisms redistribute themselves to track a shifting climate envelope or shifting food

TABLE 9 Examples of climate change adaptation strategies and actions that demonstrate intentionality

Adaptation Strategy: Reduce non-climate stressors	
Mississippi. "Continue implementing actions that address or mitigate non-climate stressors (i.e., habitat fragmentation/alteration/destruction, invasive species, disease, etc.) that *may further increase species sensitivity to extinction or extirpation under climate change*" [57].	**Puerto Rico**. "Adaptation includes reducing existing stresses on natural and human systems. *Recommendations should specify which current stressors are likely to be exacerbated by climate change impacts*" [25].
Adaptation Strategy: Develop habitat buffers and corridors	
Kentucky. "*If temperature gradients change over time* in Kentucky, corridors will facilitate the movement of fish and wildlife populations to suitable habitats/thermal regimes" [24].	**West Virginia**. "Proactive management and restoration that actively facilitates the ability of species, habitats, and ecosystems to accommodate climate change are necessary. For example, in designing critical habitat buffers, *more buffer area may be needed in the direction of cooler, moister habitats (e.g., upstream, upslope, or on cooler northerly aspects, or under denser forest cover)*" [44].
Adaptation Strategy: Protect aquatic habitats	
Alabama. "Cold water streams and cold water fish habitat can be incorporated into buffer strategies in order to conserve connected water bodies to protect vegetative canopies over streams *to help reduce the impacts of warming temperatures*" [53].	**North Carolina.** "Plant riparian areas with vegetation with a *broad elevational range* within a particular watershed. Also *plant vegetation with broad hydrologic tolerance* to promote resilience to climate change" [31].
Oklahoma. "Restoring, enhancing, and conserving existing riparian forests and other native flood plain habitats will help *shade streams, protect flood plain wetlands and areas for groundwater recharge and development*, maintain natural stream bank stability, and provide dispersal and movement corridors" [30].	**Tennessee**. "Manage instream flows to mimic ecologically relevant portions of the hydrograph. Evaluate flow management alternatives to *abate shifts in seasonal timing and duration of precipitation*" [60].
Adaptation Strategy: Protect coastal habitats	
Georgia. "Restoration of more natural hydrology in alluvial rivers that feed the coastal sand-sharing system may help mitigate setbacks and buffers and provide protection for both wildlife and humans *as sea levels and storm surge levels rise in the coming decades*" [55].	**Florida**. "*Use inundation maps and average temperature maps* as a guide for conservation and acquisition measures to ensure conservation of nesting habitat and expected migration pathways" [50].
South Carolina. "Prioritize areas for conservation actions using updated mapping capabilities. For example, *conduct SLAMM modeling* of the State's coastline as needed *to identify potential conservation focus areas for marsh migration inland*" [51].	**Virginia**. "Climate-related wetlands conservation actions include: restoring and enhancing vegetation within wetlands to support changing conditions (e.g., *using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels)*" [62].

sources. The key to successful movements and migration is the presence of contiguous suitable habitat that species are able to colonize or at least traverse" [44].

Climate mitigation. The primary focus of this study was on climate adaptation. However, it is interesting to note that nine states (Arkansas, Florida, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, and West Virginia) also considered climate mitigation in their plans – that is, efforts to address the underlying cause of recent climate change through a focus on reductions in atmospheric concentrations of greenhouse gases. Indeed, because greenhouse gas emissions and concentrations will dictate the type and magnitude of impacts to which we need to adapt, the ability to successfully accomplish adaptation over the long term will be linked to the success of such mitigation efforts [66].

In particular, states expressed interest in enhancing carbon sequestration through enhancement and protection of

forests and wetlands and managing agricultural practices. The South Carolina plan, for instance, specifically identifies longleaf pine as a "prime candidate" for carbon sequestration efforts, noting that it is considered to be especially tolerant to climatic changes and associated impacts (e.g., drought, fire, beetle infestations, hurricane-force winds) [50]. The LLP plan analysis mentioned in Section 2 also noted these factors as important [12]. As an example of actions that integrate both adaptation and mitigation, the interviewee from North Carolina highlighted the state's efforts to work with burgeoning solar farms in the state to conduct complementary pollinator habitat restoration on the same lands.

