Appendix 1
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State Wildlife Action Plans: Eight Required Elements

Congress identified eight required elements to be addressed in each state's wildlife action plan (technically called a "comprehensive wildlife conservation strategy"). Congress also directed that the plans must identify and be focused on the species in greatest need of conservation yet address the full array of wildlife and wildlife-related issues.

(1) **Information on the distribution and abundance of species of wildlife**, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and,

(2) **Descriptions of extent and condition of habitats and community types** essential to conservation of species identified in (1); and,

(3) **Descriptions of problems** which may adversely affect species identified in (1) or their habitats, **and priority research and survey efforts** needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and,

(4) **Descriptions of conservation actions** proposed to conserve the identified species and habitats and priorities for implementing such actions; and,

(5) **Proposed plans for monitoring** species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and,

(6) **Descriptions of procedures to review the plan** at intervals not to exceed ten years; and,

(7) Plans for **coordinating the development, implementation, review, and revision of the plan with federal, state, and local agencies and Indian tribes** that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats.

(8) **Broad public participation** is an essential element of developing and implementing these plans, the projects that are carried out while these plans are developed, and the species in greatest need of conservation.

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c/o Association of Fish and Wildlife Agencies
444 North Capitol Street, Suite 725, Washington, D.C. 20001
Phone: 202/624-7890 Fax: 202/624-7891 Email: teaming@fishwildlife.org
www.teaming.com

North Carolina: A Regional Perspective on Climate Change and Resiliency

In 2018, the Association of Fish and Wildlife Agencies (AFWA) adopted a resolution on landscape conservation that recognized "the importance of collaborating at landscape scales to help fish and wildlife agencies meet their statutory and regulatory responsibilities to conserve fish and wildlife and their habitats." In response to the resolution, AFWA established a President's Task Force on Shared Science & Landscape Conservation Priorities in 2020, which recommended that State Wildlife Action Plans (SWAPs) serve as a framework for regional coordination and collaboration.

Within this Plan, North Carolina has identified Species of Greatest Conservation Need (SGCN) and outlined strategies to sustain them, including conservation actions to promote species recovery and prevent federal listings under the Endangered Species Act. But to sustain the species that are the responsibility of North Carolina to protect and that also reflect the rich biodiversity, culture, and history of the state, North Carolina must consider its role and the influences of the larger Southeast landscape.

This chapter examines regional, landscape-scale considerations for North Carolina and serves as a means for the State to find potential collaborations to best support the State's SGCN and Southeast Regional SGCN (RSGCN). Additionally, some of the threats that impact SGCN (e.g., climate change) have consequences locally, statewide, and regionally. Addressing these threats effectively requires aligning conservation strategies across state boundaries. By using consistent regional information shared by other states to inform their own SWAPs, North Carolina can better contribute to regional conservation priorities, identify potential landscape-level threats, and help connect the Southeast region's lands and waters.

North Carolina's Conservation Portfolio: Connecting The Region's Lands And Waters

North Carolina supports a wide diversity of habitats, culturally and historically significant landscapes, and ecosystems that provide benefits to the state as well as the broader Southeast region. North Carolina plays an important role in connecting the lands and waters of the Southeast Region, as well as hosting some regionally important ecosystems and habitat types like maritime forests, longleaf pine, and spruce-fir forests. Many regional and local partners and partnerships are working with the North Carolina Wildlife Resources Commission (NCWRC) to help conserve the state's iconic and important landscapes. According to the Protected Areas Database of the United States (PAD-US, v4.0 considering fee simple, easements, and

designation areas), approximately 6.7 million acres (20%) of the state are considered protected land (see Figure 1). This includes important landscapes like the Pisgah and Croatan National Forests, the Cape Hatteras and Cape Lookout National Seashore, the Pocosin and Alligator River National Wildlife Refuges, and state game lands like the Sandhills Game Land and Cold Mountain Game Land.

In addition to contributing to the conservation landscape of the Southeast, North Carolina's lands and waters also benefit the state's economy. In 2023, the Bureau of Economic Analysis estimated that the outdoor recreation economy generated $16.2 billion in value for the state's Gross Domestic Product and another $7.7 billion in wages and salaries (U.S. Bureau of Economic Analysis for Outdoor Recreation, 2023). Beyond providing recreational value, natural landscapes also support working lands such as agriculture and timber. As of 2023, North Carolina supported more than 8.1 million acres of farmland across 42,500 farms and crop production alone was valued at more than $4.7 billion (U.S. Department of Agriculture, 2024).

North Carolina and the Southeast Conservation Adaptation Strategy (SECAS)

The Southeast Conservation Adaptation Strategy (SECAS) is a regional conservation initiative that spans the Southeastern United States and Caribbean. SECAS brings together diverse partners around an ambitious goal: a 10% or greater improvement in the health, function, and connectivity of Southeastern ecosystems by 2060. The Southeast Conservation Blueprint is the primary product of SECAS. The Blueprint is a living, spatial plan that identifies priority areas where conservation action would make an impact toward creating a connected networks of lands and waters, based on a suite of natural and cultural resource indicators and a connectivity analysis.

So far, more than 2,500 people from over 650 different organizations have been actively involved in developing the Blueprint. At least 37 staff from the NCWRC alone have participated in workshops to review and improve the Blueprint, along with many other conservation practitioners from across the State. Since 2014, the Blueprint has been used by a broad suite of partners to inform many different conservation actions across the state. For example, staff from the NCWRC, along with other partners, used the Blueprint to help secure an 'America the Beautiful' Challenge grant aimed at restoring longleaf pine ecosystem habitats to benefit at-risk species, improve ecosystem resilience, and decrease wildfire risk to surrounding communities and military installations. The Blueprint was also used to help inform an expansion of Roanoke River National Wildlife Refuge and has also been used by several non-profits like Upstate Forever to help prioritize restoration efforts on conservation lands.

Maps of the Blueprint and other regional data are provided within this chapter. These maps also include a boundary that extends beyond the State and includes watersheds where North

Carolina shares a conservation or species management interest with its neighboring states. This boundary was developed by identifying all watersheds (HUC 8) within 1.5 kilometers of the State boundary and then selecting shared watersheds of conservation interest with NCWRC staff and partners from the Southeast Aquatic Resources Partnership (SARP). By looking beyond the State's boundaries, North Carolina can consider how to best align conservation actions and identify cross-jurisdictional opportunities with neighboring states to maximize benefits for SGCN with wider ranges.

The Blueprint recognizes more than 17.9 million acres, or roughly 52% of the state, as a priority for connecting the region's lands and waters (Table 1, Figure 2). About 9.1 million acres (26%) are rated as highest or high priority. An additional 6.7 million acres (19.6%) are rated as medium priority and about 2.1 million acres are considered priority connections, or key linkages between priority areas that can help facilitate the flow of species and ecological processes within the State while also considering connectivity within the broader region. Together, these classes represent the most important areas for shared conservation action to connect lands and waters and improve ecosystem health. The Blueprint includes more than 60 indicators that represent both natural and cultural resources and collectively represent ecosystem health, function, and connectivity across terrestrial, freshwater, and coastal and marine systems. Examples include imperiled aquatic SGCN, cores of intact natural habitat, natural floodplain landcover, prescribed fire frequency, and more. Indicator data is available on the Blueprint page of the SECAS Atlas.

The Blueprint recognizes the vast majority (94%) of North Carolina's protected areas as a priority for connecting the lands and waters of the Southeast (Table 1). This means that while these conserved areas are contributing to the state-wide landscape and represent unique habitats and locally important areas, many of them are also contributing to a wider regional conservation strategy. The State's conservation portfolio exemplifies a complementary landscape-scale approach to conservation that links local actions with conservation outcomes that contribute to a broader geographic scale.

The Southeast Blueprint also includes a least-cost path connectivity analysis that identifies corridors that link coastal and inland areas and span climate gradients (Figure 3). The corridors connect hubs across the shortest distance possible, while also routing through as much Blueprint priority as possible. The hubs that anchor the connectivity analysis are large patches of highest priority Blueprint areas and/or protected lands. About 11.8 million acres (34%) within North Carolina are considered a hub or corridor, providing many conservation opportunities to support species movement and migration—an important strategy for helping wildlife adapt to landscape-level changes (Figure 3).

Ensuring landscape connectivity across jurisdictional boundaries is becoming increasingly important for species management as changes in land use, climate, and weather patterns shift species distributions. Collaborating with the neighboring states of Virginia, Tennessee, and South Carolina to identify cross-boundary species migration and habitat pathways can increase regional connectivity for state SGCN and RSGCN. It is also important to consider potential barriers to connectivity such as existing and future urbanization. Figure 4 represents places in the State that are already considered urban as well as places that are predicted to urbanize by 2060.

One lens to characterize the landscape of North Carolina is by its ecoregions as defined by the Level III ecoregions of the continental US (Omernik 1987, 1995): the Blue Ridge, the Piedmont, the Middle Atlantic Coastal Plain, and the Southeastern Plains (Figure 5.1). Ecoregions are identified by analyzing areas where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar.

In comparison, North Carolina's state Wildlife Action Plan (SWAP) uses these ecoregional boundaries as a framework for ecoregional descriptions. Figure 5.2 shows the boundaries for the Mountains, Piedmont, Sandhills, and Coastal Plain ecoregions used in the NC SWAP. Evaluating ecoregions that North Carolina shares with its neighbors is one way to identify cross-boundary conservation opportunities, as these areas share similar mosaics of biotic, abiotic, terrestrial, and aquatic ecosystems. Table 2 shows the ecoregions of North Carolina and its shared watersheds, as well as how much of each ecoregion within North Carolina is prioritized in the Southeast Blueprint (Table 2). In particular, the Blue Ridge and Middle Atlantic Coastal Plain within North Carolina significantly contribute to the Blueprint.

North Carolina and the SECAS goal

Through SECAS, partners work together to design and achieve a connected network for the benefit of ecosystems, species, and people, and to achieve the SECAS goal: a 10% or greater improvement in the health, function, and connectivity of Southeastern ecosystems by 2060. The work of the NCWRC and conservation partners within the State help advance this goal. In addition to the Southeast Blueprint, SECAS releases an annual report—*Recent Trends in Southeastern Ecosystems*—that assesses progress toward the SECAS goal using the best available data. This report assesses progress toward the SECAS goal using information from existing monitoring programs and is intended to facilitate discussion around conservation actions needed to meet the goal.

Recent Trends in Southeastern Ecosystems (2023) synthesizes 14 different assessments to evaluate indicator trends. Assessments ranged from remotely sensed data like the National Land Cover Database to long-term volunteer-driven monitoring programs like the Breeding Bird

Survey. States can use this SECAS goal report to assess their own progress and overall trends for the broader Southeast Region.

Based on the 2024 goal report, 11 out of 20 indicators improved overall during the period covered (see Table 3). Longleaf pine area, prescribed fire in longleaf pine, aquatic connectivity, forested wetland birds, working lands conservation, coastal condition, and marine fisheries indicators improved fast enough to stay on track to meet the SECAS goal. These have all been major areas of shared conservation focus in the Southeast, and those efforts are clearly having a big impact.

Only 9 of the 20 indicators had declining trends. Of these, pine and prairie birds continue to be the most off track for meeting the SECAS goal. Regional declines in habitat, especially within the West Gulf Coastal Plain, Piedmont, Southeast Coastal Plain, Central Hardwoods, and Peninsular Florida, are likely driving this pattern. There is still hope that focused conservation can have an impact as Bachman's Sparrow, subject to significant conservation attention, increased in abundance through much of the longleaf pine range. This further reinforces the importance of accelerating open pine, pine/oak savanna, and other grassland restoration throughout the Southeast for grassland birds, pollinators, and other key species.

The 2023 goal report shows North Carolina has experienced declining trends in certain habitats and landscape characteristics including: forested wetland areas, landscape condition, and natural landcover in the floodplains. There are also declining trends for specific bird species in the state such as Yellow-Throated Warbler, Northern Bobwhite, Grasshopper Sparrow, Prairie Warbler, Louisiana Waterthrush, and the Worm-eating Warbler.

Regional Species of Greatest Conservation Need

Each state's wildlife action plan identifies SGCN, or the species most in need of proactive conservation attention (see Chapter 3 and Appendix P for a list of North Carolina's SGCN identified for this SWAP revision). After the 2015 SWAP revision cycle, the combined lists of SGCN for the 15 states that fall within the SEAFWA geography included more than 7,000 species. However, many SGCN occur across multiple states. Effectively managing and conserving these species requires actions and management strategies that will best allow for species movement and ensure the availability of key ecological attributes provided by different habitats across the landscape at different times. To help support long-term conservation goals for imperiled plant and animal species conservation partners have developed Regional Species of Greatest Conservation Need (RSGCN) list.

Animal RSGCN

In 2019, the National Wildlife Federation, as part of the Vital Futures project funded by the U.S. Geological Survey, prioritized the large number of SGCN collectively identified in the previous iteration of 15 Southeastern SWAPs. Across the 15 southeastern states, the combined lists of SGCNs totals nearly 6,700 species (National Wildlife Federation 2023). The Southeastern Association of Fish and Wildlife Agencies (SEAFWA) Wildlife Diversity Committee collaborated with the National Wildlife Federation and other partners to evaluate these species and produce a list of 960 regional priority species (1,034 including subspecies), or animal RSGCN. A report, "Regional Species of Greatest Conservation Need in the Southeastern United States," was written to detail the methodology used to develop the RSGCN list (Rice et al. 2019). A dataset for the RSGCN list is available online (GADNR 2024). This effort aligns with the Northeast Association of Fish and Wildlife Agencies' similar project to develop a RSGCN list for the Northeast Region.

Identifying animal RSGCN drew upon a collaborative process among Southeastern State fish and wildlife agencies and partners that involved more than 100 experts and used a set of consistent criteria to review current scientific information and evaluate state-identified SGCN. Species were evaluated based on several primary factors, including: 1) the level of conservation concern (i.e. extinction risk), 2) regional stewardship responsibility (i.e. importance of the Southeast in conservation of the species), and 3) biological or ecological significance (e.g., unique evolutionary lineages). The regional assessment focused on species in key taxonomic groups, including vertebrates (mammals, birds, reptiles, amphibians, and fishes) as well as several better-known groups of invertebrate animals (freshwater mussels, crayfish, and bumblebees). Scientific experts in each of these groups convened to evaluate and identify those species that warranted identification as a regional priority. Additionally, the science teams characterized the level of conservation concern for each regional priority, ranging from moderate to high and very high concern. Through this established process, the RSGCN list can be updated as the States' SGCN lists change over time. See Table 4 for list of RSGCN by taxa and levels of concern.

Out of the total animal RSGCN list, two-thirds are freshwater fish, crayfish, and freshwater mussels. The number of RSCGN that are considered the stewardship responsibilities of each state varies widely (Figure 6). These patterns reflect the underlying diversity of species in each state–particularly the number of imperiled and/or limited range species–which is also influenced by a state's size and diversity of habitats. These patterns are also influenced by the "regional stewardship responsibility" criterion in the assessment of priority species.

Nearly 70% of regional priority species are endemic to the 15-state SEAFWA region. Overall, more than half (55%) of RSGCN are shared by three or more states, presenting opportunities for

cross-state conservation collaboration. The remaining 45% of RSGCN have narrow ranges and are found in just one or two states. By taxa, fish and crayfish represent 47% of all RSGCN within the region. Many aquatic habitats and ecosystems within the Southeast are highly fragmented, resulting in severe limitations to ecosystem integrity and species persistence regionwide. Habitat fragmentation in rivers and streams is a determining factor in the decline in abundance of numerous species such as Eastern brook trout, freshwater mussels, and fully aquatic amphibians such as Eastern hellbender.

Several regional datasets can help North Carolina identify lands and waters that support animal RSGCN and find opportunities to collaborate with other states. For example, habitat maps at the species level from the USGS Gap Analysis Project (GAP) are available for approximately 290 animal species, and 90 sub-species, on the RSGCN list. While GAP does not include species habitat maps for invertebrates or plants, it does include a high percentage of vertebrate RSGCN (93% of amphibians, 92% of birds, 76% of mammals, and 77% of reptiles). Figures 7 through 10 show RSGCN richness using GAP species habitat models. This data, in combination with other tools like the Southeast Blueprint, can help identify areas where conservation actions are likely to yield co-benefits for RSGCN as well as other species, habitats, and ecosystem services. As recommended by AFWA, cross-jurisdictional or regional strategies can enhance ecosystem resiliency, function, and connectivity–especially in the face of climate change.

All data, including model inputs, are available from the USGS Gap Analysis Project Species Habitat Maps on their website: https://www.usgs.gov/programs/gap-analysis-project.

Plant RSGCN

The Southeast is home to more than 11,000 native plant species, 30% of which are regional endemics (i.e., found only in the Southeast). In 2023 the Southeast Plant Conservation Alliance (PCA) released the first plant RSGCN list in the nation. The PCA worked with a broad coalition of partners including the Atlanta Botanical Garden, NatureServe, and Terwilliger Consulting, and received funding from the U.S. Fish and Wildlife Service. This list narrows down the vast number of plants native to the Southeast to 1,824 species that are a regional conservation priority based on criteria such as rarity, threats, and needed conservation actions. The plant RSGCN list complements the Southeastern animals RSGCN list developed in 2019 to create a more complete picture of the region's exceptional biodiversity. The report, "Southeastern Plants Regional Species of Greatest Conservation Need (Radcliffe et al. 2023)," and the dataset of plant RSGCN are available online at https://www.se-pca.org/southeastern-plants-rsgcn/.

To develop a pool of potential species to draw from, the PCA worked with NatureServe to compile a list of more than 10,000 vascular plants native to any of the SEAFWA considering each species' G-Rank (global rarity), S-Rank (state rarity) and endemism. Unfortunately, due to data limitations, plants native to Puerto Rico and the U.S. Virgin Islands could not be included.

The full list received extensive review from botany experts, a technical team composed of representatives from each state, and NatureServe. Based on partner feedback, the technical team assigned each species a level of conservation concern rating ranging from low to very high or “manual review needed”. Any plant scoring moderate or above was ultimately considered an RSGCN. After cleaning the data to remove redundancies, the complete Southeastern plant list evaluated 9,271 species and prioritized 1,824 as RSGCN. Southeast endemic species make up 72% of the plant RSGCN list (Figure 11)

To better understand shared plant needs and threats at the ecosystem level, the PCA crosswalked each plant RSGCN to its primary habitats using U.S. National Vegetation Classification (USNVC) “Groups” (Table 5). The USNVC provides a widely-used, standardized system of classifying vegetation types and habitats. The distribution of RSGCN across ecosystems demonstrates their diversity and broad geographic extent. A total of 31 USNVC Groups contained at least 10 plant RSGCN, indicating that many of the region’s ecosystems support plant species of conservation need. As many of these same habitats tend to provide crucial habitat for animal RSGCN as well, conserving these ecosystems can safeguard regional biodiversity more broadly.