3.4.2 Prioritization of Adaptation Strategies and Actions

Prioritizing conservation actions is a necessary step toward implementation. As with the prioritization of SGCN and habitats, states in the region have applied (or intend to apply) a variety of approaches to identify the most important conservation actions. A few states considered efforts to address climate change among the broad suite of conservation actions identified in their action plans and prioritized them as a whole. For example, Georgia's SWAP planners prioritized the more than 200 initial priority conservation actions, including those for climate adaptation, through a scoring process based on seven specific criteria [55]:

Brook Trout (USFWS)

1. Providing multiple benefits for high priority species/habitats
2. Addressing un(der)funded needs
3. Overall importance of Georgia efforts
4. Timeliness or urgency
5. Connections with other conservation actions
6. Building public support for wildlife conservation
7. Probability of success

The Tennessee team prioritized climate adaptation actions based on "key vulnerabilities" — those impacts determined as most likely to affect their ability to meet their conservation goals. In particular, they identified actions to address impacts of changing precipitation timing and duration, increasing temperatures, and altered disturbances (e.g., fire, wind damage, and ice storms). Virginia's plan emphasizes "Climate-Smart Management Actions" on top of its general Conservation Management Actions to reflect particular concern about the emerging risks from climate change.

For states that considered climate change separately from other threats (i.e., states with stand-alone climate change chapters and/or reports), climate adaptation strategies were prioritized distinctly from other conservation actions. Many of the actions chosen as priorities for implementation align with the general adaptation strategies highlighted above. Alabama's plan, for instance, identifies the need to prioritize areas of climate refugia for acquisition and enhanced conservation efforts. Puerto Rico's plan emphasizes "'softening' the mosaic of fragmented habitat" and the "creation or enhancement of biological corridors linking public and private wildlife habitats" to facilitate projected changes in species ranges caused by climate change [59]. Coastal states also largely emphasized the identification and protection of upland buffers to allow habitat migration under sea level rise as priorities for current and future conservation action. One of South Carolina's highest priority actions for its Climate Change Conservation Action Area (CAA) includes finalizing and implementing high-level suggestions in its 2013 report, *Climate Change Impacts to Natural Resources in South Carolina* [39].

3.4.3 Implementation Challenges and Opportunities

Implementation of SWAPs is an ongoing endeavor. Depending on when action plan updates were completed, states in the region are in varying stages of implementing key actions. Given that climate adaptation is a new feature in the majority of the plans, it is not surprising that implementation of "on-the-ground" adaptation actions (versus "process-based" actions such as conducting vulnerability assessments) has thus far been limited. Below we discuss some of the key challenges and opportunities for implementation that states have experienced to date.

Emphasis on business-as-usual and "low-hanging fruit." As with some of the adaptation strategies highlighted in this review, implementation efforts identified by the states tend to reflect a more business-as-usual approach. During the interviews, participants from Georgia, Florida, Missouri, Oklahoma, South Carolina, Tennessee, and West Virginia each indicated that they were implementing a range of "common" conservation strategies and actions (e.g., land use planning, land management, land acquisition and protection, and dam removals) but suggested that they are also likely to be useful and relevant for climate adaptation. Several of the participants admitted, however, that such actions have largely capitalized on available opportunities rather than reflect strategic responses to climate change.

States expressed interest in enhancing carbon sequestration through enhancement and protection of forests and wetlands and managing agricultural practices.

Interviewees also highlighted existing programs that they considered applicable to climate adaptation, even though such programs were initially intended to address other conservation threats. Examples included a gopher tortoise conservation initiative (Georgia), a rare mussel and fish propagation program (North Carolina), prescribed burns and habitat management programs to maintain healthy fire-dependent habitats (North Carolina), and dam removals to improve access to cool upstream waters (Tennessee).

Round Hickorynut Mussel (USFWS)

Some interview participants indicated that their states' existing conservation actions address climate change "indirectly." This approach may reflect several prevailing factors: political challenges in openly connecting actions and activities to climate change; the need to use limited resources wisely to address multiple conservation priorities; or the perception that existing activities will provide opportunities to help species cope with and adapt to climate change in the future. Assimilating climate adaptation considerations into existing priorities and activities and implementing strategies that represent "low-hanging fruit" (i.e., the simplest or most straightforward actions) appears to make climate adaptation more feasible and acceptable with some agencies and their conservation partners.

However, as discussed previously, while current (i.e., business-as-usual) conservation practices can be beneficial and essential for addressing a variety of threats, they may or may not be effective or sufficient under changing climate conditions. Indeed, the interview participant from Florida cautioned that when states perceive that "anything can be a climate change project," long-term issues may not be adequately addressed. As specific strategies and activities are initiated in the future, agencies should continue to evaluate if and how conservation actions adequately address climate change threats and impacts.