Table 6 lists the USNVC groups serving as primary habitat that support the most plant RSGCN in North Carolina. By far the USNVC group that supports the most plant RSGCN within the State is wet-mesic longleaf open woodland. These wet open woodlands occur within coastal plains and includes wet pine flatwoods and wet pine savannas (NatureServe Explorer, 2024). These habitats are dominated by longleaf pine with grassy understories (NatureServe Explorer, 2024).

North Carolina’s stewardship of RSGCN

As of the current 2022 Wildlife Action Plan, Addendum 2, North Carolina identified 483 wildlife SGCN and 462 plant SGCN. North Carolina also has stewardship responsibility for 204 RSGCN, most of which are also included in the state’s list of SGCN. The most common RSGCN taxa type represented in North Carolina are birds (n=43) and fishes (n=43) (Figure 12).

North Carolina is also home to multiple species that are not only endemic to the SEAFWA region but are not often found in many other states within the region. North Carolina shares the highest amount of RSGCN with Virginia, South Carolina, and Tennessee. In particular, North Carolina shares RSGCN stewardship responsibility for six mammals with Virginia that are considered very high concern. By identifying shared RSGCN, North Carolina can prioritize conservation actions that not only provide local benefits but support a regional landscape.

Climate resiliency

Many factors impacting the Southeast regional landscape are often too pervasive for any one agency to address independently, like sea-level rise, changing weather patterns, and habitat loss. While North Carolina must evaluate the impact of landscape level stressors and threats like climate change and land use change within its own boundaries, management efforts must also be coordinated on a regional scale. The AFWA 2022 (2nd Edition) Voluntary Guidance for States to Incorporate Climate Adaptation into State Wildlife Action Plans provides recommended steps for developing and implementing adaptation strategies. Much of the guidance includes taking a broader, regional approach to incorporating climate adaptation into SWAPs.

Projections of Earth's future surface temperatures depend primarily on future emissions and how sensitive the climate system will be to these emissions. Projections of climate change can be examined using two approaches: 1) global warming levels (GWLs); and 2) scenarios.

- GWLs are defined levels of warming for Earth's average temperature that correspond to increases of 2.7 °F (1.5 °C), 3.6 °F (2 °C), 5.4 °F (3 °C), and 7.2 °F (4 °C) degrees above pre-industrial levels (IPCC2018; Arias et al. 2021).

- A scenario-based approach can be used to explore plausible climate outcomes under a coherent future trajectory of greenhouse gases and other anthropogenic forcings (Leung et al. 2023).

The Fourth National Climate Assessment (NCA4), used projections created with Representative Concentration Pathways (RCPs) to project and talk about future climate in the United States (USGCRP 2018). However, the Fifth National Climate Assessment (NCA5) used newly developed climate projections created with Shared Socioeconomic Pathways (SSPs), that represent plausible trajectories of GDP and population growth, and trends of economic and technological progress globally for the 21st-century (USGCRP 2023). The climate projections used in the NCA5 were created using global climate models from the Coupled Model Intercomparison Project Phase 6 (CMIP6) that were statistically downscaled to translate large scale changes in the climate under a given SSP or GWL to local scales for impact assessment and planning (Basile et al. 2023). Three of the SSPs used with the new climate models from the CMIP6 correspond to three of the RCPs used with past global climate models from the Coupled Model Intercomparison Project Phase 5 (CMIP5) in their overall forcing levels (SSP1-2.6 corresponds with RCP2.6, SSP2-4.5 with RCP4.5, and SSP5-8.5 with RCP8.5) (Leung et al. 2023). Using scenarios can help inform when the planet will reach a certain global warming level and throughout this section, a mix of the SSPs and GWLs data will be used to show climate impacts.

Using available climate change data and information that assumes a specific Global Warming Level (GWL) or SSP-based scenario can allow land managers to consider possible future conditions. Exactly when and if we reach a particular GWL depends on the trends of Global emissions and how sensitive the climate system is to these emissions (Figure 13).

- For example, **in a very high scenario such as SSP5-8.5, the Earth is very likely to exceed a GWL of 2 (3.6 °F) between 2033 and 2054**, depending on the climate sensitivity to greenhouse gas emissions from each global climate model (Marvel et al 2023; Figure 14).

- By contrast, **in a low scenario such as SSP1-2.6, the Earth is very likely not to cross GWL 2 at all** (Marvel et al. 2023; Figure 14).

However, the rate of global warming varies across these scenarios, as well, with high and very high scenarios assuming the Earth warms faster (Marvel et al. 2023). Since 1850, the Earth's temperature has risen by an average of 0.11° Fahrenheit per decade and, as of 2023, rising about 2 °F in total (Climate Change: Global Temperature | NOAA Climate.gov). However, since 1982, the rate of warming increased over 3 times as fast to about 0.36°F per decade. Currently, the planet is estimated to warm by nearly 5.4°F by the end of this century, **meaning crossing a GWL 3 threshold**, despite current global emission reduction pledges, according to the most recent United Nation's Annual 2023 Emissions Gap Report (Emissions Gap Report 2023 | UNEP - UN Environment Programme). Based on these trends, it is likely that the habitats, ecosystems, and conditions of North Carolina will also change as faster rates of climate change also increase the challenge of adaptation for natural systems and wildlife

Climate projections use the best available physical science to predict how the climate system will respond to changes in human activities, but not all climate projections are developed in the same manner (IPCC 2023). Climate experts across the world have produced more than 50 global climate models under multiple greenhouse gas emissions and socioeconomic scenarios, each with unique variations and nuances. Some have undergone transformations like downscaling to improve spatial resolutions for smaller areas in order to make management decisions at a local scale.

The most recent climate projections used in the NCA5 and associated climate parameters can be viewed on the National Climate Change Viewer. This tool, developed by the U.S. Geological Survey, allows for visualizations of climate change impacts, such as days of extreme heat under projects of degree warming days, under SSP-based scenarios and Global Warming Levels (Alder and Hostetler 2013). Additionally, these data are available as interactive maps and layers as part of the Fifth National Climate Assessment Interactive Atlas (National Climate Assessment Interactive Atlas) and is where we have derived our spatial climate data for this report. Information pertaining to sea-level rise, as well as easy-to-understand state-level summaries on

climate change impacts, are available from the National Oceanic and Atmospheric Administration (NOAA) via their Sea-level Rise Technical Reports and Sea-level Rise Viewer Tool, and their State Climate Summaries website (Kunkel et al. 2022; Sweet et al. 2022).

In the Southeast, climate change will have pervasive impacts on natural habitats, ecological processes, and ecosystem services and regional efforts to mitigate or adapt to these impacts will be extremely important. According to NCA4 and NCA5, conditions in the Southeast may change dramatically (USGCRP 2018, 2023). Both Assessments indicate that current trends will continue such as increasing frequency, intensity, and duration of heatwaves, increasing wildfire risk, and rising sea levels.

The most pertinent projected changes include extreme heat, extreme precipitation events, drought, sea-level rise, and tropical cyclones, as well as decreases in the intensity and frequency of cold-season events. Despite the significant threat climate change poses to the landscape, understanding the tools and resources available to address climate change and develop effective strategies is difficult.

As part of the survey administered to SWAP coordinators in 2021, the majority of SEAFWA states/territories reported integrating climate change as one of the most challenging aspects of the upcoming SWAP revision. Anecdotally, some SWAP coordinators noted that it is difficult to discern what tools are available, decide which tool is the right one to use, and choose the appropriate scale and timeframe when using tools. Some reported it is also challenging to determine what climate-change associated threats to include and how to spatially represent their impacts. As such, the Southeast and South Central Climate Adaptation Science Centers (SECASC and SCCASC) have provided data and information for this chapter to help translate the actionable implications of future climate projections.

North Carolina and climate hazards

Like the rest of the Southeast, North Carolina is predicted to experience a number of climate impacts, though the magnitude of change often varies by ecoregion, emissions scenario, and future timeframe. Generally, these impacts include hotter summers, warmer winters, more frequent extreme precipitation events, and rising sea levels (USGCRP, 2018; Hoffman, 2023).

Hotter summers, warmer winters, and more intense droughts

Generally, the number of extremely hot days (i.e., days with afternoon high temperatures of at least 95°F) are predicted to increase, although there are differences in the degree of how many hotter days are expected across the state (Table 7). Temperatures in North Carolina have risen by 1°F since the beginning of the 20th century, which is about half of the average warming for the contiguous U.S. (Frankson et al. 2022) and under various global warming levels, summer

nighttime minimum temperatures that exceed 70°F, and daytime maximum temperatures that exceed 95°F (Figure 14), become the norm in North Carolina (Alder and Hostetler, 2013; USGCRP, 2018; Hoffman, 2023). To underscore this, summer average temperatures for the state between 2005-2020 have been some of the warmest on record (Frankson et al. 2022).

The years spanning 2010–2020 have also seen the largest number of very warm nights (Frankson et al. 2022). As nighttime temperatures rise, some species may also be impacted. Warmer nights can have a profound impact on animal and plant health because temperatures are generally lower at night, normally allowing the environment to cool down. Additionally, heatwaves in the U.S. have become hotter, more frequent, larger, and longer lasting in recent decades and are projected to continue, which has implications for drought in the region (Hoffman, 2023). The 5th NCA projects that the number of extremely hot days (days with maximum temperatures ≥95°F) may increase across North Carolina, with the most pronounced changes occurring in central portions of the state. Additionally, heatwaves in the U.S. have become hotter, more frequent, larger, and longer lasting in recent decades. These trends are projected to continue, which has implications for drought in the region (Hoffman, 2023).

Higher temperatures throughout the year in North Carolina will increase the rate of soil moisture loss (i.e., evapotranspiration) during dry spells, which could lead to more intense droughts (Frankson et al, 2022). Any increases in temperature will cause more rapid loss of soil moisture during consecutive dry days (i.e., consecutive days without rainfall), increasing the intensity of naturally occurring droughts in the future (Runkel et al. 2022). Although, hydrological droughts have become less frequent in eastern regions of the country since the 19th century, higher increases in evapotranspiration (the processes by which water is transferred to the atmosphere from Earth's surface) have generally made the Southeast more drought-prone than the Northeast (Hoffman, 2023). However, future changes in the annual number of consecutive extreme dry days in North Carolina are fortunately not projected to increase substantially: by 1 to 3% by 2025-2049, and by 1 to 4% by 2050-2074 depending on ecoregions and emission scenario (Alder 2024).

Table 7 summarizes historical observed and future projections of extremely hot days (maximum temperatures ≥95°F) under different SSP scenarios and at GWL 2 (3.6°F warmer than the1991-2020 time period) for North Carolina ecoregions; while Figure 14 shows the change in the projected the number of extremely hot days in North Carolina at GWL of 1.5 (2.7°F warmer than the 1991-2020 time period) and GWL 2 (3.6°F warmer than the1991-2020 time period). Overall, the projections used in the NCA5 indicate that the number of extremely hot days (maximum temperatures ≥95°F) will increase across North Carolina, with the most pronounced increases occurring in the southern, inland portions of the state, though the magnitude of change often varies greatly by GWL or SSP scenario and location within the state.

Winter temperatures are the fastest warming season in most of the U.S. In general, the number of extremely cold days (i.e., days with low temperatures of at least 32°F or lower) in North Carolina is predicted to decrease (Table 8). Winter conditions are key drivers of individual species performance and community composition in terrestrial habitats because species vary in susceptibility to these winter drivers (Williams et al., 2014). Shorter and warmer winters may cause species range shifts that would allow for warm-adapted species to dominate and shift distributions of cold-adapted species. For example, overwintering bird populations are responding to warming climate (e.g., poleward shifts) by favoring the formation of winter bird communities dominated by warm-adapted species instead of cold-adapted species (Princé and Zuckerberg, 2014; Osland et al., 2021). Additionally, winter conditions (e.g., snowfall, low temperatures) have a major effect on ecological processes such as litter decomposition, mineralization rates, nutrient leaching and gas fluxes in the soil and hydrological processes. Winter soil freezing also affects insect and microbial communities for the subsequent warm season (Campbell et al., 2005).

Overall, projections used in the NCA5 indicate that the number of extremely cold days (days with low temperatures of ≤ 32°F) will decrease across North Carolina, with the most pronounced decreases occurring throughout the southern and coastal parts of the state, but the magnitude of change often varies greatly by GWL or SSP scenario and location within the state (Table 8; Figure 15). If the Earth surpasses a GWL of 1.5 (2.7°F) or 2 (3.6°F) for a sustained period of time, the number of days where the temperature reaches 32°F or lower (freezing temperatures) will decrease across the state, compared to the years between 1991 and 2020 (Table 8).

In North Carolina, the majority of years between 2000 to 2020 have been characterized by warm-season drought conditions. However, little change in total annual precipitation is projected over this century, although the timing and intensity of precipitation events will change (Hoffman et al., 2023). However, increases in temperature will cause more rapid loss of soil moisture during consecutive dry days, increasing the intensity of naturally occurring droughts in the future (Runkel et al. 2022). In other words, more days of extreme heat can exacerbate drought conditions.

The Southeast has, in general, received more precipitation in the fall seasons but experienced drier conditions in spring and summer (Hoffman et al., 2023). Although, hydrological droughts have become less frequent in eastern regions of the country since the 19th century, higher increases in evapotranspiration (the processes by which water is transferred to the atmosphere from Earth's surface) have generally made the Southeast more drought-prone than the Northeast (Hoffman, 2023).

Extreme precipitation events and altered flows

Other potential climate hazards may impact the state, such as extreme precipitation events, which are expected to increase in the future and often manifest as extreme weather and increased flooding (Wong et al., 2014). Climate change projections suggest that the Southeast as a region will get wetter overall, with increases to some seasonal averages and the annual average. Also, extreme precipitation amounts will increase across the region, driven mainly by more extreme events (e.g., precipitation of 3 or more inches in 24 hours) at higher levels of global warming (Hoffman, 2023). In other words, little change in total annual precipitation is projected over this century, although the timing and intensity of precipitation events will change (Hoffman et al., 2023).

However, southwestern North Carolina is one of the wettest locations in the Southeast, receiving more than 90 inches of precipitation annually in a few locations. The number of 3-inch extreme precipitation events was highest during the 2015–2020 period and the wettest consecutive 5-year interval for the state was 2016-2020, averaging 56.9 inches per year (Frankson et al. 2022). Extreme precipitation events are expected to increase in the future and often manifest as extreme weather and increased flooding due to compounded affects from high tides or storm surges that inundates low-lying areas on the coast (Wong et al. 2014).

In the Southeast region, extreme weather events are generally characterized by hurricanes and tropical storms that will likely increase in frequency and magnitude (USGCRP, 2018). Tropical storms and hurricanes have been responsible for some of the Southeast's biggest and most damaging flooding events since 2018 and hurricane-associated storm intensity and rainfall rates are projected to increase as the climate warms (Hoffman, 2023). The likelihood of hurricanes slowing down or stalling near the Southeast coastline has increased, which exacerbates the rainfall-related flooding threats from these storm systems (Hoffman, 2023). Climate change is expected to strengthen North Atlantic hurricanes to at least Category 4 intensity and to undergo rapid intensification, as well as potentially increase the likelihood of storms making landfall (Hoffman, 2023).

North Carolina's location along the Atlantic coast makes the state vulnerable to tropical storms and hurricanes**:** a storm at hurricane intensity reaches the state about once every 3 years; however, storms at less than hurricane intensity can also have major impacts in the form of damaging winds, coastal flooding from storm surges, and extreme precipitation (Frankson et al. 2022). However, western North Carolina, the Blue Ridge and Piedmont ecoregions of the Appalachians, are also highly vulnerable to extreme precipitation events, including tropical cyclones that move inland (cite). Mountainous terrain constrains where water can flow and rainfall will accumulate quickly in lower-elevation areas, worsening effects.

Additionally, hurricanes can produce widespread and damaging landslides in the mountains, like the recent hurricane Helene that dumped more than 18 inches across western North Carolina (Martinez et al., 2024). Landslides, flooding and large amounts of surface water runoff from extreme precipitation events and tropical storms have many negative impacts on wildlife including increased sediment and contaminated floodwater draining into waterways, flooding of animal nests, and erosion and more (Dolloff et al., 1994; Mirus et al., 2020). There is high spatial overlap between landslide susceptibility and biodiversity in the Appalachians provides an opportunity to achieve co-benefits in both species conservation and development if these vulnerable sites are protected and restored (Li et al., 2022).

Table 9 summarizes approximate values for historical observed and future projections of extreme rainfall under different SSP scenarios for North Carolina ecoregions; while Figure 16 shows the projected future percent change in the number of days per year with extreme precipitation (e.g., days with the top 1% of rainfall) in North Carolina at GWL 1.5 (2.7°F warming) and GWL 2 (3.6°F warming) compared to the last 30 years. Estimates of when these GWL might be reached depend on the emission scenario. While all ecoregions within North Carolina will experience changes in days with extreme precipitation, the western part of the state, in the Blue Ridge and Piedmont Ecoregions, is projected to experience the greatest percent change by GWL3 (Figure 16).

The Southeast has the highest aquatic diversity of any temperate system; however, the ecological relationships and life histories of many of the endemic species are not yet well understood within the constraints of climate change (Ingram et al., 2013). Freshwater ecosystems (e.g., streams, rivers, lakes, and wetlands) of the Southeast are highly vulnerable to warming. Impacts on rare species of fish and mussels are of particular concern in a changing climate. The combined effects of warming and changes in precipitation will likely alter overall hydrology including increased evapotranspiration and reduced stream base flow. Currently, many species declines are associated with widespread alteration of flow regimes and are expected to be exacerbated by climate change. Impacts of climate change on riverine and wetland ecosystems are predicted to also include increased water temperatures, which dictate many species ranges and exacerbates low dissolved oxygen conditions (Ingram et al., 2013). In general, temperature regimes of freshwater ecosystems are projected to increase in parallel with shifts in air temperatures, which in turn may alter plant and animal communities including migratory birds (Princé and Zuckerberg, 2015).

Sea-level rise

Beyond the changes for temperature and precipitation, sea-level rise will also impact North Carolina. Coastal and low-lying areas are highly likely to experience a myriad of changes due to sea-level rise like flooding, erosion, and submergence (Wong et. al. 2014). Due to the

magnitude of sea-level rise projected throughout the 21st century and beyond—coupled with subsidence—coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, flooding, and erosion (Wong et. al. 2014). Historically, coastal ecosystems in the region have adjusted to sea-level rise by vertical (accretion) and horizontal movement across the landscape. As sea levels continue to rise, some coastal ecosystems will be submerged and convert to open water, and saltwater intrusion will allow salt-tolerant coastal ecosystems to move inland at the expense of upslope and upriver ecosystems.

The National Oceanic and Atmospheric Administration (NOAA) 2022 Sea Level Rise Technical Report, *Global and Regional Sea Level Rise Scenarios for the United States*, provides the most recent projections available to all U.S. coastal areas out to the year 2150 (Sweet et. al 2022). Tables 10 and 11 show the predicted extent of flooding for North Carolina at the average highest daily tides due to sea level rise. Figure 17 represents a map of areas likely to experience flooding at high tide based on each foot of sea-level rise above current levels.

Species' response to changes in climate

As the climate, regional landscape, and weather patterns change, there is value in identifying regional strategies and conservation actions to support the SGCN and RSGCN that are most vulnerable to the impacts. A species is considered vulnerable to climate change if it is both sensitive and exposed to climate change impacts (Williams et al. 2008; Figure 18). For example, a species may be exposed to climate change because it experiences an impact like warmer stream temperatures, but if it is resilient to that change or able to disperse into new habitats, it may ultimately have low vulnerability. Conversely, a species that would be sensitive to climate change but is unlikely to experience any impacts and is therefore not exposed, may also not be Understanding if a species is sensitive and will be exposed to climate change can help managers develop strategies to support the species most likely to be impacted.

Two common tools that have been used to determine climate vulnerability of species are 1) the Climate Change Vulnerability Index (CCVIs) (Young et al., 2016) developed by NatureServe and 2) environmental niche modeling-based vulnerability estimates produced by the academic research community. The CCVI is a worksheet-based tool where users apply readily available information about a species' natural history, distribution, landscape circumstances, and expert opinions to predict whether it will likely suffer a range contraction and/or population reduction due to climate change that is in the form of a vulnerability score. By design, this score is distinct from NatureServe's national vulnerability ranking system that considers other threats. A species could score as not particularly vulnerable in terms of its Global or State rank (G-or S-rank), which is based on other factors, but could still rate as vulnerable to climate change. CCVI is based on an evaluation of the species' direct and indirect exposure to climate change and its sensitivity to climate change. To date, several SEAFWA states (West Virginia, Byers & Norris

2011; Tennessee, Glick et al. 2015; FL, DuBois et al. 2011; and Louisiana, Holcomb et al. 2015) have used the CCVI tool to conduct assessments of their SGCN in order to inform previous SWAPs, management priorities, and research and conservation planning. Their previous CCVI assessments can be accessed from their 2015 SWAPs or from an archived online integrated dataset collated by the Armsworth lab at the University of Tennessee - Knoxville (DOI to come) and can serve as references for what has been done before and to shape planning and conservation efforts.

Ecological niche models (also called species distribution models) are a common approach for evaluating a species' vulnerability to climate change by the academic research community. These models start by identifying shared climate conditions at sites where a species is known to have occurred and then predict where similar climate conditions may be found on the landscape in the future. Some models also take into account the ability of a species to disperse to reach any new areas that may become climatically suitable. These resulting predictions from these models allow researchers to create spatially explicit estimates of whether suitable climate conditions for a species are likely to remain stable, become more widespread in the landscape (i.e. increase), or become more geographically rare in the future (i.e. decrease).

For example, if suitable climate conditions for a species were projected to decrease greatly in an area in the future, then the species would be considered more vulnerable to climate change than a species for which climate conditions were predicted to remain stable. It is important to note that raw data from niche models (e.g., spatial raster data) is not usually readily available to the public due to the large size of the files but instead is available in summary form in the research literature (i.e., academic journal articles). Therefore, more translational effort is needed with niche model results as the form of the data might not be readily interpretable by users. A collated and readily interpretable dataset of niche models conducted for Southeast RSGCN by researchers to date has been developed by the Armsworth lab at the University of Tennessee - Knoxville (DOI to come).

Niche model results can be used in tandem with CCVI estimates to enhance the understanding of a given species' vulnerability, because CCVIs and niche models have complementary strengths that can help land managers make informed conservation decisions. Niche models offer more refined and spatially explicit predictions (i.e., changes in suitable habitat) about the direct exposure of a species to climate change but are only available for a limited set of species, in part because the models require extensive data on a species before they can be applied. CCVI estimates use an expert judgment-based approach that allows integration of different types of information about species and what might make them vulnerable to climate change (e.g., their natural history). It is important to compare CCVI estimates with available ecological niche model predictions for SGCN to fully understand a given species' vulnerability to climate change

while keeping in mind the geographic (e.g., region or habitat evaluated) and biological contexts (e.g., estimated dispersal distance) of these assessments.

Summary of available climate change vulnerability indices

The USGS Southeast Climate Adaptation Science Center (SE CASC) and the University of Tennessee - Knoxville launched a research effort to support the SEAFWA states in integrating climate change considerations into their 2025 SWAP updates. This effort collated CCVI scores from 10 data sources within the eastern United States. It draws from CCVI assessments published in four SWAPs in the Southeast (West Virginia, Byers & Norris 2011; Tennessee, Glick et al. 2015; Florida, DuBois et al. 2011; and Louisiana, Holcomb et al. 2015) as well as the Illinois SWAP (Walk et al. 2011), Natural Heritage Programs in the Northeast (Schlesinger et al. 2011, Furedi et al. 2011), the Appalachian and North Atlantic Landscape Conservation Cooperatives (Sneddon & Galbraith 2015, Sneddon & Hammerson 2014), and the National Park Service Cumberland Piedmont Network (Bruno et al. 2012), all of which were informed by state conservation practitioners. This work compiles 1,600 CCVI estimates for 795 species (note: some species have multiple CCVI estimates coming from different states). Many of these are on the RSGCN list for the Southeast. For North Carolina, 207 SGCN have been scored via CCVI estimates to date by other institutions (Armsworth et al., DOI to come).

Most CCVI assessments for North Carolina's SGCN to date have focused on birds. Many of these CCVI assessments indicate that while some bird species may be vulnerable, a larger proportion may remain stable or increase under changing climatic conditions (Figure 19). Though more assessments are needed for other taxa, especially those that are not as well studied (e.g., plants or invertebrates), these current CCVI estimates show that amphibians, mammals, and mussels have the largest proportions of North Carolina' SGCN vulnerable to climate change; and mammals having the least. For example, more than half of the assessed mussel SGCN in North Carolina are vulnerable to climate change (Figure 19).

Summary of available ecological niche models

In addition to the collation and summary of CCVI estimates, the SE CASC and the University of Tennessee have summarized complementary information on available ecological niche models. For North Carolina, 184 SGCN have been evaluated across 12 academic research studies (Mckenny et al. 2007; Iverson et al. 2008; Matthews et al. 2011; Sutton et al. 2014; Bucklin et al. 2015; Struecker & Milanovich 2017; Pandey & Papeş 2018; Bateman et al. 2020; Lawler et al. 2020; Zellmer et al. 2020; Zhu et al. 2021; Lyon & Papeş 2022). Figure 20 summarizes the combined results for these ecological niche models. Like the CCVI assessments, most niche models to date focus on birds, and based on these assessments, many bird species may experience increases in their climatically suitable landscape within North Carolina or remain stable. However, for the other animal taxa evaluated with niche models to date, there appears

to be roughly equal proportions of climatically suitable areas for SGCN decreasing as increasing amphibians being the exception. More assessed amphibian species are projected to experience a large decrease in climatically suitable area than species projected to remain stable.

Comparing CCVI and available ecological niche models results

Comparing the results of the ecological niche models to the CCVI estimates for SGCNs within North Carolina reveals similar trends for taxa that were evaluated using both methods. All taxa within the Southeast will experience some vulnerability (i.e., moderately, highly, extremely vulnerable) and some decreases (i.e., decrease or large decrease). Birds have the greatest number of SGCN with predicted stable or increasing populations across both approaches, partially due to how many more bird SGCN have been evaluated compared to other taxa. But looking beyond birds, results from both CCVI and niche models suggest that amphibian SGCN in North Carolina are projected to have large proportions of their populations vulnerable to climate change.

Currently, few species overlap between both the CCVI and ecological niche model datasets, which limits the scope of comparisons. In particular, niche model estimates are not yet available for many aquatic species such as fishes and mussels; which the scientific literature suggests may be some of the most vulnerable to climate change in North Carolina and the Southeast region (Halpern and Kappel 2012; Poff et al. 2012; Ingram et al. 2013). However, the available CCVI for these aquatic taxa suggest that mussels have the greatest number of North Carolina SGCN predicted to be extremely and highly vulnerable to climate change (Figure 19).

A closer look – Coastal Georgia as crucial habitat for at-risk migratory shorebirds and seabirds

The Western Atlantic Flyway is a major north-south flyway for migratory birds in North America as they travel up and down this route following food sources, heading to breeding ground, or traveling to overwintering sites. Several species of shorebirds and seabirds, including hundreds of thousands of individuals, make trans-Atlantic flights from three major staging sites in the US along the flyway; one of which is the Georgia Bight (Smith et al. 2019; Smith et al. 2020; Tuma & Powell 2021; Watts et al. 2021a, 2022; Smith et al. 2023a). Migratory staging sites play a critical role in the life cycle of many shorebird species where they can stop to rest and refuel before continuing their migration (Watts and Smith 2018). For example, breeding populations of Whimbrels (*Numenius phaeopus*) from both the Mackenzie River Delta and the Hudson Bay of the arctic, use the South Atlantic as sites for spring staging and stopover that last for about a month (Watts et al. 2021a; Figure 21). Several seabird species, including the LeastTern (*Sternula antillarum)* and Gull-Billed Tern (*Gelochelidon nilotica*), use Georgia beaches and coastline as their summer breeding grounds in eastern North America (Walker & Seymour 2018; Goodenough & Patton 2019). Key habitat types in the Georgia Bight include tidal- creeks, salt marsh, sand dune/beach, which host many different species of migratory birds.

Figure 21.*Whimbrel flock in flight (photo credit to Fletcher Smith/GA DNR);* ***B)*** *Least tern feeding a chick (photo credit to Tim Keyes/GA DNR);* ***C)*** *American oystercatcher pair prospecting on new spoil island while it is still under construction chick (photo credit to Tim Keyes/GA DNR);* ***D)*** *Wilson's plover male, female and chick on Brunswick Harbor dredge island (photo credit to Tim Keyes/GA DNR).*

Despite an increase in conservation efforts, there are widespread accelerating declines of many species of North American shorebirds, with the greatest declines being found at staging sites along the Atlantic Coast near the Georgia Bight (Smith et al. 2023b). Shorebirds, as a group, are likely to be highly vulnerable to changing climate based on a number of factors: climate impacts to habitat, extreme weather, and shifting phenologies. Table 12 summarizes the available climate change vulnerability assessments and species distribution models conducted to date for Georgia shorebird and seabird species of greatest conservation concern (SGCN). Many of these species breed, migrate through, or winter in areas that are likely to be severely impacted by climate change (particularly Arctic tundra, coastal breeding, and wintering, and migration stopover sites). Second, the extensive migrations many shorebirds undertake expose them to risks of changing weather patterns (e.g., increased frequencies and intensities of tropical storms and hurricanes) (Klaassen et al. 2012; Watts et al. 2021b). Shorebirds that require specific staging areas may be more vulnerable to climate change than are those species using stopover sites (Warnock 2010; Iwamura et al. 2013). Lastly, the synchronous ecological phenologies that many shorebirds depend on (e.g., the complementary timing of invertebrate prey availability) might suffer disruptions (Galbraith et al. 2002; Hedenström et al. 2007; Small-Lorenz et al.

2013). These migratory birds face many other threats including habitat loss and human disturbance (e.g., recreation on beaches), for example, and when paired with threats from climate change, the potential impacts are great. Galbraith et al. (2014) found that of the 52 shorebird taxa evaluated that breed in North America, 45 (87%) were predicted to exhibit an increased extinction risk when the risks posed by climate change were added to their current vulnerabilities as estimated in the US Shorebird Conservation Plan.

Table 12. *Georgia shorebird and seabird SGCN conservation and climate change vulnerability assessments to date. X's for the RSGCN column indicate whether the species is a regional SGCN. Global IUCN Red List Status assessments were taken from https://www.iucnredlist.org/, but many species haven't been assessed for five to nine years. If available assessments of climate change vulnerability based on NatureServe climate change vulnerability index (CCVI) calculations from southeastern states (Sneddon & Hammerson 2014; Glick et al. 2015; Holcomb et al. 2015) and labeled as "NatureSErve CCVI by SE States", and ecological niche model vulnerability scores from recent studies using eastern North America geographic areas (Bateman et al. 2020, Lawler et al. 2020, and Bucklin et al. 2015) summarized by Armsworth et al. (DOI to come), labeled as "Niche Models for SE Region". Lastly, the percent change in abundance for species, as available from monitoring data since 1980 were included, called "% Change in Abundance". For a species, if multiple studies had different climate change vulnerabilities estimated from niche models, boxes were color filled with orange to indicate this.*

	Species	GA SCGN	RGSCN	Global IUCN Red List Status	NatureServe CCVI by SE States	Niche Models for SE Region	% Change in Abundance
Shorebirds							
Red Knot	*Calidris canutus*	X	X	Near threatened	Presumed stable	Stable	-95%
Semipalmated Sandpiper	*Calidris pusilla*	X		Near threatened	Not assessed	Not assessed	-68%
Piping Plover	*Charadrius melodus*	X	X	Near threatened	Moderately Vulnerable	Decrease	-45%
Wilson's Plover	*Charadrius wilsonia*	X	X	Least Concern	Moderately Vulnerable	Stable/ Decrease	Not Assessed
American Oystercatcher	*Haematopus palliatus*	X	X	Least Concern	Moderately Vulnerable	Decrease	Not Assessed
Black-necked Stilt	*Himantopus mexicanus*	X		Least Concern	Not Assessed	Not Assessed	Not Assessed
Short-billed dowitcher	*Limnodromus griseus*	X		Least Concern	Not Assessed	Not Assessed	-85%
Whimbrel	*Numenius phaeopus*	X	?	Least Concern	Presumed Stable	Decrease	-78%
Lesser Yellowlegs	*Tringa flavipes*	X		Least Concern	Not Assessed	Not Assessed	-75%
Willet	*Tringa semipalmata*	X	X	Least Concern	Moderately Vulnerable	Stable	+25%
Seabirds							
Gull-billed Tern	*Gelochelidon nilotica*	X	X	Least Concern	Not Assessed	Stable/Increase Likely	Not Assessed
Black Skimmer	*Rynchops niger*	X	X	Least Concern	Moderately Vulnerable	Stable/ Decrease	Not Assessed
Least Tern	*Sternula antillarum*	X	X	Least Concern	Extremely Vulnerable	Stable/ Decrease	Not Assessed

Shorebird and seabird breeding habitat and staging sites in coastal Georgia consist of sandy beaches and barrier islands, offshore bars, shell rakes and intertidal mud/sand flats and salt marshes, which are highly vulnerable to climate change impacts. Sea level rise (SLR) is predicted to affect these key coastal habitats with losses of 20-45% for salt marsh and 23-35% for tidal forest projected (Brittain and Craft 2012). However, significant degradation and loss of nesting habitat in coastal Georgia has already occurred, particularly offshore bar habitat. Loss of American Oystercatcher (*Haematopus palliatus*) habitat from climate change, sea-level rise, and loss of oyster reefs is likely to continue throughout their range; thus, creation and restoration of oyster reefs and nesting islands for the species will become increasingly important (Vitale et al. 2021). A recent study found approximately 40% exposure to habitat change from sea level rise for the American Oystercatcher and Wilson's Plover (*Charadrius wilsonia*) in Georgia's coastal plain (Paulukonis et al. 2021).

Climate change can also impact seasonal food availability for shorebirds and seabirds who need to consume thousands of marine bivalve mollusks and horseshoe crab eggs for their energetically costly migrations. Climate change drivers such as warming ocean temperatures, ocean acidification, and hyposalinity (i.e., lower amounts of salt in seawater that there is normally) all negatively impact marine bivalve mollusks including saltwater clams and mussels that shorebirds forage on (Steeves et al. 2018; Thomas and Bacher 2018; Huang et al. 20230; Masanja et al. 2023; Tan et al. 2023). The importance of American Horseshoe Crab (*Limulus polyphemus*) eggs by shorebirds, especially to Rufa Red Knots and Semipalmated Sandpipers, in the Georgia Bight is also well documented; with densities of shorebirds being directly correlated with densities of horseshoe crabs at stopover sites (cite FWS report). However, if climate change affects the timing or success of horseshoe crab breeding, this would disrupt synchronicity between horseshoe crab egg laying and spring migration (Galbraith et al. 2014; Smith et al. 2017).

Additionally, droughts affect invertebrate communities in coastal wetlands, which can have bottom-up effects on the condition and survival of shorebird and seabird predators (Anderson et al. 2021). Even short-term moderate drought conditions can negatively affect shorebird refueling performance at coastal wetlands, which may carry-over to affect subsequent stopover decisions on their migration (Anderson et al. 2021). Reducing the availability of important food resources would significantly impact the migratory shorebirds that rely on the Georgia Bight as a stopover site. Destruction or degradation of a stopover habitat may compromise a bird's ability to reach its destination and, for individuals migrating to the breeding grounds, this could negatively affect nesting success and long-term population viability (Skagen 2006). Given shorebird population declines and predicted changes in the severity and duration of droughts with climate change for Georgia, resource managers and researchers should prioritize a better understanding of how droughts affect shorebird refueling performance and survival (Anderson et al. 2021).

Each year hundreds of millions of birds cross the Atlantic Ocean during the peak of tropical cyclone and hurricane activity although the extent and consequences of their interactions with storms remain largely unknown. However, recent research on whimbrels has shown that the Hudson Bay whimbrel breeding population departs North America from the south Atlantic Coast across the Caribbean Basin, encountering a high percentage of storms in crossings (Watts et al. 2021b). In fact, the researchers found that more than half of the Hudson Bay population storm encounters resulted in grounding on Caribbean islands, requiring grounded birds take longer to complete the trans-Atlantic crossing and some individuals being lost to predation and hunting (Watts et al. 2021b). Demographic consequences of storm encounters will likely play a key role in the ongoing evolution of trans-Atlantic migration pathways as climate change continues to increase the frequency and intensity of storms (Watts et al. 2021b).