Implementation facilitated by partnerships. Florida is perhaps the furthest along in implementing its climate adaptation-related actions, in part because their initial update was completed in 2012 – several years before those of most other states in the region. The state has worked to integrate climate change considerations into its considerable land use planning and management activities. Toward this, the Florida interviewee acknowledged that the state has a relatively high degree of capacity (including staff, expertise, and funding) to help move the climate change elements of their plan forward. For most other states in the region, the interview process revealed a lack of capacity as a significant hurdle for both adaptation planning and implementation.

Local agencies, communities, and conservation groups can play an important and leading role in the implementation of climate adaptation strategies and actions. The interview participants from Florida, Virginia, and West Virginia described progress in gaining support from local stakeholders to implement climate-oriented conservation practices at the community level. For example, the Virginia representative highlighted how addressing climate change has helped a broad range of conservation planners consider longer planning horizons, noting that at least one community group was encouraged to think: "20, 30, 70 years down the line, what do we want our community to look like, understanding that these eventual changes are coming."

3.5 *Step 5: Track Ecological Conditions and Management Effectiveness*

This section highlights results for the following questions and topics:

- Is climate change considered or included in discussion of monitoring and evaluation?
- What specific methods, resources, or tools are you considering in monitoring and evaluation efforts related to climate change adaptation?

Within the documents and/or during the interviews all states referenced monitoring, evaluation, and adaptive management as important in light of climate change. Indeed, research and monitoring to both address data gaps and inform management practices were among the most commonly-identified "adaptation actions." Several documents specifically note that monitoring and evaluation strategies in the context of climate adaptation need to be designed to anticipate climate-driven changes and identify new challenges and opportunities.

The Arkansas plan seeks to "[c]ontinue to implement monitoring priorities as outlined in the Wildlife Action Plan. This includes breeding bird surveys, Christmas bird count surveys, pollinator surveys, etc. These long-term data are important for determining population trends and will be especially important for detecting any changes in species phenology or distribution as a result of climate change" [54].

The Kentucky strategy includes the following: "Goal 4: Monitor fish, wildlife, and ecosystem responses to climate

The interview process revealed a lack of capacity as a significant hurdle for both adaptation planning and implementation.

change. To effectively conserve Kentucky's fish and wildlife resources amidst changing environmental, climatic, and social conditions, we must monitor the success of our conservation actions and create future goals based on these results." Examples of actions under this goal include: "*Action 4c.* Design and implement specific projects to monitor fish and wildlife responses to climate change indicators" [56].

The Texas plan notes the need to "[i]mplement an adaptive management framework that will respond to changing conservation priorities as new information is collected and analyzed.

- Develop a climate change adaptation framework for conserving the biodiversity of Texas
- Establish long-term monitoring objectives that will serve as the basis of adaptive management" [61].

Plans from eight states (Alabama, Arkansas, Louisiana, Mississippi, North Carolina, Tennessee, Texas, and Virginia) identify the national Wildlife Tracking and Reporting Actions for the Conservation of Species (TRACS) database as likely to be particularly useful in monitoring and evaluation over longer time horizons [67]. The Louisiana plan, for instance, acknowledges that adoption of Wildlife TRACS actions and outputs among multiple states in the region will also provide a better sense of the success of SWAPs more broadly [33]. These examples suggest a more deliberate approach to adaptive management than in the previous iteration of SWAPs [68], which is testament to the success of efforts such as the State Wildlife Grants Effectiveness Measures project [69]. The plans from Arkansas, Louisiana, North Carolina, South Carolina, Tennessee, and Texas also highlighted citizen-science programs as a potentially useful tool for enhancing monitoring capacity.

During the interviews, several participants acknowledged that they currently lack information about many species to make informed decisions about conservation management actions and climate change adaptation. However, a variety of efforts are underway to fill in these gaps. For example, Arkansas has initiated projects to determine the required environmental flows for certain systems and species. Texas created the "Herps of Texas" project, using the iNaturalist platform [70] to enlist citizen scientists in the collection of reptile and amphibian observations. This information supplements state agency monitoring efforts. The North Carolina interviewee noted a need for case studies that document applied adaptation measures and their results, stating: "[t]here's a lot of generic information available that does not have monitoring data to support whether or not the application is successful."

3.5.1 Identifying Ecological Triggers and Climate Change Attribution

Interview participants from several states noted that one particular challenge is identifying "triggers" that indicate whether and when a system might be reaching an ecological threshold or tipping point, beyond which certain management actions or even underlying conservation goals may no longer be feasible. In Florida, for instance, coastal managers are contending with how much a vegetative community must change before they say, "ok we need to stop managing this way and change it to that way, because that community isn't going to be there anymore!" The interviewee from Florida also acknowledged that coordination among different entities working on conservation poses another challenge and identified a need for consistent and agreed upon triggers, baseline measures, and targets across different efforts.