Climate change in the Arctic is leading to earlier summers there, creating a mismatch in timing, called a phenological mismatch, between the hatching of migratory shorebirds and the availability of their invertebrate prey (Saalfeld et al. 2021). While phenological mismatch with food sources would presumably lower the survival of chicks, climate change is also leading to longer, warmer summers that may increase the annual productivity of birds by allowing adults to lay nests over a longer period of time, replace more nests that fail, and provide physiological relief to chicks (i.e., warmer temperatures that reduce thermoregulatory costs). However, a recent study by Saalfeld *et al.* (2021) found that any physiological relief experienced by chicks will likely be overshadowed by the need for adequate food. Thus, the phenological mismatch between hatching of shorebird young and invertebrate prey emergence ensures that warmer, longer breeding seasons will not translate into abundant food throughout the longer summers for chicks (Saalfeld et al. 2021). For example, a recent study found evidence that egg clutch initiation dates for Willets (*Tringa semipalmata)* in the US have become earlier over time but did not investigate shifts in food availability for their chicks (Abernathy et al. 2023). Identifying what primary climate drivers of shorebird and seabird phenology, and the life stages during which they occur, can help predict the influence of dynamic selection pressures at different phases of their annual cycle, which either conflict with or complement species' ability to adapt to climate change (Smith et al. 2020).

Overall, across both climate change vulnerability assessment methods, most of the evaluated Georgia shorebird and seabird SGCN are estimated to be at least Moderately Vulnerable to climate change and projected to experience decreases in suitable land area (i.e., habitat) (Table 1). The only SGCN previously evaluated that was estimated to have an Increase Likely in its climatically suitable habitat was the Gull-Billed Tern by Bateman et al. (2020) (Table 1). Additionally, most of the CCVI estimates and vulnerability scores from ecological niche models in Table 1 generally align. For example, the American Oystercatcher and Wilson's Plover are both estimated to be moderately vulnerable to climate change from CCVI assessments and are projected to experience decreases in climatically suitable areas in their Southeast ranges based

on ecological niche models (ENM) (Table 1). Because CCVI estimates do not include spatially explicit data, the ENM results here inform us that they may be more vulnerable than estimated by the CCVIs due to changes in suitable habitat in these instances. However, there are a couple species, the Whimbrel and Willet, for which the two vulnerability assessments differ due to disparities in the scale of analysis between their various methods (i.e., CCVI estimates conducted by/for individual states and niche models conducted at the continental or regional level). Additionally, in the case of the Red Knot, both assessments presumed the species' climate vulnerability to be Stable, but coastal Georgia is a major stopover area annually for *rufa* Red Knots in spring migration, and thus the vulnerability of the species in this crucial habitat may need to be evaluated particularly (Smith et al. 2019).

In instances of complete disagreement of the vulnerability estimates between the two methods, like with these two species, it is important to examine the spatial extent and biological assumptions (e.g., the assumed dispersal capacity of the species) of the niche models and the parameters used for the CCVI assessments, as they could be driving the discrepancies in vulnerability conclusions. For a given species, when large discrepancies are seen in results between the two methods, states may want to consider conducting their own assessments or implementing climate change mitigation measures or expanded species monitoring as a precautionary measure. Likewise, if a species has not been assessed by either method, in the case of four shorebird SGCN: Semipalmated Sandpiper (*Calidris pusilla*), Black-necked Stilt (*Himantopus mexicanus*), Short-Billed Dowitcher (*Limnodromus griseus*), and the Lesser Yellowlegs (*Tringa flavipes*) (Table 1).

In summary, all the shorebird species breeding in the USA and Canada are migratory, which means climate change could affect extinction risk via changes on the breeding and/or migratory refueling grounds, and that their habitat and prey synchronicities could be disrupted throughout coastal Georgia. The declines in shorebird populations and climate impacts reported in studies cited here are worrisome and signal the need for conservation action. In addition, it could be beneficial to validate some of these reported results to allow for the development of more targeted efforts to reverse declines through conservation action: through the collection and analysis of complementary data, and to initiate shorebird demographic studies throughout the annual cycle to determine where and when declines are most likely to originate.

Adaptation strategies

Identifying adaptation strategies to address impacts and vulnerability is a step towards climate resiliency. Climate adaptation and mitigation comes in various forms and multiple frameworks have been built to support planning for and implementing climate adaptation. Most climate adaptation frameworks generally include:

1. Recognizing adaptation limitations to adaptation, such as the degree of natural resource management, availability of funding, or staffing capacity; and
2. Deciding which type(s) of adaptation approach(es) meet specific conservation goals.

Two well-known examples of frameworks include the Resist-Accept-Direct (RAD) Framework developed by the U.S. National Park Service and the Climate Adaptation in Practice: Resistance, Resilience and Transition (RRT) Framework developed by Colorado State University. There are also multiple sources for adaptation and mitigation strategies. The Adaptation Workbook, a compilation of resources developed by the Northern Institute of Applied Climate Science and its partners provides an excellent overview of strategies.

The Adaptation Workbook is broken down into sections, one of which being Adaptation Strategies and Approaches. In this section, climate adaptation strategies are listed in what are known as "menus"—categorized by focus areas—with the goal of the menus being to provide conservationists with specific, actionable adaptation options to select from. The menus are not all encompassing, nor are they intended to serve as guidance for management decisions. They simply serve as a starting point for those interested in climate adaptation so that they do not have to start from scratch. Climate adaptation menus and the recommended strategies and approaches that apply to the U.S. Southeast include:

- Agriculture
- Fire-Adapted Ecosystems
- Forests
- Forest Carbon Management
- Forested Watersheds
- Grasslands
- Non-Forested Wetlands
- Recreation
- Saltwater Coastal Ecosystems
- Tribal Perspectives
- Urban Forests
- Wildlife Management

Working in resilient landscapes

Regardless of the projected impacts of climate hazards, some portions of the State are predicted to be more resilient than others. Focusing conservation action within resilient places is a climate-smart investment.

Terrestrial resilience

Roughly 30% of North Carolina's inland landscape is considered to score above average for terrestrial resilience. The Nature Conservancy (TNC) developed a data set called the Resilient Land Data and identifies areas with different landscape characteristics such as the number of depicts an area's capacity to maintain species diversity and ecosystem function in the face of climate change. It measures two factors that influence resilience.

- The first, landscape diversity, reflects the number of microhabitats and climatic gradients created by topography, elevation, and hydrology.
- The second, local connectedness, reflects the degree of habitat fragmentation and strength of barriers to species movement.

Highly resilient sites contain many different habitat niches that support biodiversity, and allow species to move freely through the landscape to find suitable microclimates as the climate changes. Resilience emphasizes diverse landscapes where species are likely to be able to move and adjust to changing conditions. While the species themselves may change, these areas are likely to be able to host a continued diversity of species into the future.

Coastal resilience

North Carolina's coastal and estuarine environments are key areas to build and sustain resiliency in the face of climate change. In particular, tidal marshes and habitats provide vital ecosystem services like shoreline stabilization, water filtration, food production, and recreational opportunities. Identifying places where tidal marshes and habitat provide resiliency to climate hazards currently and in the future is a key strategy in mitigating climate change impacts.

The U.S. Geological Survey (USGS) used remote sensing to calculate the unvegetated-vegetated ratio of tidal wetlands, which compares how much of a wetland is not covered by plants (e.g., sediment, rocks, open water) to how much is covered by plants. Marshes that maintain a higher proportion of vegetation tend to be more stable and resilient to threats like sea-level rise, erosion, and coastal development. This data offers a lens to identify marshes that may be good candidates for restoration to help them persist in the face of changing conditions (USGS 2017). Recent research shows that a high unvegetated-vegetated ratio correlates with elevation measurements that detect vertical changes due to accretion, subsidence, or compaction—meaning that stable marshes with high vegetative cover tend to better keep pace with sea-level rise.

In addition to resilient terrestrial sites, TNC also developed Resilient Coastal Sites, which provides a way to map and visualize coastal habitats with the capacity to migrate to adjacent lowlands in order to sustain biodiversity and natural services under increasing inundation from sea-level rise. Scientists from TNC evaluated more than 1,200 coastal sites in the South Atlantic region that contained tidal marsh and tidal habitats to identify places more likely to continue to support biological diversity and ecological functions under rising sea levels (Anderson and Barnett, 2019). It is based on the physical and condition characteristics of current tidal complexes, their predicted migration space, and surrounding buffer areas. These characteristics include marsh complex size, shared edge with migration space, sediment balance, water quality, natural landcover, landform diversity, and many others.

Case study - Adapting to changing weather patterns - prescribed burning

Wildland fire has shaped much of the biodiversity across the Southeast. Not only do many SGCN rely on habitats maintained by fire, but also several game species like wild turkey and bobwhite quail. Prescribed fire, also called prescribed burning or controlled burning, is a critical tool for managing habitat for wildlife, reducing wildfire risk, and meeting ecological objectives, like suppressing invasive species and maintaining disturbance-dependent habitat like grasslands (i.e. Piedmont prairies) and longleaf pine savannas. Historically, wildland fire occurred at large landscape-level scales with much of the coastal plain, sandhills and piedmont ecoregions likely adapted to fire return intervals of 4-6 years with longer fire return intervals closer to the Blue Ridge ecosystem (Guyette et al. 2012, Figure 22).

In the Southeast Region, it is likely that a changing climate will impact fire regimes (defined by factors including frequency, intensity, size, pattern, season, and severity of fire), which may have a large impact on natural habitats and systems. In order to conduct prescribed burns safely, land managers must burn during times where specific meteorological criteria (suitable weather conditions within which burning may occur based on maximum daily temperature, daily average relative humidity, and daily average wind speed) are met, along with as the social criteria of municipalities (Kupfer et al. 2021). Based on available research for historical and future prescribed burn windows, changes in climate are projected to shift the available time windows where these conditions are available (Kupfer et al. 2021). Moreover, rapid urban expansion near managed forests may reduce opportunities to use prescribed fire, which could lead to declines in native species, increases in nonnative species, increases in wildfire occurrence, and negative impacts to economic and human health.

Given that the Southeast is a historically fire-adapted landscape, this has significant implications for overall ecosystem health in the Southeast. Many animal and plant SGCN and RSGCN are fire-dependent, like Red-Cockaded Woodpeckers, Indigo Snakes, pitcher plants, and Smooth Purple Coneflower. According to the 2024 Southeast Blueprint fire frequency indicator, an estimated 487,062 acres were burned from 2013-2021 in North Carolina with only slightly more than 12,400 acres burned three times or more (Southeast Conservation Adaptation Strategy, 2024). While across the Southeast, prescribed fire is increasing in some ecosystems like longleaf pine, this trend needs to continue to increase in order to meet the regional SECAS goal as well as to support SGCN and other state-wide objectives.

Researchers working with the SE CASC conducted a study aimed at evaluating the potential impacts of projected climatic change on prescribed burning opportunities in the Southeast (Kufer 2020). Understanding how prescribed burn windows, or when there are suitable weather conditions to conduct a prescribed burn, will shift is important for land managers not only for managing habitats but also for securing the resources required to conduct the burns like fire

specialists, burn crews, equipment, and securing permits. The study, which included much of the Southeast, considered how many days per season met the conditions to conduct prescribed burns under two RCP scenarios: RCP 4.5 representing an intermediate scenario and RCP 8.5 representing a very high scenario.

The study also provided a baseline for comparison by projecting conditions from 2010 to 2017. The seasonal trends from this time window show that North Carolina has experienced year-round opportunities to conduct prescribed burns, especially during the spring (March to May). While conditions were less favorable during the summer months (June to August), especially in the Piedmont ecoregion, there were still opportunities to conduct burns in this growing season. Conducting prescribed burns in the summer growing season can help control invasive plants and improve habitat quality.

The study found under both scenarios, the percentage of suitable days for conducting prescribed burning significantly decreased by 2100, especially during summer months (Figure 23) (Kupfer et al. 2021). Although historically, almost 65% of summertime days met the burn window criteria, under the intermediate scenario 40.6% of days in the summer were suitable and under the very high scenario only 21.9% of the days in summer were suitable for conducting prescribed burns (Jewell, 2020, Kupfer et al. 2021). These results also vary across the region with much less opportunities to conduct summer burns in some states, like Louisiana and Alabama, compared with North Carolina. These changes are even more significant for land management given that summers may start earlier, be hotter, last longer, and have more periods of drought.

Examining future conditions from 2040-2049 under the intermediate-emissions RCP4.5 and higher-emissions RCP 8.5 scenarios suggests that there will be less suitable conditions to conduct prescribed burning during the summer growing season in North Carolina, especially in the Piedmont ecoregion. Overall North Carolina will likely continue to experience favorable conditions to conduct prescribed burns during the fall, spring, and winter seasons. In addition, other states with shared RSGCN stewardship responsibility with North Carolina—like South Carolina and Tennessee—are projected to experience much more dramatic declines in the percentage of suitable days to conduct prescribed burns. Therefore, North Carolina might be in a better position than other Southeastern states to conduct prescribed burning to maintain important fire-dependent habitats, as well as contribute to local and regional goals for prescribed burning.

With shifting seasonal windows and conditions that will be conducive to conduct prescribed burns, it will also be important to consider how to best distribute resources across the State to adapt to these changing conditions along with airsheds and air quality. With a constricted window to be able to conduct prescribed burns, it is likely that more practitioners will burn in

concentrated timeframes where conditions are suitable (S. Cammack, GADNR, pers. Comm). This may lead to concerns with overwhelming airsheds as they can only hold so much smoke and if transport winds or dispersion are low, smoke will remain in the airshed over longer times (S. Cammack, GADNR, pers. Comm). This may also impact the size or duration of burns through the burn permit system, especially with recent changes in the National Ambient Air Quality Standards (S. Cammack, GADNR, pers. Comm). It may be important to balance what are currently considered as marginal or poor days for burning with future opportunities while also considering information on fine particle matter (PM2.5).

Key Partners & Regional Partnerships

In addition to SECAS, many active partnerships are working across the Southeast region to connect lands and waters, sustain species, and protect and restore habitats. These partnerships provide opportunities for North Carolina to collaborate with new organizations, leverage new funding opportunities, align with shared priorities to make a bigger impact outside its borders, and access new tools and data.

Tribal Nations

Currently, the Eastern Band of Cherokee Indians is the only federally recognized tribe in North Carolina. State recognized tribes include the Coharie, the Haliwa-Saponi, the Lumbee Tribe of North Carolina, the Meherrin, the Sappony, the Occaneechi Band of the Saponi Nation, and the Waccamaw Siouan. The Lumbee tribe has partial federal recognition (the Lumbee Act of 1956). There are also many federally recognized tribes with ancestral homelands within North Carolina.

Department of Defense priorities and North Carolina

The Department of Defense (DoD) manages nearly 27 million acres within the United States (Department of Defense, DoD Natural Resources Program Fact Sheet 2023). While the primary function of these lands and waters is to support vital military readiness testing, training, and operations, military installations also encompass some of the most important and biodiverse lands under federal control. DoD managed lands provide habitat for nearly 500 federally listed plant and animal species and for over 550 additional at-risk species, including 60 listed species and 74 at-risk species that occur only on DoD lands (Department of Defense, DoD Natural Resources Program Fact Sheet 2023). Maintaining habitat in a natural condition, especially in broader landscapes around military installations, can help preclude the need to list species and helps DoD sustain the use of their lands for realistic and mission-essential testing, training, and operations. Given the frequent alignment between military and conservation goals, working with military bases offers opportunities to promote conservation actions and collaborate with the DoD to support both SGCN and RSGCN.

North Carolina has one of the largest military footprints of any state in the Nation. There are eight military bases in the State. They include: Pope Air Force Base, Seymour Johnson Air Force Base, Fort Liberty (formerly Bragg), Camp Mackall Army Base, Simmons Army Airfield, Air Station Elizabeth City Coast Guard Base, National Strike Force Coast Guard, Camp Lejeune Marine Corps Base, the Marine Corps Air Station Cherry Point Marine Corps Base, and the Military Ocean Terminal Sunny Point. The largest of these facilities is Fort Liberty. Beyond the facilities and bases themselves, the military also conducts training exercises in a larger physical

footprint across the State. There are several main tools that North Carolina can use to look for opportunities to manage and support SGCNs through the DoD. These tools include Integrated Natural Resource Management Plans, the Army Compatible Use Buffer, the Readiness and Environmental Protection Integration program, and the Sentinel Landscapes Partnership.

Integrated Natural Resource Management Plans (INRMPs) provide an existing avenue of collaboration with the DoD. INRMPs serve as management plans for the highly diverse habitats for which the DoD is responsible. These plans are installation-specific and are mandatory, as required by the Sikes Act, for most installations (U.S. Fish and Wildlife Service, 2024). INRMPs must be prepared in cooperation with the U.S. Fish and Wildlife Service and state fish and wildlife agencies as they are meant to reflect the mutual agreement and shared priorities concerning the conservation, protection, and management of fish and wildlife resources.

The Army Compatible Use Buffer (ACUB) program is designed to minimize incompatible development and loss of habitat in the area around military installations by using permanent conservation easements, fee-sales, or other interests in land from willing landowners. In the case of conservation easements or similar agreements, the landowner retains ownership and rights to use the land for the purposes specified in the agreement.

While INRMPs focus primarily on lands and resources within DoD installation boundaries, many installations' species and habitats are more effectively and efficiently managed at the ecosystem or landscape scale. Examples include preserving uninhabited flight lines and allowing for prescribed burn regimes to reduce wildland fire risks. Also, the presence of natural intact habitats can enhance wilderness training exercises. The DoD has legal authority to spend appropriated funds for conservation beyond its installation boundary lines through the Readiness and Environmental Protection Integration (REPI) Program.

The REPI Program addresses land-use conflicts that restrict military activities. A key component of the REPI Program is the use of encroachment management partnerships, referred to as REPI projects. The REPI Program enables DoD to enter into cost-share agreements to acquire additional lands in order to, among other purposes, preserve habitat or improve installation resilience. Eligible properties targeted for acquisition need only be ecologically related to military installations. These cost-sharing partnerships between the military services, state and local governments, and private conservation organizations allow for the acquisition of easements or other interests in land from willing sellers that preserve critical buffer areas and habitat near military installations. Importantly, REPI funding may be used to facilitate off-installation natural resources management when easements or land acquisitions may not be necessary nor available.

As North Carolina already has a statutory seat at the table during the preparation and annual reviews of DoD installation INRMPs, the REPI Program offers an opportunity to bring off-

installation conservation opportunities to the installation's attention. Conversely, inviting installation natural resources managers to be more engaged in the SWAP process could reveal to the State previously unrecognized opportunities to collaborate on cost-shared conservation projects to the mutual benefit of DoD and the State, as well as to the species and habitats addressed by the effort.

The Eastern North Carolina Sentinel Landscape Partnership

Sentinel Landscapes represent well-defined geographies where the military, conservation, agriculture, and forestry communities have shared interests. Founded in 2013 by the US. Department of Agriculture, Department of Defense, and Department of the Interior, Sentinel Landscapes Partnerships are coalitions of federal agencies, state and local governments, and non-governmental organizations that work with willing landowners and land managers to advance sustainable land use practices around military installations and ranges. These partnerships achieve their missions by empowering landowners and managers, supporting climate resilience efforts, increasing public access to recreation, promoting compatible land use near military installations, and fostering collaboration among various stakeholders. Sentinel Landscape designation leads to a myriad of benefits for local partners, including resources to hire a local Sentinel Landscape coordinator and priority consideration for certain federal funding opportunities.