The representative from Missouri reflected similar concerns. To address the challenge, the state is developing a conceptual model for a Landscape Health Index. This resource is intended to help them determine when they reach "that tipping point in priority geographies when they have saturated the best management practices and are starting to get a limited return on investment." Ultimately, that would necessitate identifying other conservation opportunity areas or "stick[ing] with certain ones for a longer period of time." According to the interview participant from Texas, gaining a better understanding of the rate at which some changes, such as sea level rise, are occurring could create a "different urgency" if it appears likely that such changes "will outpace the ability of the system to react."

Another issue raised during the interviews involved the degree to which certain impacts could be attributed to climate change vs. other stressors. For example, the Georgia interviewee suggested that, while species such as brook trout appear highly vulnerable to climate change, it is "difficult to determine whether climatic factors such as rising temperatures, or problems such as eastern hemlock die off due to the hemlock woolly adelgid, are most significant" from a management perspective. North Carolina's representative noted that the state needs to do more to monitor the interactions of pollutants and temperature, salinity, and altered flows to better understand the impacts of multiple stressors on freshwater mussels and other aquatic communities.

Certainly, understanding the complex synergisms between climate change and the many other near-and long-term challenges the region faces will no doubt be important to inform the development of adaptation strategies over time. However, such complexities also underscore the need for states to make decisions under uncertainty, which is inherent in predicting both future climatic and non-climatic factors.

Conasauga River (USFWS)

4 Observations and Recommendations

This review demonstrates that considerable progress has been made among the southeastern state fish and wildlife agencies in addressing climate change since the first iteration of SWAPs in 2005. Here, we summarize some of our most significant findings. We also offer some general suggestions to help state agencies and their partners overcome challenges and build on opportunities to enhance conservation efforts in this era of rapid change.

4.1 Key Observations

States applied a diversity of climate change-related planning approaches, while coping with limits to their capacities

States varied in their climate change-related planning approaches. Some states assimilated climate change throughout their Wildlife Action Plans while others considered it in separate chapters and/or documents. Staff capacity, availability of resources and expertise, and consistency with other planning approaches had a significant influence on both the methods and extent to which states integrated climate change into the plans. A number of interview participants acknowledged that limited staff time and funding hindered their climate-related planning capacity. However, most states were able to capitalize on a range of external resources and experts, including the regional Landscape Conservation Cooperatives and the Southeast Climate Science Center (CSC)[4] which were seen as especially helpful. Internally, supportive leadership helped to advance climate change-related planning efforts within some states, while interviews verified that the political environment in other states made it difficult to address climate change directly.

Development of the updated State Wildlife Action Plans involved minimal interstate and regional collaboration

Many interviewees noted a lack of interstate and regional collaboration in both the broader SWAP planning process and on addressing climate change threats specifically. The primary reasons identified for a lack of interstate collaboration included differing priorities among states; variation in the scope, scale, and timing of plan updates; and, in some cases, a sense of competition for federal funding. These findings are not surprising, given that SWAPs and guidelines for their development are mainly state focused. That said, many participants acknowledged the importance of regional cooperation given the broad-reaching challenges posed by climate change, and several pointed to important opportunities for multi-state collaboration, such as where species of concern or habitat types are common across state borders.

States share a collective concern about the threat of climate change

The updated SWAPs universally acknowledge climate change as a threat to species and their habitats. Most plans identify the synergies between climate change and other problems, such as urbanization and land use change, as especially challenging. States primarily relied on existing information about climate change impacts and vulnerability, although a few conducted vulnerability assessments expressly designed to inform their SWAP updates. The low number of dedicated assessments appears to reflect limitations in agency capacity rather than a lack of interest in gathering more detailed information. Indeed, most states identified the importance of and need for further investment in vulnerability assessments at the state and regional levels.

[4] In 2018 the Southeast Climate Science Center was renamed the Southeast Climate Adaptation Science Center.

Adaptation strategies tend to be general and often vague, with relatively few examples of actions explicitly linked to climate impacts

Red Wolf (Steve Hillebrand, USFWS)

Most climate adaptation strategies included in the action plans and/or companion materials are highly-generalized (e.g., enhance connectivity, protect refugia, reduce non-climate stressors, increase resilience). A few states demonstrated the concept of intentionality by specifically linking actions to impacts. However, many of the actions described in the plans reflect a "business-as-usual" approach (e.g., protect biodiversity, restore habitat), suggesting a perception that existing conservation practices will be sufficient as climate adaptation even though such might not actually be the case. Few states set climate-related priorities within the broader suite of conservation actions, and interviews suggest relatively little progress towards implementation of adaptation actions. Those adaptation actions that have been carried out (e.g., land acquisitions and dam removals) have tended to capitalize on available opportunities and approaches rather than represent strategic or novel responses to climate-related impacts.