The Eastern North Carolina Sentinel Landscape, established in 2016, is one of the largest in the country. Encompassing more than 11 million acres and ranging across a 33-county region (Figure 24). The partnership aims to maintain and enhance working and natural lands, water resources, conservation, and military readiness in eastern North Carolina.

The South Atlantic Salt Marsh Initiative

Healthy and intact salt marsh ecosystems are widely recognized as important for shoreline stabilization, increasing coastal resilience to extreme weather events, and providing habitat for many coastal species. They also significantly contribute to local, state, and national economies as well as national defense. Beyond their ecological and commercial value, salt marshes are also iconic landscapes that are intertwined with cultural resources and history.

Within the South Atlantic Region, salt marshes collectively form an extensive habitat totaling approximately 1 million acres along the coasts of North Carolina, South Carolina, Georgia, and Florida. The South Atlantic Salt Marsh Initiative (SASMI) is a regional effort and a voluntary, non-regulatory partnership that brings together leaders from the Southeast Regional Partnership for Planning and Sustainability (SERPPAS) and other local, state and federal partners, communities and nongovernmental organizations to determine the greatest threats to the salt marsh ecosystem and opportunities to ensure its survival. This coalition effort

officially launched in May 2021, and since then SERPPAS and The Pew Charitable Trusts have brought together approximately 300 diverse partners across the region.

The goal of the SASMI is to enhance the long-term abundance, health and resilience of the approximately 1 million acres of salt marshes within the South Atlantic states to ensure no overall loss of the benefits these wetlands provide to fish, wildlife and people. In order to achieve this goal, SASMI has rallied partners to develop the South Atlantic Salt Marsh Plan, which offers a voluntary and collaborative approach towards how partners can best work together to achieve the salt marsh goal. Coastal North Carolina supports approximately 360,000 to 400,00 acres of salt marsh (NOAA CCAP and Huixuan et al. 2021). Already a leader and actively working on salt marsh restoration efforts, staff from the NC Wildlife Resources Commission participated in and helped develop the SASMI plan.

The Southeast Aquatic Resources Partnership (SARP)

The Southeast Aquatic Resources Partnership (SARP) is a regional collaboration of natural resource and science agencies, conservation organizations and private interests developed to strengthen the management and conservation of fish and aquatic resources in the southeastern United States. Officially, SARP is a joint party committee under SEAFWA. SARP was formed in 2001 to address the here-to-fore uncoordinated management of aquatic resource issues in the southeastern United States. It is a voluntary collaboration of natural resource managers and professionals, both inland and coastal, working together to protect, conserve and restore aquatic resources throughout the Southeast. The core members of the partnership include the state and territorial fisheries agencies in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, US Virgin Islands, Virginia, and West Virginia, along with the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and USDA Forest Service. Nongovernmental organizations, industries and private citizens with goals and objectives that parallel those of the SARP member agencies participate in the partnership as well. SARP is recognized as one of the 20 official partnerships of the National Fish Habitat Partnership (NFHP).

SARP's mission is to "…with partners, protect, conserve, and restore aquatic resources including habitats throughout the Southeast for the continuing benefit, use and enjoyment of the American people." It works to accomplish this mission through many different activities. Since its inception, SARP has conducted over 130 restoration projects throughout the Southeast. These projects include numerous types of actions, including restoring riparian zones, implementing agricultural best management practices to improve water quality, restoring stream banks, removing invasive species, restoring oyster reefs, constructing living shorelines, restoring seagrass beds, removing dams, and remediating road/stream crossings. SARP

supports various programs and initiatives based on the needs of the region. SARP is currently placing an emphasis on aquatic connectivity. SARP has developed a comprehensive database of dams and road stream crossings that allows conservationists to identify and prioritize barriers for remediation or removal. SARP also coordinates Aquatic Connectivity Teams in each of the states in the Southeast. The teams are state-specific and comprised of partners from all sectors. In the ACTs, interested partners work together to improve aquatic connectivity across the region through implementation of on the ground projects, improved outreach and education related to barrier removal and related topics, and improved coordination across agencies and organizations.

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Figure 1 – Protected Lands in NC – PAD 4.0

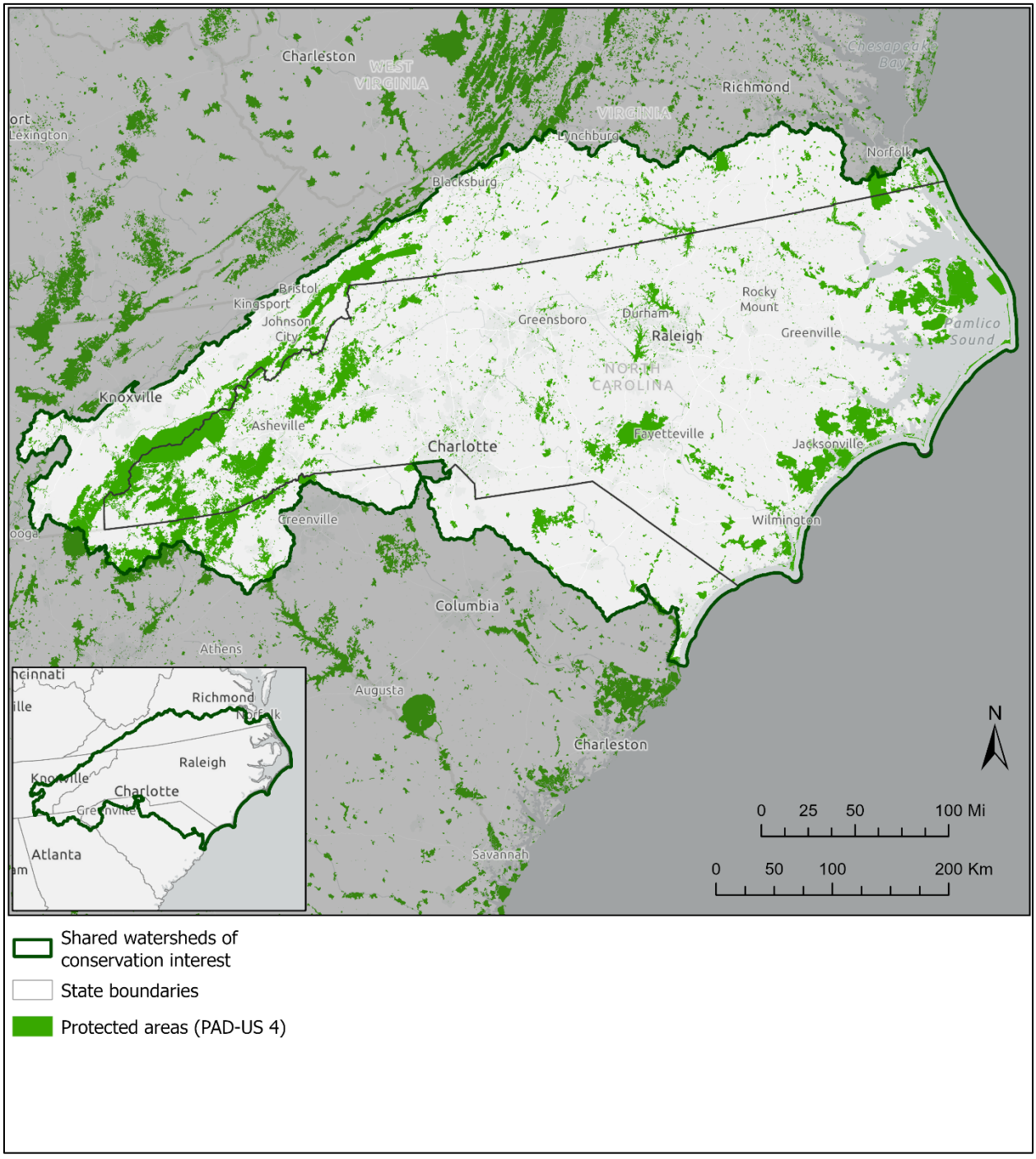

Figure 1. Protected areas within and surrounding North Carolina. Protected lands are represented by the USGS Protected Areas Database of the United States (PAD-US). PAD-US is the nation's inventory of protected areas, including public land and voluntarily provided private protected areas. It is regularly updated to reflect new places.

Figure 2 – Blueprint (2024 version)

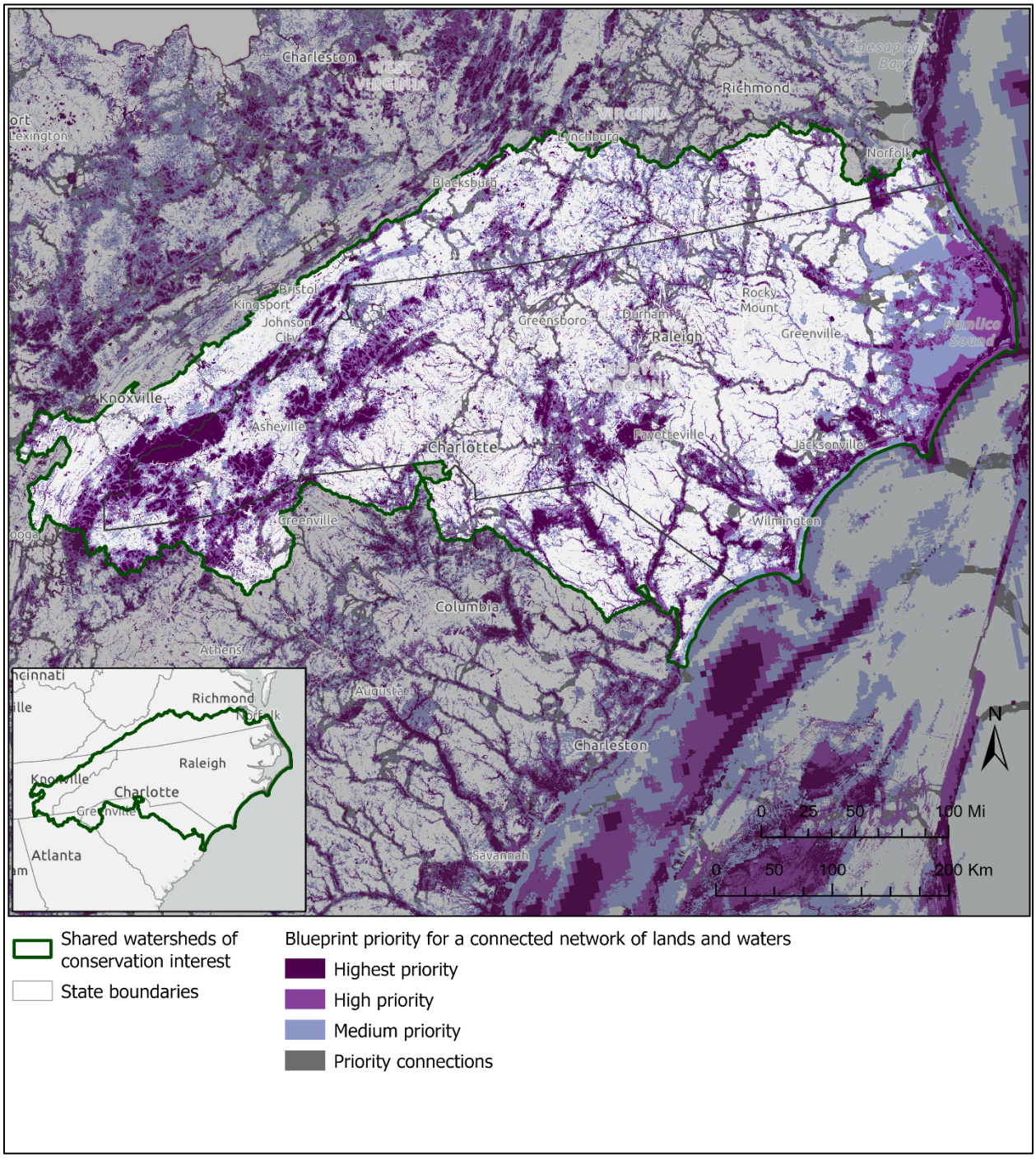

Figure 2. Southeast Blueprint (v2024) priorities within North Carolina and surrounding watersheds of conservation interest shared with Virginia, Tennessee, and South Carolina.

Figure 3 – Blueprint, Hubs and Corridors

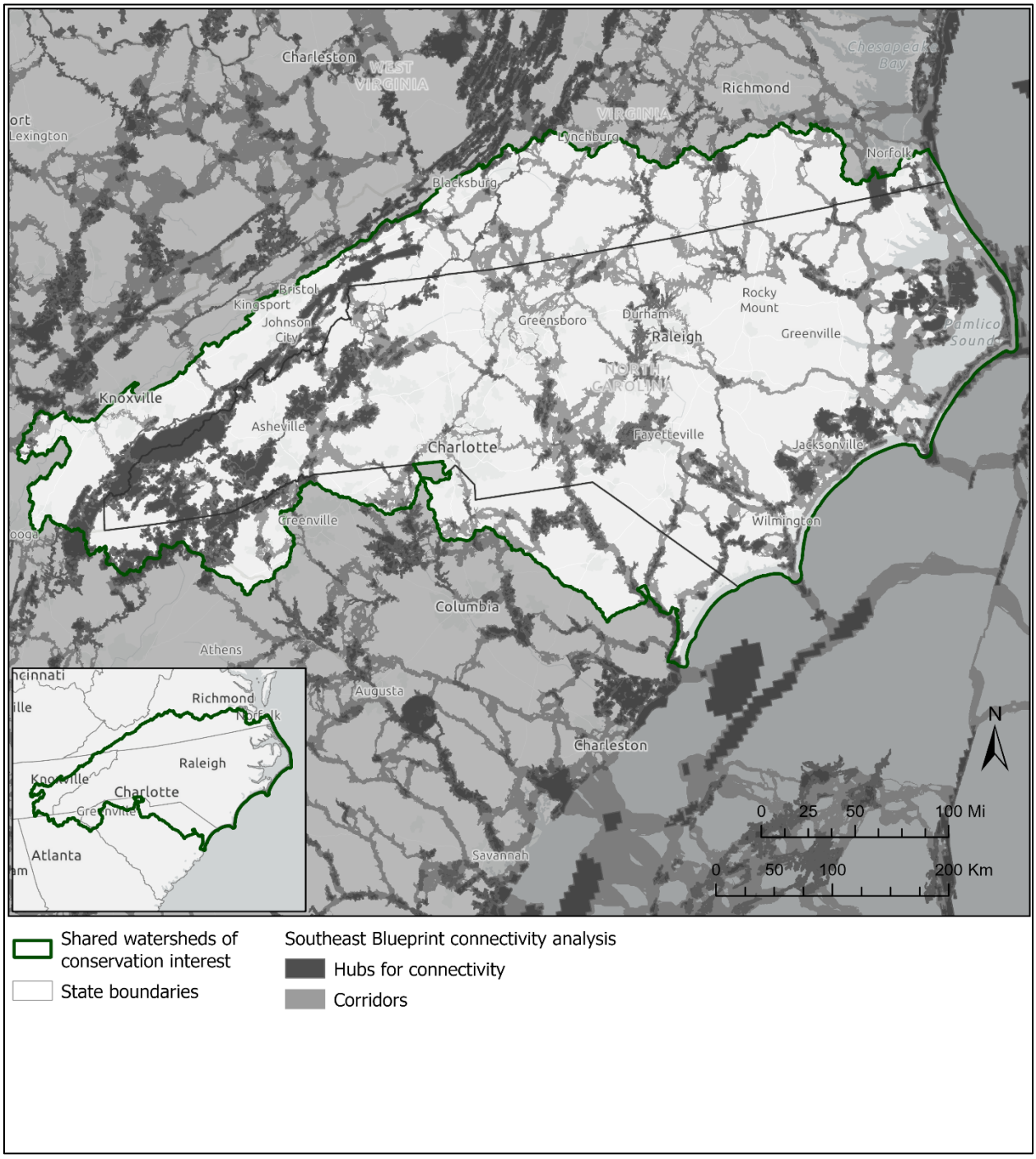

Figure 3. Southeast Blueprint connectivity analysis showing hubs and corridors in North Carolina and surrounding watersheds shared with Virginia, Tennessee, and South Carolina. The Blueprint uses a least-cost path connectivity analysis to identify corridors that link hubs across the shortest distance possible, while also routing through as much Blueprint priority as possible. In the continental Southeast, hubs are large patches (~5,000+ acres) of highest priority Blueprint areas and/or protected lands.

Figure 4 – Urbanization

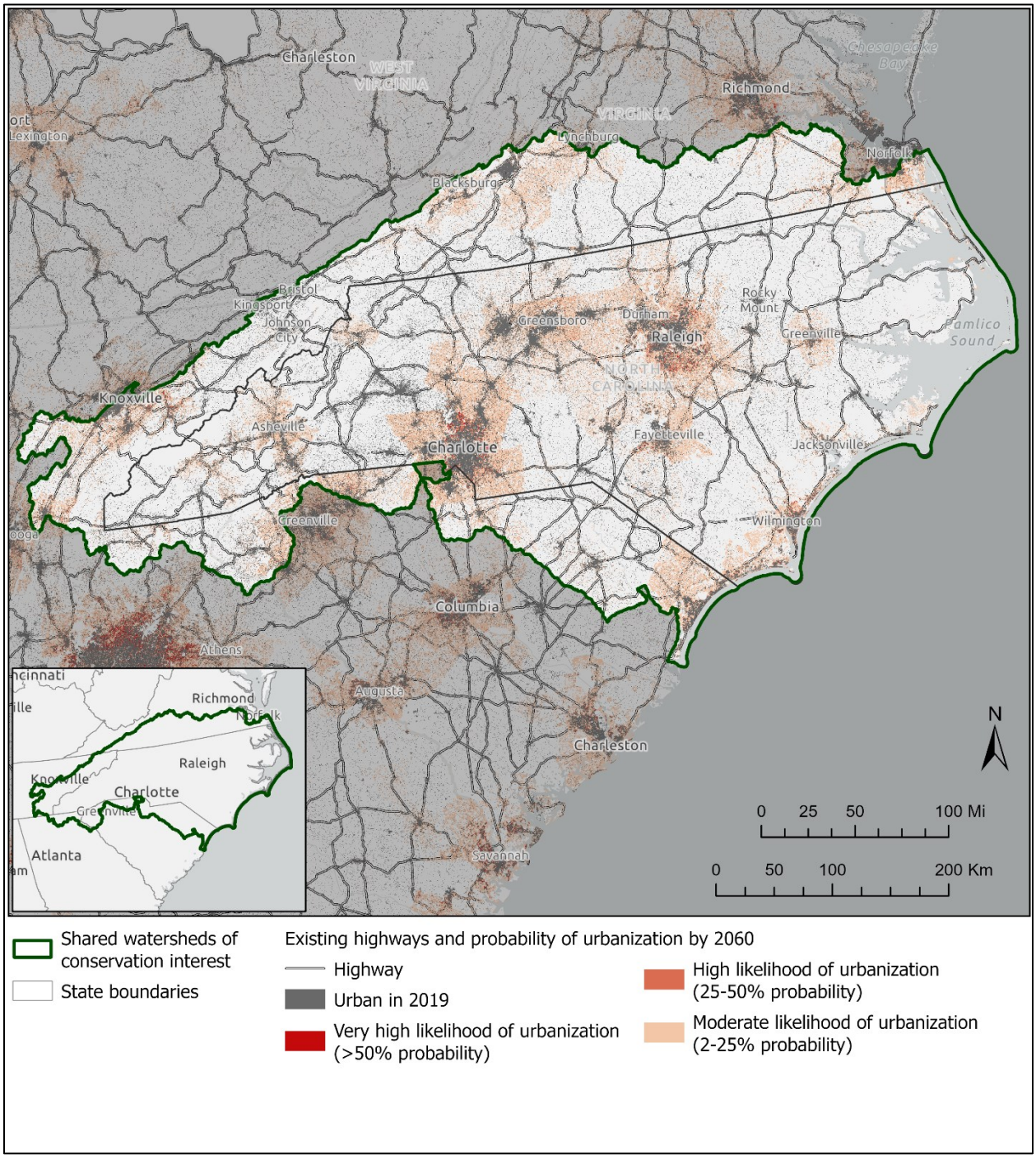

Figure 4. Current urbanization (based on the 2019 National Land Cover Database) and future probability of urbanization represented by FUTURES model projections for the contiguous United States. Data provided by the Center for Geospatial Analytics, NC State University.