Management goals tend to emphasize the persistence of species and habitats, with only a limited number of examples focused on managing for future system changes

Overarching conservation goals articulated in the updated action plans tend to emphasize the persistence of existing species, habitats, and systems, reflecting a combination of legislative mandates, organizational missions, and continuity of efforts. When highlighting goals specific to climate adaptation, states frequently emphasized the concept of resilience, although their definitions of that concept varied. Only a few examples of change-related, future-oriented goals occur within the plans themselves. However, several interviewees acknowledged the need to reconsider and update conservation targets (e.g., SGCN), if not goals altogether, in the future. Internally, states are clearly engaging in discussions about the feasibility and achievability of existing conservation goals in light of climate change, and whether and how those goals might need to be updated.

States articulate broad support for climate-informed monitoring and evaluation

As reflected in both the action plans and interviews, states widely recognize that monitoring and evaluation are essential for climate adaptation. This includes efforts to track climatic changes and ecological responses, and to evaluate the effectiveness of adaptation actions. However, many interview participants acknowledged that implementing effective monitoring and evaluation in general is often hindered by a lack of sufficient resources. Monitoring and evaluation in an era of climate change faces added challenges because of the long-term nature of climate change, and because the results of some adaptation actions will not be known for years, if not decades. Several interview participants emphasized the need to better understand how to identify potential tipping points or other triggers to inform when, where, and how to modify management approaches or apply new adaptation strategies.

4.2 Recommendations

Based on these observations, we offer several suggestions to enhance existing assets and opportunities and to further advance the integration of climate change into wildlife conservation planning throughout the Southeast. While most of these recommendations are envisioned for action by state fish and wildlife agencies, some are targeted toward funders and federal policy makers; all will require collaboration with relevant governmental and non-governmental partners. Our hope is that the actions highlighted below will help bolster the SECAS vision for a united, region-wide conservation mission to ensure "thriving fish and wildlife populations and improved quality of life for people" in the face of the dramatic changes affecting the southeastern United States [8].

Enhance collaborative planning and implementation efforts through regional resources and expertise

- Increase emphasis on formal and informal communications within and among state agencies, and with non-governmental partners, to share experiences and ensure that intra- and interstate efforts are connected.
- Work with partners to enhance regional collaborations in species and habitat planning and conservation, building on similar work conducted in other regions (e.g., Northeast Association of Fish and Wildlife Agencies). Identifying a list of "Regional Species of Greatest Conservation Need" (RSGCN), for instance, would be useful to inform shared priorities and promote cross-state collaboration.

- Capitalize and build on existing regional frameworks and efforts, such as SECAS, the Southeast Aquatic Resources Partnership, and the Joint Ventures, which can be catalysts for further cross-state collaboration.
- Support efforts to implement the recommendations of the Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources, particularly calls for substantial increases in funding for SWAP implementation.
- Continue to promote and demonstrate the utility to state-based conservation from federally funded entities such as the Climate Adaptation Science Centers, which are dedicated to convening regional conservation partners, developing climate-related resources and information, and facilitating climate adaptation.
- Seek to identify new, non-federal funding sources to facilitate state-based adaptation efforts and SWAP implementation.

Advance the application and use of both state and regional climate change impact and vulnerability assessments

- Make use of the existing inventory of vulnerability assessments conducted by state agencies and other entities across the Southeast region, for example assessments conducted for the Gulf Coast [34] and Appalachian regions [72]. Better understanding of what has been done by other partners can help identify information needs, augment state- or regional-level efforts, and inform future assessments.
- Clearly identify information needs and pursue opportunities to fill those gaps. Dedicate sufficient funding and time for the development and use of vulnerability assessments in adaptation planning.
- Participate in efforts to further develop resources and methods to facilitate planning under uncertainty and over longer time frames, such as through scenario planning.

Facilitate development and implementation of adaptation strategies and actions

- Continue to build state-based adaptation capacity by encouraging staff to take advantage of existing adaptation guidance and training opportunities.
- Strive to be as clear and specific as possible in identifying adaptation needs and actions, including through explicitly linking those actions to relevant climate impacts.
- Be anticipatory and forward-looking. Take an active role in managing for ecological transitions to ensure that the new conditions are more, rather than less, likely to meet societal expectations and values.
- Consider novel and innovative approaches when developing adaptation strategies and pursuing funding mechanisms, such as through the U.S. Fish and Wildlife Service State Wildlife Grant Competitive Program.