Figure 5.1 – Omernik Ecoregions

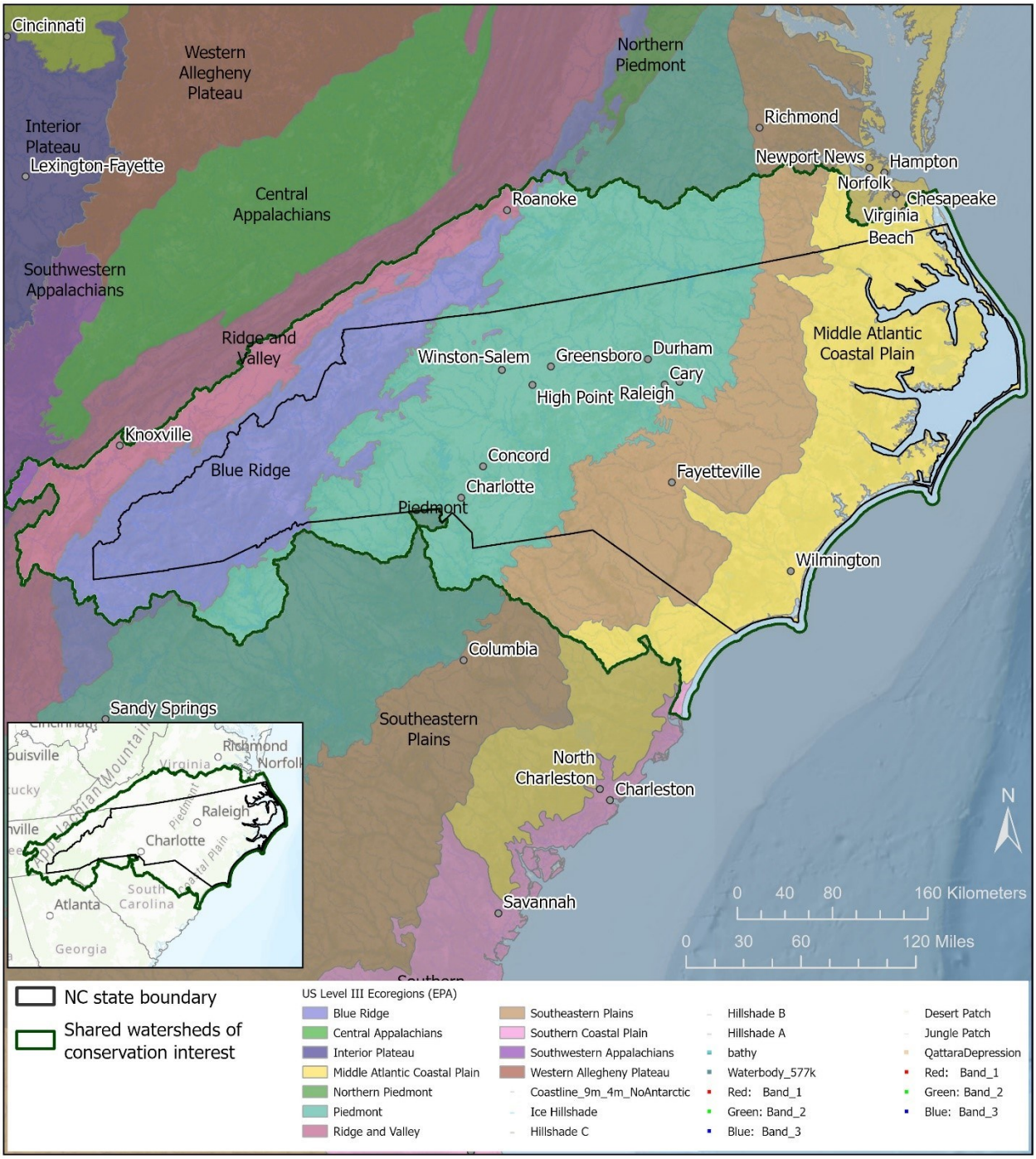

Figure 5.1. Level III ecoregions of the Continental US (Omernik 1987, 1995).

Figure 5.2 –NC SWAP Ecoregions

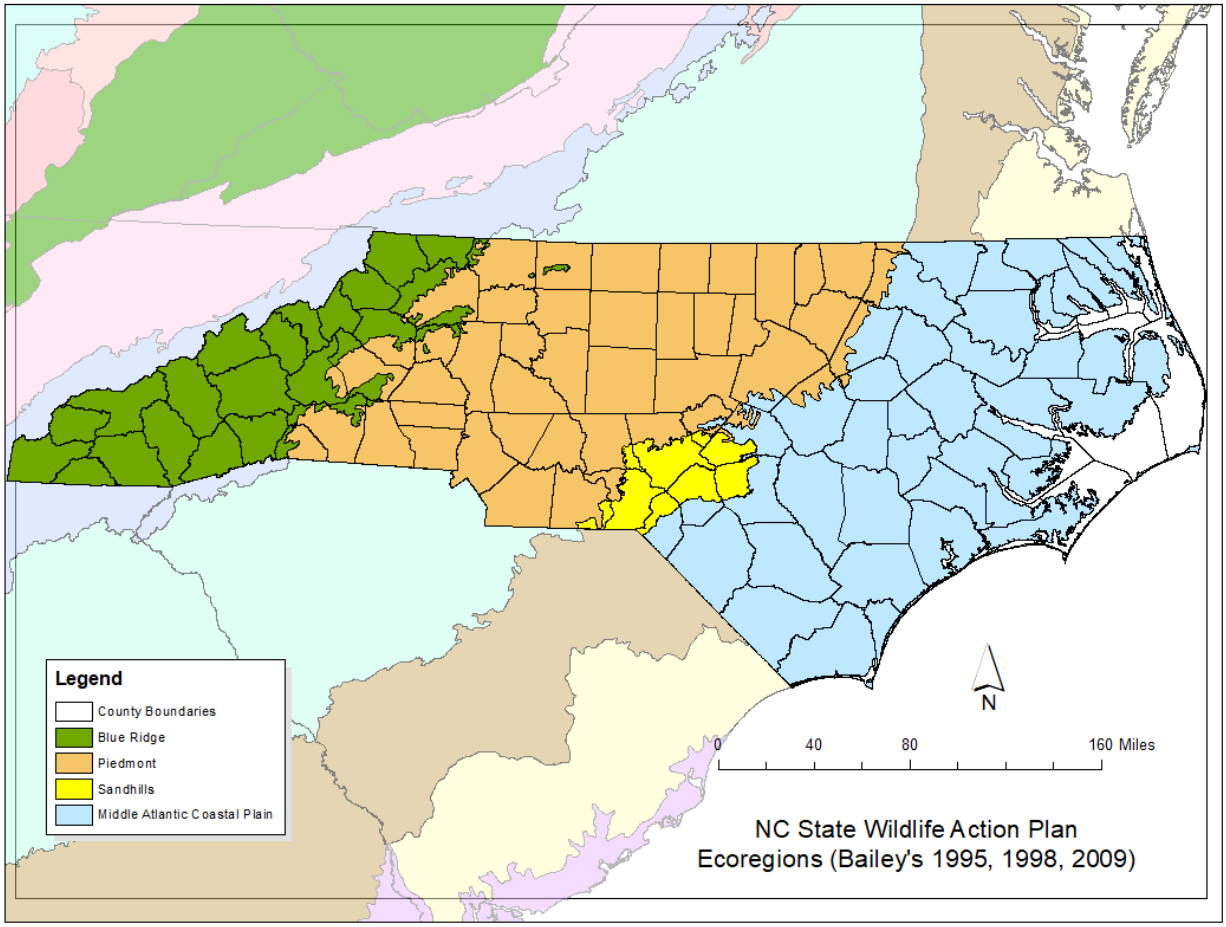

Figure 5.2. Ecoregions from the NC State Wildlife Action Plan (Bailey 1995, 1998, 2009).

Figure 6 – SGCN and RSGCN By SEAFWA States

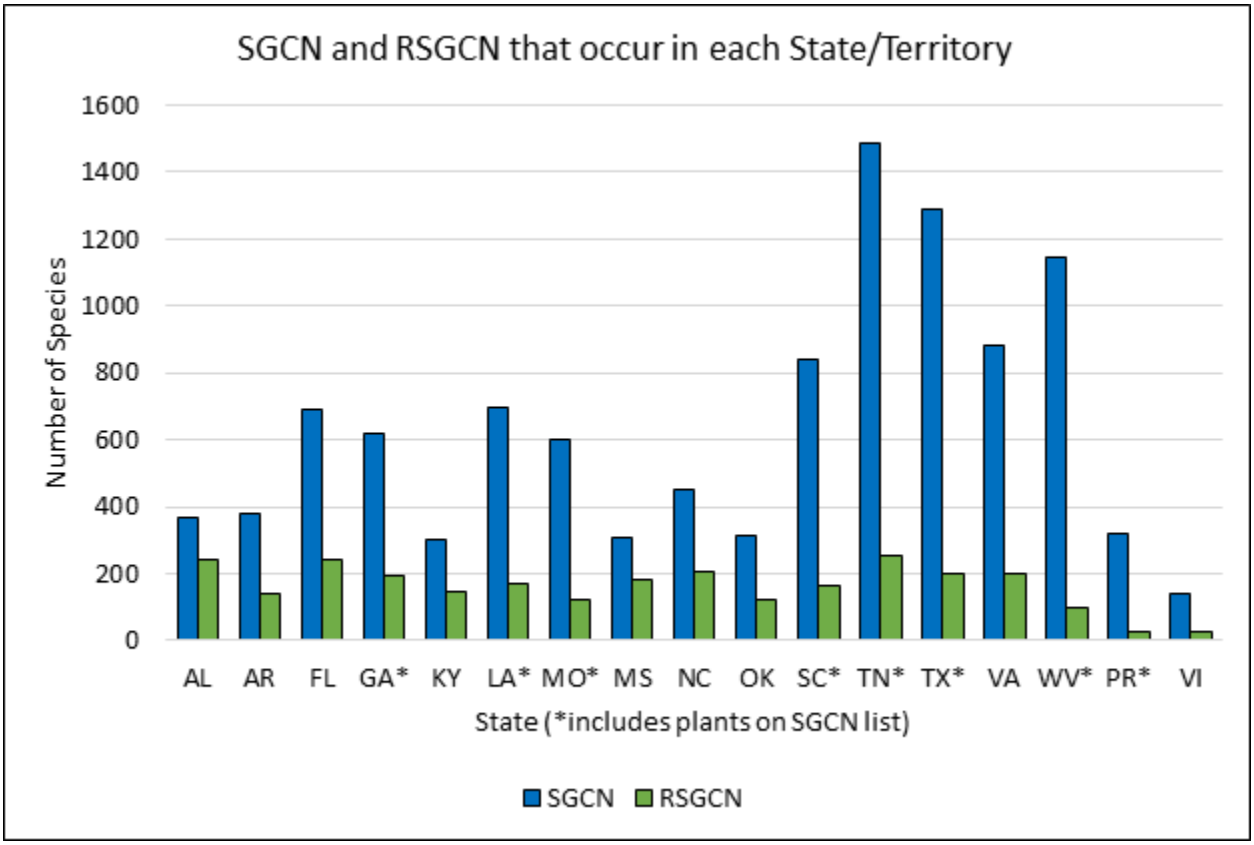

Figure 6. Species of Greatest Conservation Need (SGCN) and Regional SGCN (RSGCN) within each state and territory. Puerto Rico and the US Virgin Islands were not included in the RSGCN effort but so support some of the species or are within the range of some RSGCNs, which is why the numbers of RSGCN are much lower in these territories.

Figure 7. Amphibian RSGCN, Species Richness

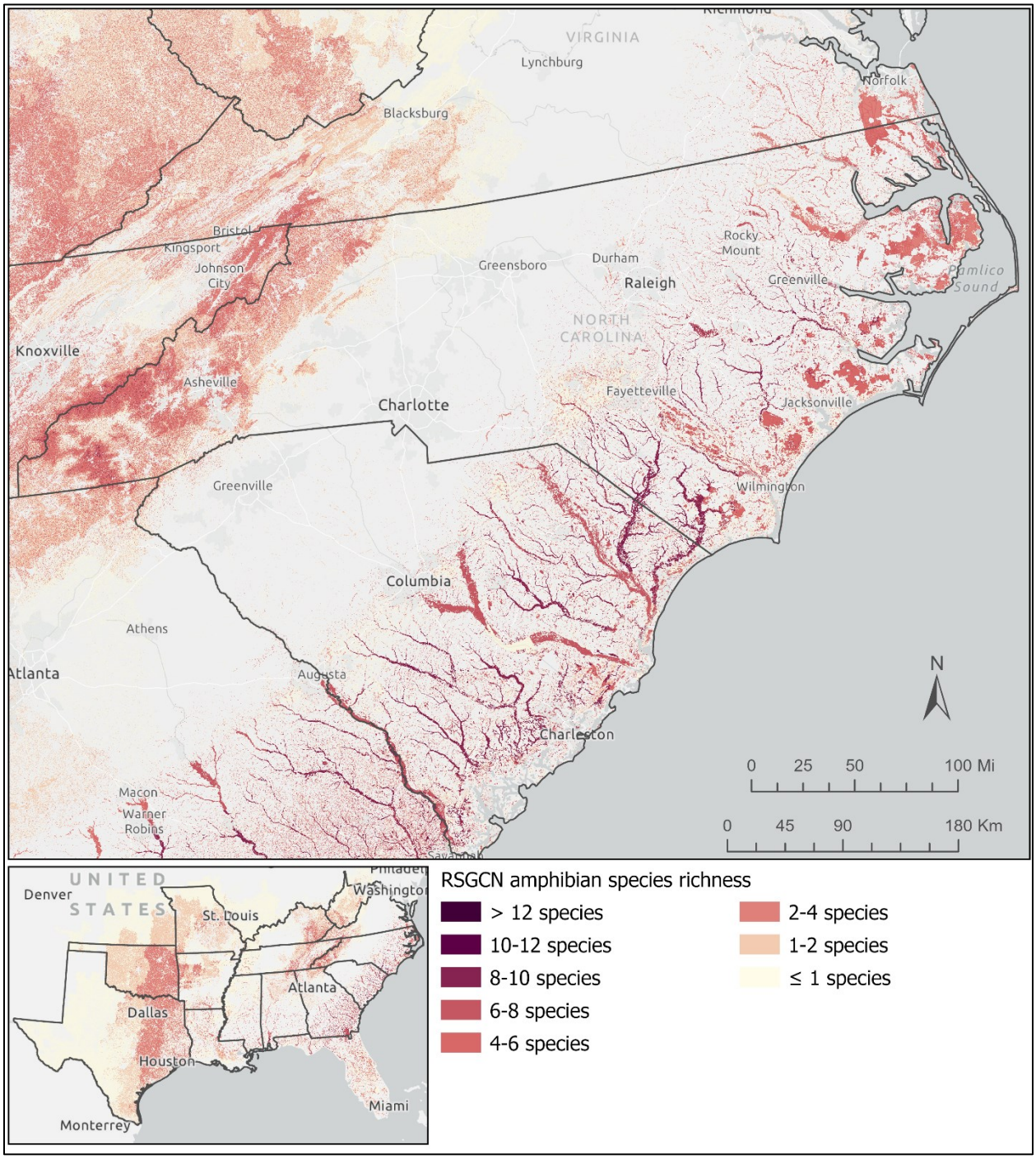

Figure 7. Species richness for amphibian RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (2001) for 66 of the 72 amphibian RSGCN in the very high or high concern category.