Foster adoption of climate-informed conservation goals

- Explore how climate change may affect the feasibility of achieving existing conservation goals and objectives in given states and across the region. Consider whether revisions or updates of existing goals may be necessary to take into account expected or inevitable climatic and ecological changes.
- Consider how climate change may affect the focus of conservation efforts, including selection of priority species (e.g., SGCN) and habitats, the location and connections among conservation lands and waters, and the time frame during which existing goals and objectives may be feasible.

- Broaden the conversation within and among state fish and wildlife agencies, their partners, and the public to ensure that conservation goals reflect both desired and achievable conditions now and into the future.

Enhance monitoring and evaluation efforts

- Engage with scientists and others to enhance the identification of effective indicators of climatic changes, including those that capture thresholds and tipping points of associated ecological responses.
- Improve capacity to monitor across broader areas and improve consistency in approaches by establishing new partnerships, including enhanced citizen-based monitoring programs, and ensuring that specific data and information needs are met.
- Evaluate the effectiveness of adaptation strategies. As adaptation efforts continue to progress, understanding the factors that contribute to favorable or unfavorable outcomes will help inform adaptive management and improve opportunities for success.

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Appendix A: Document Analysis

Most State Wildlife Action Plans (SWAPs) are extensive documents; their length ranged from 144 to 2,142 pages. The questions listed below provided a systematic way to search for, organize, and code the climate change-related content in the SWAPs, any appendices (which were often separate documents), and supplementary technical reports (e.g., documents detailing vulnerability assessments conducted for the SWAP process). Questions are organized here according to the modified climate smart-conservation cycle used in the analysis. The "Guidance" column shows additional instruction provided to guide the document review. As many SWAPs were organized by the eight required elements for state comprehensive wildlife conservation strategies [18], the corresponding element is listed in the third column.

Step in the Climate Smart-Conservation Cycle	Guidance	Corresponding Required Element
Step 1: Define planning process and scope		
Does plan include a stand-alone climate chapter or section? *Is climate change integrated into particular chapters or sections?*	Look for and document relevant sections, page numbers, and text	*Element 3:* Problems which may affect species and their habitats
Is climate change considered a conservation threat? If yes, › What methodologies or processes were used to determine climate threats? › Which datasets, models, scenarios, or other resources were used to identify and assess climate threats?	Look for use of literature reviews, external tools, 'in-house' analysis, expert elicitation, scenario planning Look for climate-specific data and information, models such as SLAMM, tools such as Climate Wizard, resources such as the Climate Science Centers or Landscape Conservation Cooperatives	
Step 2: Assess Climate Change Impacts and Vulnerabilities		
If climate change is considered a conservation threat, which aspects of climate change are discussed? Specifically: › Climate and physical changes › Ecological and biological changes › Human or social responses	Look for references to: › Physical change: changes in temperature, precipitation, sea level rise, extreme events, ocean acidification › Ecological change: expanding or shifting ranges, phenological changes › Human response: direct or indirect impacts caused by human responses to climate	*Element 3:* Problems which may affect species and their habitats
What is the time frame for consideration of threats? › If the future is considered, over what time frame? › Was future climate considered in evaluation of other, existing threats or stressors?	› Indicate whether plan considers current threats only, or current and future threats › Indicate not specified, next 10 years (corresponds with SWAP review cycle), or longer (e.g., 30-, 50-, 100 years)	

Appendix A: Document Analysis

Does plan indicate if climate change was explicitly considered in the identification and evaluation of SGCN? If yes, ▸ How is climate information used in the SGCN identification process? ▸ Which datasets, models, scenarios, or other resources are used?	Look for information in main text as well as in appendices and technical reports Look for references to tools such as the NatureServe Climate Change Vulnerability Index (CCVI)	*Element 1:* Information on the distribution and abundance of wildlife species
Were formal climate change vulnerability assessments conducted of SGCN? If yes, ▸ What assessment approach or technique was used? ▸ What components (sensitivity, exposure, adaptive capacity) of vulnerability were assessed?	Look for references to: ▸ Sensitivity: a measure of whether and how a particular species or system is likely to be affected ▸ Exposure: a measure of how much of a change in climate and associated impact the target species is likely to experience ▸ Adaptive Capacity: a measure of species' ability to accommodate or cope with change	
Were species included on the SGCN list as a result of their climate-related vulnerabilities? ▸ Which ones? ▸ Was climate vulnerability used in setting priorities for SGCN?	List species, identified climate vulnerabilities, and how climate was used in priority setting (if specified in the SWAP or supplementary documents)	
Is climate change considered in habitat assessments? If yes, ▸ How is climate information used in habitat assessments? ▸ Which datasets, models, scenarios, or other resources are used?	▸ Look for information in main text as well as in appendices and technical reports ▸ Look for references to tools such as the Habitat Climate Change Vulnerability Index (HCCVI), The Nature Conservancy's Resilient and Connected Landscapes	*Element 2:* Information on the location and relative condition of key habitats
Were formal climate change vulnerability assessments conducted of habitats? If yes, ▸ What assessment approach or technique was used? ▸ What components (sensitivity, exposure, adaptive capacity) of vulnerability were assessed?	Look for references to: ▸ Sensitivity: a measure of whether and how a particular habitat or system is likely to be affected ▸ Exposure: a measure of how much of a change in climate and associated impact the target habitat is likely to experience ▸ Adaptive Capacity: a measure of a habitat's ability to accommodate or cope with change	
Were *key habitats identified as a result of their climate-related vulnerabilities?* ▸ Which ones? ▸ Was climate vulnerability used in setting priorities for key habitats?	List habitats, identified climate vulnerabilities, and how climate was used in priority setting (if specified in the SWAP or supplementary documents	

Appendix A: Document Analysis

Step 3: Review Conservation Goals and Objectives		
How does the plan articulate overarching conservation goals and objectives?	▸ Look for text that describes the wildlife and habitat conservation outcomes that the state hopes to achieve	*Element 6:* Review the Strategy at intervals not to exceed ten years
Does the plan articulate goals related to climate change? ▸ Does the plan articulate forward-looking goals? ▸ Does the plan provide examples of strategies intended to "manage for change"?	▸ Look for references to goals that address longer-term and broader-scale challenges such as climate change, not only current conditions and threats ▸ Look for goals and strategies that move beyond persistence and envision transformation of ecological systems	
Are actions proposed that may be compromised by likely climate change or future conditions?	▸ Look for text that acknowledges if or where planned actions and/or conservation targets might need modification due to climate change	
Step 4: Identify, Select, and Implement Adaptation Strategies and Actions		
Is climate change explicitly discussed with regard to conservation actions? If yes, ▸ What specific actions are discussed in context of climate change? ▸ What adaptation planning framework or approach was used to identify or select adaptation actions?	▸ Look for actions that exhibit "intentionality" or are explicitly designed to address climate change and related vulnerabilities, threats, or impacts, e.g., habitat loss due to sea level rise; range shifts due to temperature changes ▸ Look for activities such as scenario planning, structured or robust decision making, adaptive management or references to resources such as National Fish Wildlife and Plant Climate Adaptation Strategy, Climate-Smart Conservation	*Element 4:* Conservation actions determined necessary to conserve identified species and habitats and priorities for implementation
Does the plan prioritize climate-change specific actions? ▸ If plan prioritizes climate change-specific actions, what process, methods, or information was used to select priorities?	▸ List or describe prioritized actions ▸ List or describe how priorities were identified (if specified in SWAP or supplementary documents)	
Are there actions that reflect climate change adaptation best practices, but are not referred to in a climate change context?	Look for activities that indicate the following general adaptation options, as discussed in Stein et al. (2014)[11]: ▸ Reduce non-climate stressors ▸ Protect key ecosystem features ▸ Ensure connectivity ▸ Restore structure and function ▸ Support evolutionary potential ▸ Protect refugia ▸ Relocate organisms	

Appendix A: Document Analysis

Does the plan identify other climate-related adaptation plans or efforts being conducted and used by the state?	Look for references to plans developed by or with other conservation partners, such as Natural Heritage programs, Joint Ventures, The Nature Conservancy, Southeast Aquatic Resources Partnership (SARP)	
Step 5: Track Ecological Conditions and Management Effectiveness		
Is climate change considered or included in discussions of monitoring and evaluation? If yes, › Describe how climate is included › List specific methods, resources, or tools to be used to monitor changing climate conditions or impacts	Look for discussions of climate monitoring activities or needs within the plan, may include stand-alone monitoring sections and/or discussion of monitoring as a conservation action	*Element 5:* Plans for monitoring species, effectiveness of conservation actions, and adapting actions to respond to new information or changing conditions

Appendix B: Interview Questions

Under each section, "ground truth" questions were intended to confirm interpretations from the document analysis. Subsequent questions were designed to obtain information that was difficult to ascertain from documents alone. For example, this included interviewee perspectives on the challenges (or opportunities) associated with incorporating climate into the SWAP process.