Figure 8. Reptile RSGCN Species Richness

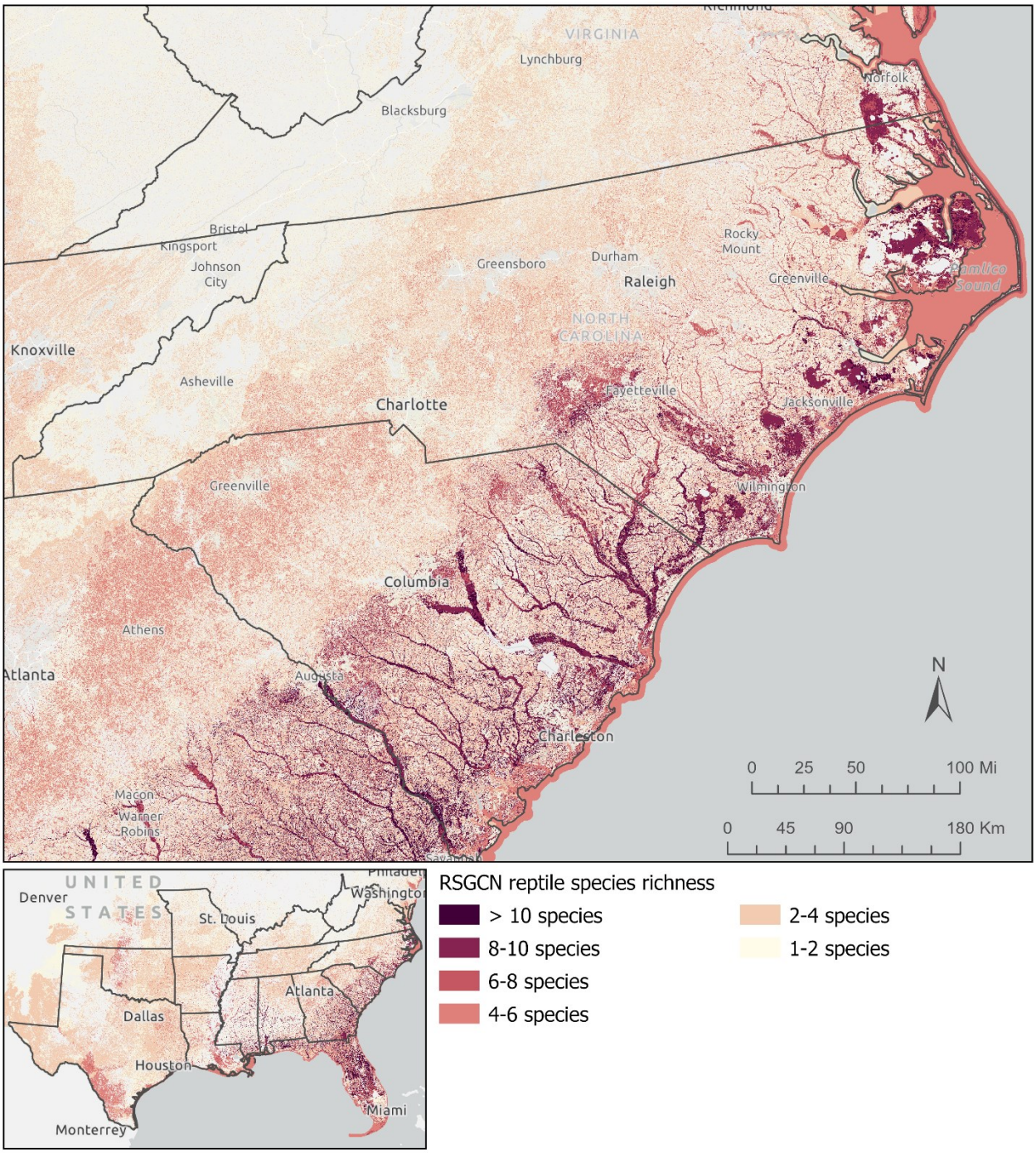

Figure 8. Species richness of reptile RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (2001) for 49 of the 58 reptile RSGCN in the very high or high concern category.

Figure 9. Bird RSGCN Species Richness

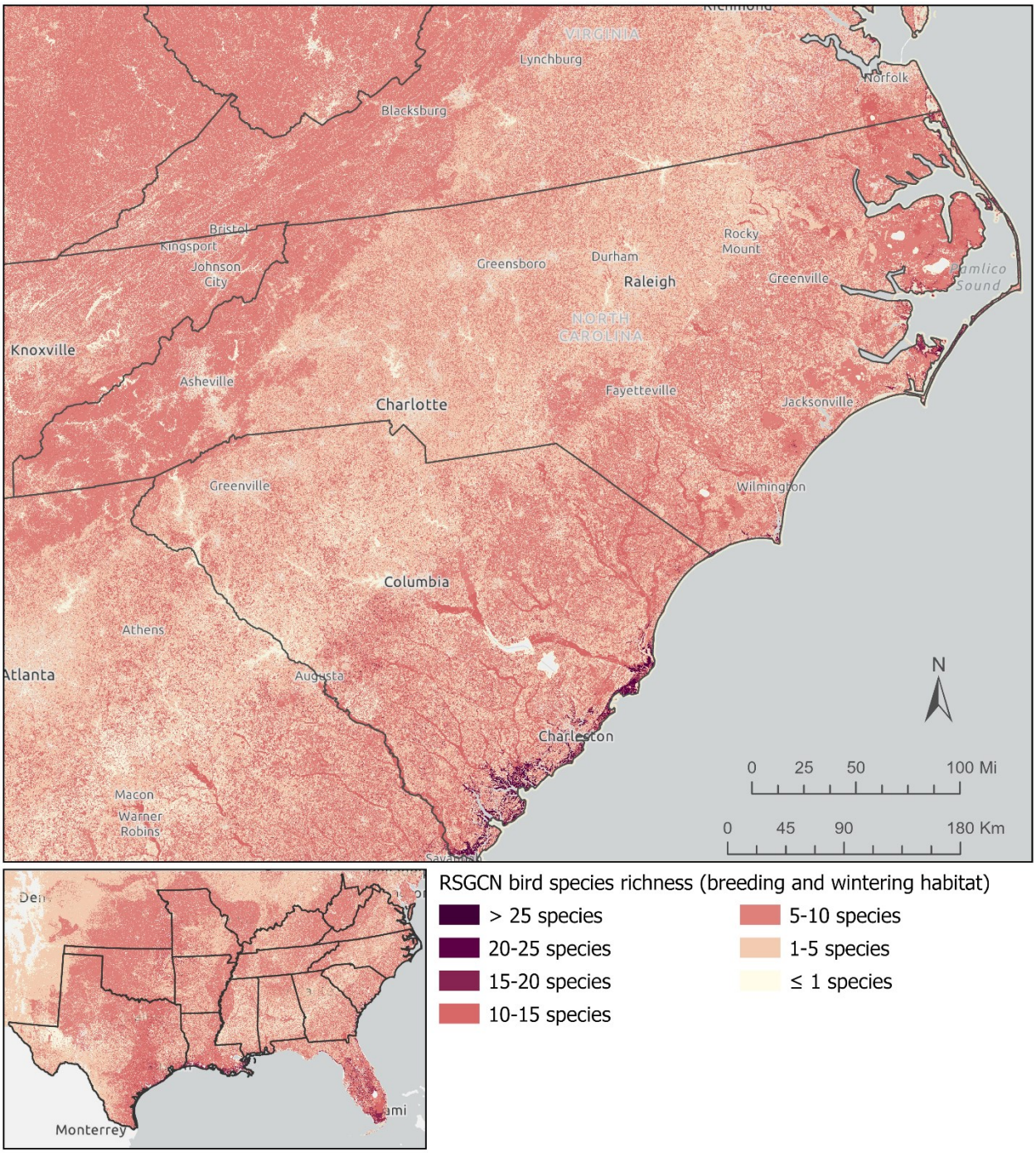

Figure 9. Species richness of bird RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (2001) for 50 of the 57 bird RSGCN in the very high or high concern category.

Figure 10. Mammal RSGCN Species Richness

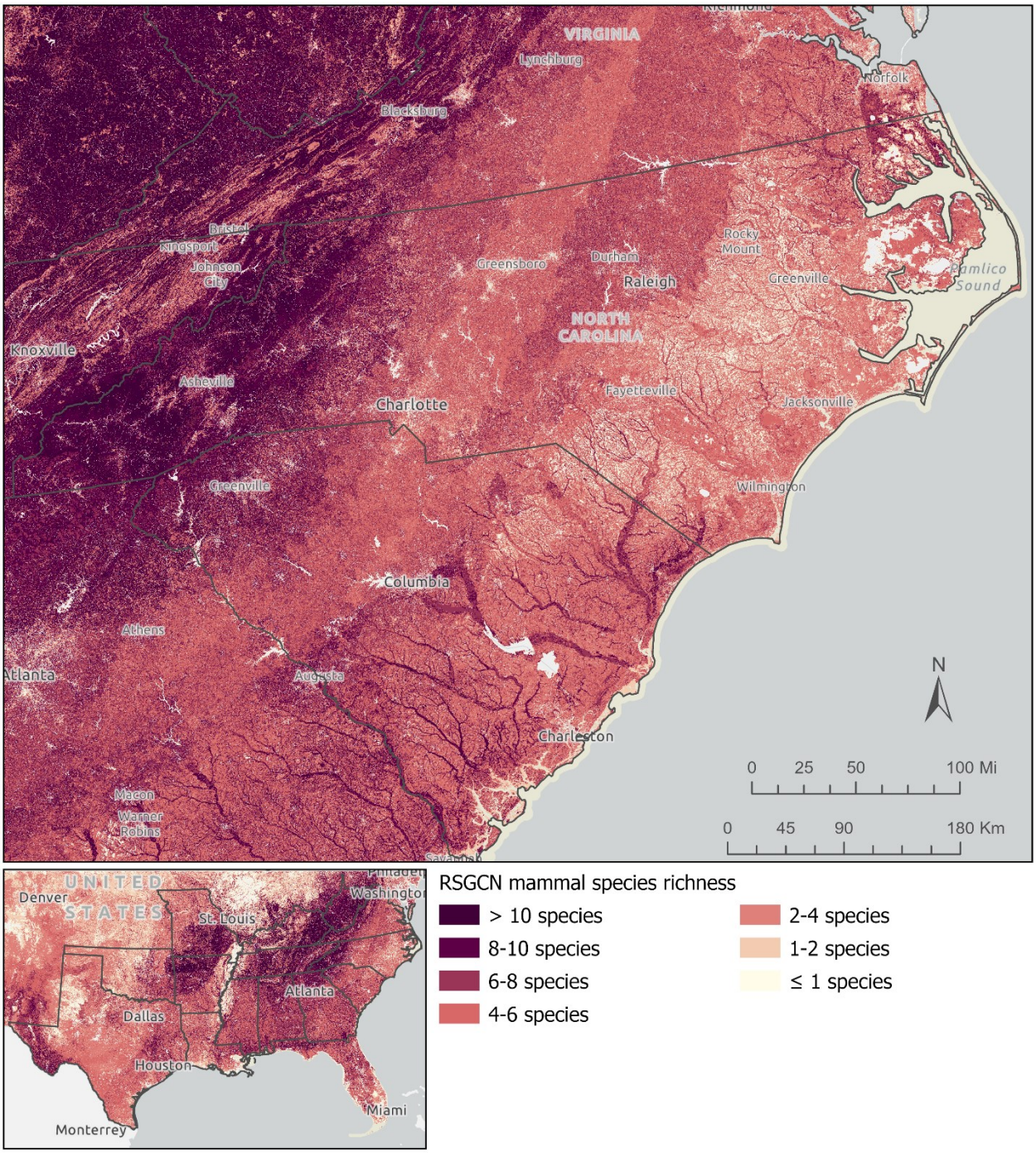

Figure 10. Species richness of mammal RSGCN that are considered very high or high concern. Species richness is represented using available GAP species-habitat models (2001) for 33 of the 37 bird RSGCN in the very high or high concern category.

Figure 11. Plant RSGCN.

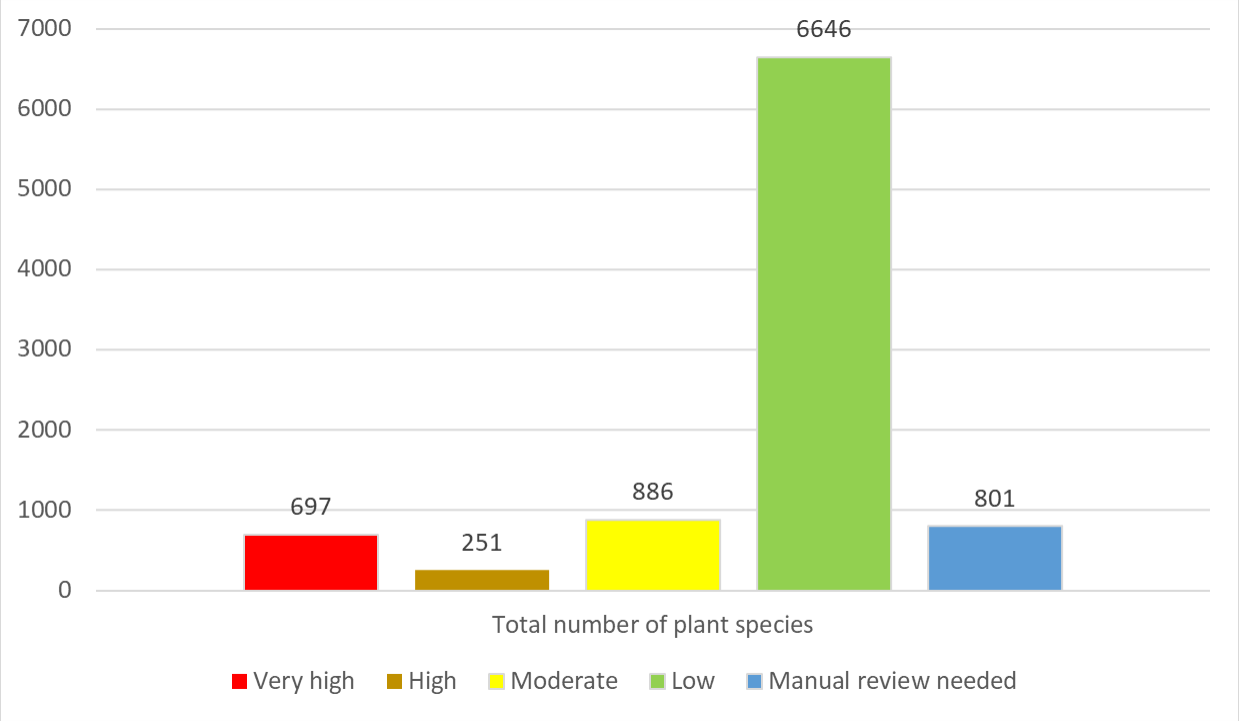

Figure 11. Plants with a very high, high, or moderate level of conservation concern are considered plant RSGCN

Figure 12. Number of RSGCN by Taxon

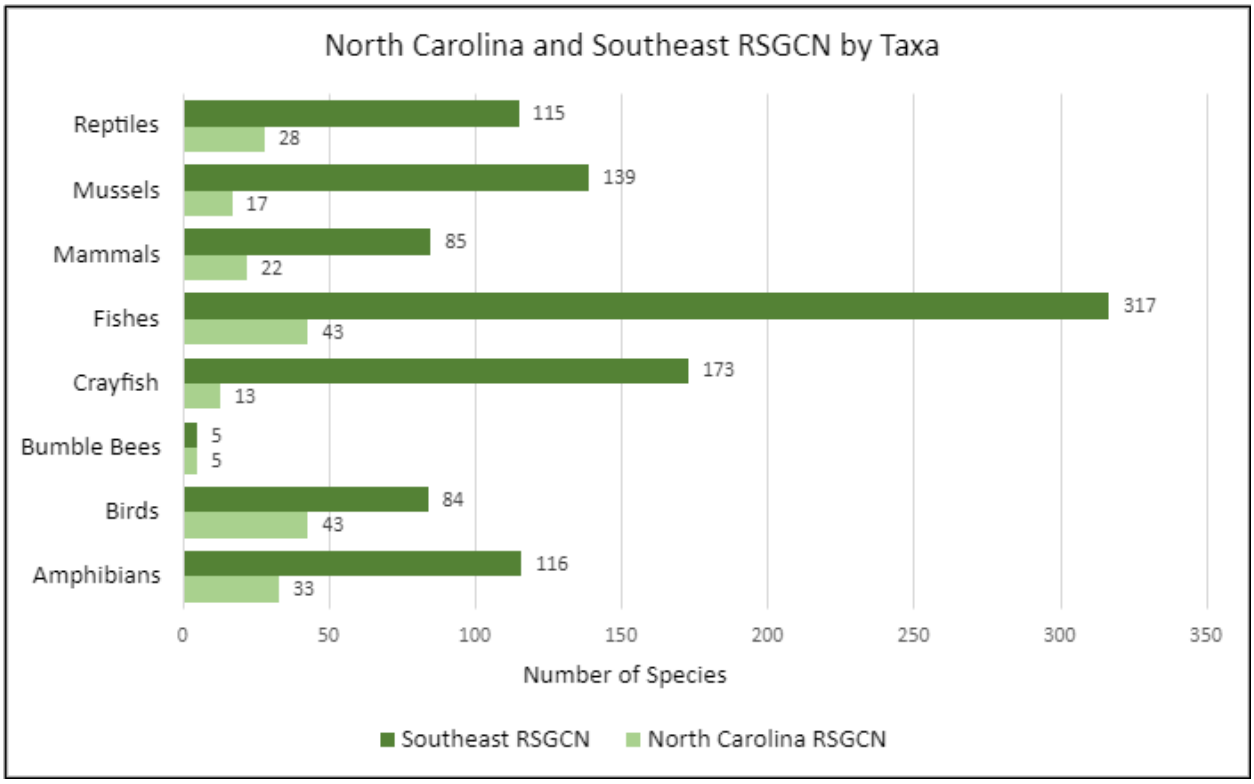

Figure 10. The number of Southeast animal RSGCN that occur in North Carolina compared to overall region.

Figure 13. Global Warming Levels.

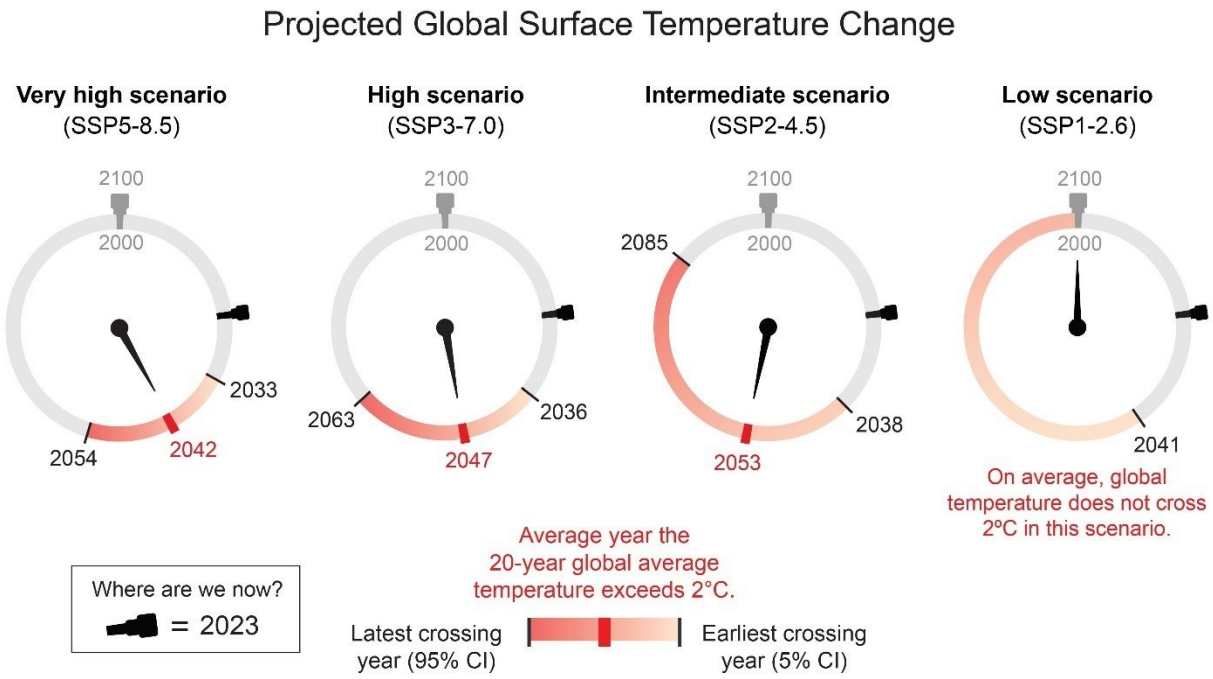

Figure 13. This figure represents an example of how various scenarios can be linked to specific GWLs and different timescales and is taken from the NCA5, Figure 2.14 (Marvel et al. 2023). In this example, the IPCC AR6 assessed warming projections for four future scenarios, with projected years at which the 2°C (3.6°F) global warming level would be reached. For example, under a very high scenario (SSP5-8.5), models project reaching 2°C between 2033 and 2054, with an average estimate of 2042. Under a low scenario (SSP1-2.6), the 5% CI (confidence interval) range begins in 2041, but the average projection shows that warming would actually stay below 2°C.