General Questions

Ground truth:

1. How was climate change addressed and integrated in the plan?

Understanding the approach taken to integrating climate change and the associated challenges, strategies and opportunities

1. What factors guided the approach to addressing climate change in the report?
   a. What was the reasoning for deciding to do a stand-alone section versus integrating climate change throughout the plan?
   b. Did your approach to addressing climate change evolve as you worked on the plan?
   c. Was there interstate collaboration?
2. What, if anything, was *less challenging* about addressing climate change in your SWAP than you expected? *More challenging?*

Vulnerability Assessment

Ground truth: vulnerability assessment approaches

1. To what degree were previously existing and/or dedicated climate change impact and vulnerability assessments used
   or conducted?
2. Was climate change considered in the *selection* of SGCN (i.e., in which species were chosen for the list)?
3. Was climate change considered in the *prioritization* of SGCN?

Understanding approaches to vulnerability assessment

1. What factors led the team to decide on your approach to assessing vulnerability (e.g., using existing information versus conducting a dedicated assessment specifically for the SWAP)?
2. What information sources and/or tools related to assessing climate change vulnerability were *most useful*? *Least useful*?
   a. What information/tools were not available that you believe would have been useful?
3. What, if anything, was *less challenging* about assessing vulnerability than you had anticipated? *More challenging*?

Appendix B: Vital Futures SWAP Interview Questions

Conservation Goals

Ground truth:

1. Does the plan acknowledge the need or potential need to review/revise conservation goals/targets (e.g., focal species and habitats) in light of climate change?

How did working on climate change influence thinking about overall goals?

1. Did considering climate change influence thinking about what goals might be achievable or not?
   a. If so, in what ways?
   b. Over what time frames?
2. In what ways, if any, did consideration of "resilience" factor into your thinking about achieving the goals in light of climate change?
   a. If so, how did you and your team define "resilience"?
3. Are any of the conservation goals focused on managing for change given the realities of climate change (and not
   just, say, persistence of current or pre-existing conditions)?
   a. If so, in what ways?

Adaptation Actions

Ground truth:

1. To what extent does the plan include specific climate actions?
2. To what degree are adaptation actions explicitly linked to climate change impacts?
3. Did the plan prioritize conservation actions based on climate change?

How were adaptation actions identified and how is implementation proceeding?

1. In what ways, if any, did consideration of climate change lead you to consider new/different conservation actions or use existing actions in different ways than you might have otherwise used in your SWAP?
2. Have you and/or your partners implemented any climate adaptation actions since you finished the plan?
3. Are there any adaptation actions that you and/or your partners expect to implement within the next few years?
4. Since publication of the SWAP, have you been engaging with other states to coordinate implementation of climate change-related actions and/or other relevant conservation plans?
   a. If so, in what ways? With whom?
   b. Which climate-related issues do you believe would be especially important to address in a multi-state/ regional fashion?

Appendix C: List of Abbreviations

AFWA	Association of Fish & Wildlife Agencies
CAA	Conservation Action Area
CCVI	Climate Change Vulnerability Index
CMI	Conservation Management Institute
CMP	Conservation Measures Partnership
CSC	Climate Science Center
ESA	Endangered Species Act
HCCVI	Habitat Climate Change Vulnerability Index
IUCN	International Union for Conservation of Nature
LCC	Landscape Conservation Cooperative
LLP	Longleaf pine
NEAFWA	Northeast Association of Fish & Wildlife Agencies
NFWPCAS	National Fish, Wildlife and Plants Climate Adaptation Strategy
NGO	Non-governmental organization
NWF	National Wildlife Federation
RSGCN	Regional Species of Greatest Conservation Need
SARP	Southeast Aquatic Resources Partnership
SEAFWA	Southeastern Association of Fish and Wildlife Agencies
SECAS	Southeast Conservation Adaptation Strategy
SGCN	Species of Greatest Conservation Need
SLAMM	Sea Level Affecting Marshes Model
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grant
TACCIMO	Template for Assessing Climate Change Impacts and Management Options
TCSI	Terrestrial Climate Stress Index
TNC	The Nature Conservancy
TRACS	Tracking and Reporting Actions for the Conservation of Species
USFWS	U.S. Fish & Wildlife Service

Appendix D: Photo Credits, Figures, Boxes and Tables

Photo Credits

Cover: Pine Barrens Tree Frog, Florida Fish and Wildlife Conservation Commission
p. 2: Least Sandpiper, M. J. Sandoz
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p. 7: Little Brown Bat, Ann Froschauer/USFWS
p. 9: Bullfrog Creek Wildlife Environmental Area, Florida Fish and Wildlife Conservation Commission
p. 13: Eastern Hemlock, Doug McAbee
p. 19: Green Anole, Chaney Shultz
p. 23: Brook Trout, USFWS
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