Figure 14. Very High vs. Low Scenario, High Temperature Projections

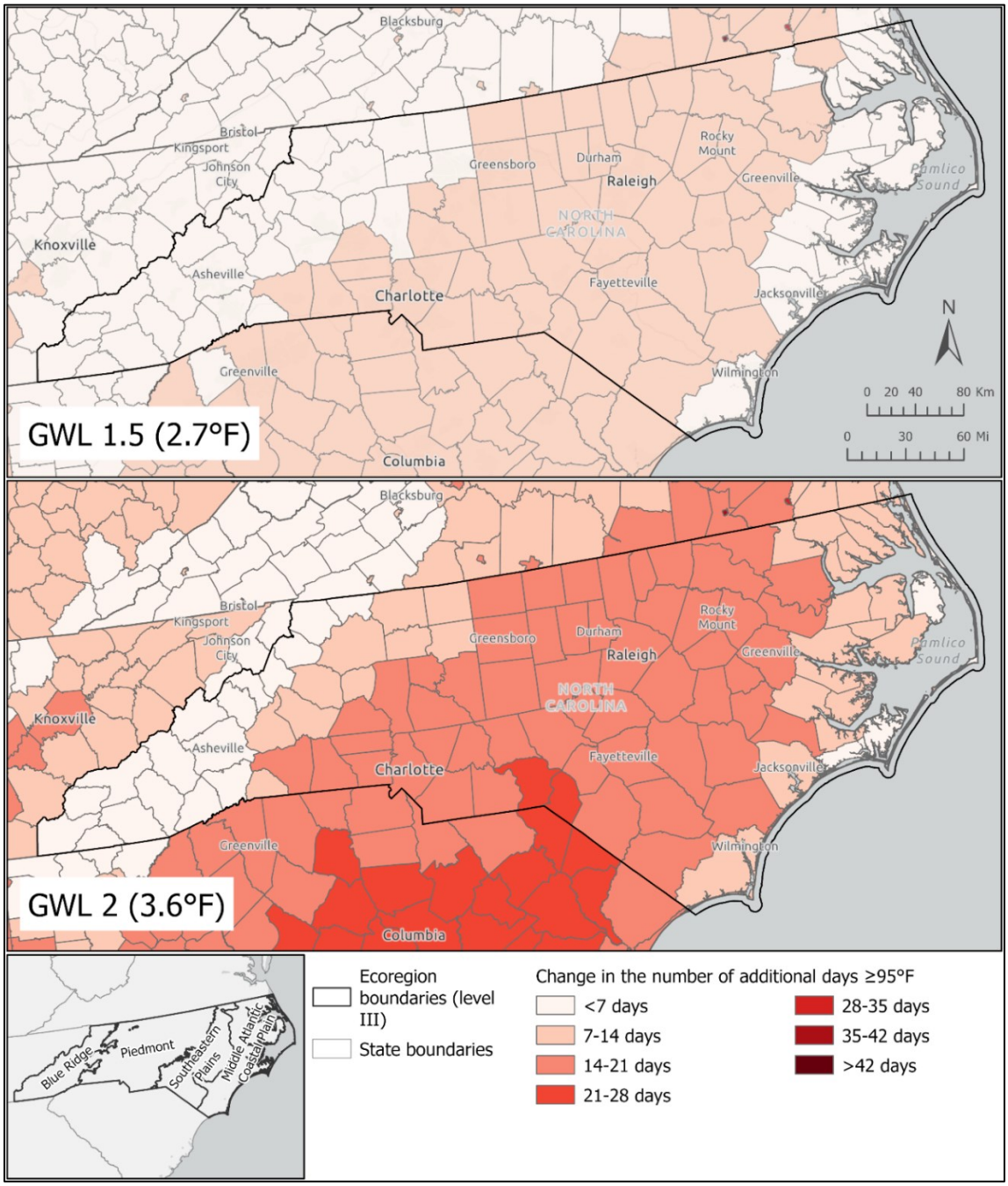

Figure 14. Projected future changes in the number of days of Extreme Maximum Temperatures (threshold temperature of 95°F) compared to preindustrial levels (1851-1900) based on GWL 1.5 (global temperature increase of 2.7°F) and GWL 2 (global temperature increase of 3.6°F). Note that this is not the total number of days, as presented in the table above, but the number of additional days where temperatures will reach ≥ 95°F. Figure created from data in the 'Atlas of the 5th National Climate Assessment" web tool (National Climate Assessment Interactive Atlas; USGCRP et al. 2024).

Figure 15. Very High vs. Low Scenario, Low Temperature Projections

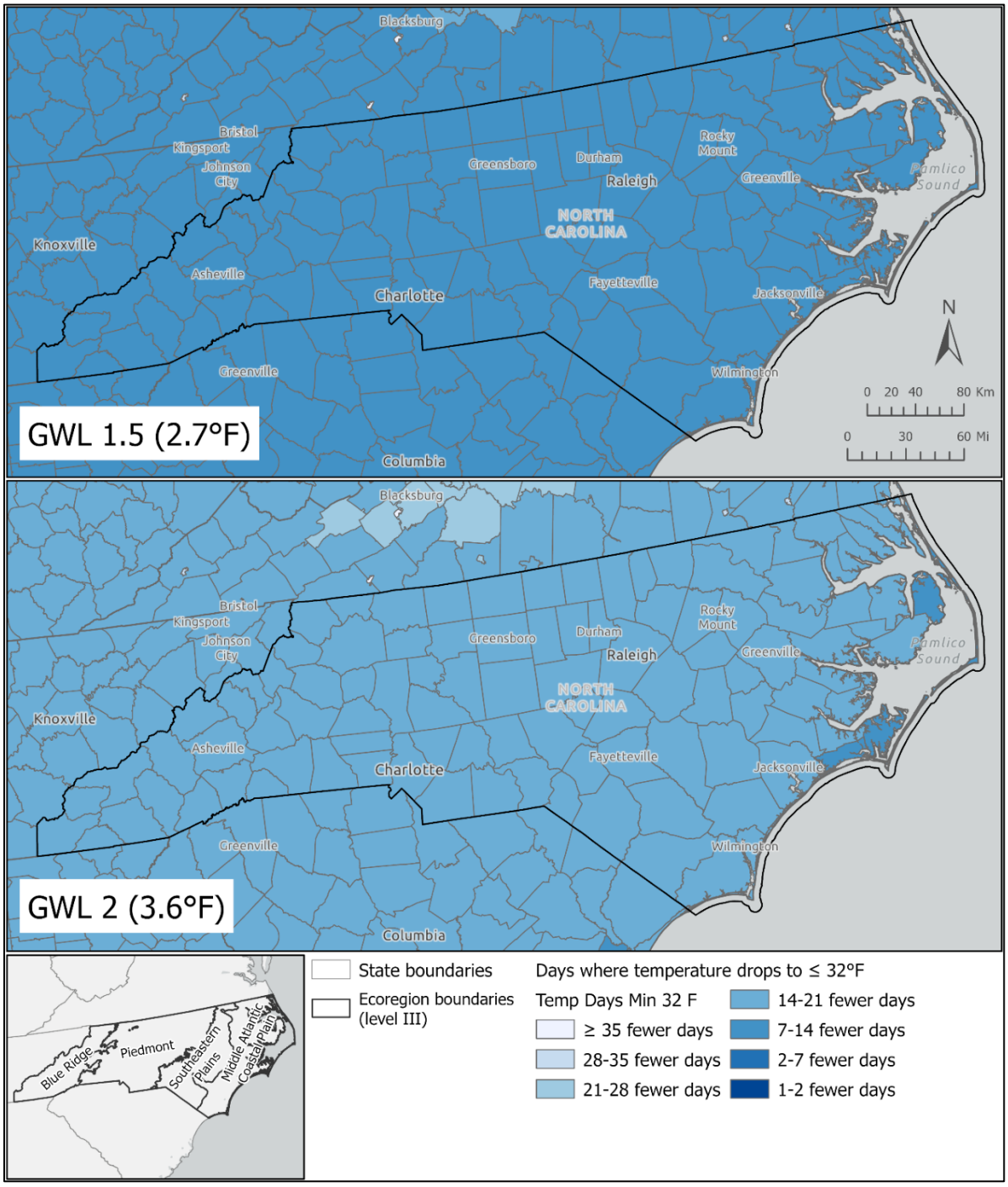

Figure 11. Change in days with minimum temperatures reaches or drops below freezing (32°F) compared to preindustrial levels (1851-1900) based on GWL 1.5C (global temperature increase of 2.7°F) and GWL 2C (global temperature increase of 3.6°F). Figure created from data in the 'Atlas of the 5th National *Climate Assessment" web tool (National Climate Assessment Interactive Atlas; USGCRP et al. 2024).*

Figure 16. Very High vs. Low Scenario, Extreme Precipitation Projections

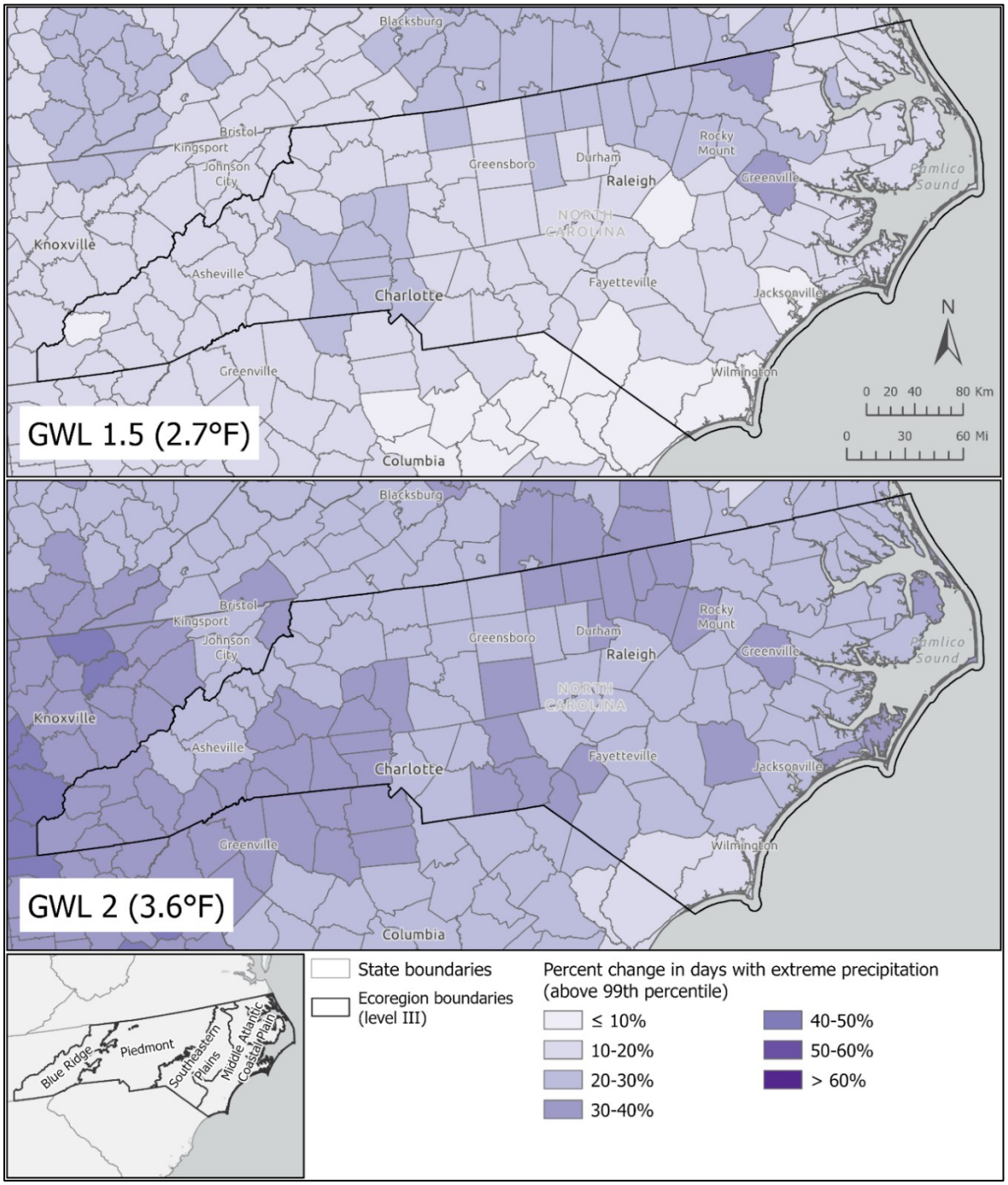

Figure 1612. Future projected changes in the number of days per year of extreme precipitation (top 1% of rain events) compared to preindustrial levels (1851-1900) based on GWL 1.5C (global temperature increase of 2.7°F) and on GWL 2C (global temperature increase of 3.6°F). Figure created from data in the 'Atlas of the 5th National Climate Assessment" web tool (National Climate Assessment Interactive Atlas; USGCRP et al. 2024).

Figure 17. High Tide Flooding

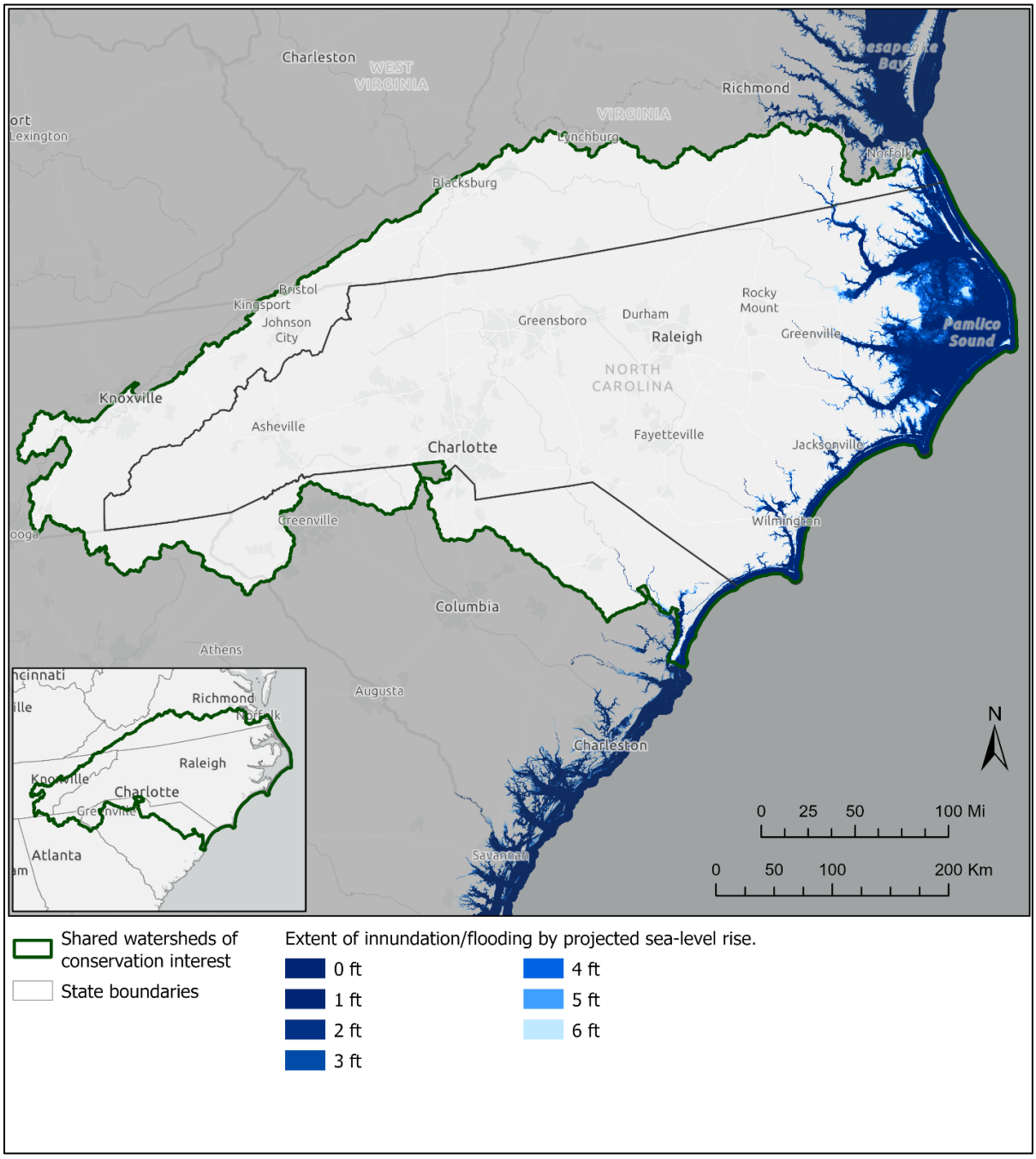

Figure 17. NOAA's sea-level rise (SLR) inundation models represent areas likely to experience flooding at high tide based on each foot of SLR above current levels. Darker blue areas will experience flooding first, and at greater depth, compared to lighter blue areas. These models are not linked to a future timeframe; see the projections in tables 10 and 11. NOAA calculates the inundation footprint at "mean higher high water", or the average highest daily tide. The area covered in each SLR scenario includes areas projected to be inundated at lower levels. For example, the area inundated by 4 ft of SLR also includes areas inundated by 3 ft, 2 ft, 1 ft, and 0 ft of SLR (where 0 ft represents current levels).

Figure 18. Climate Change Vulnerability

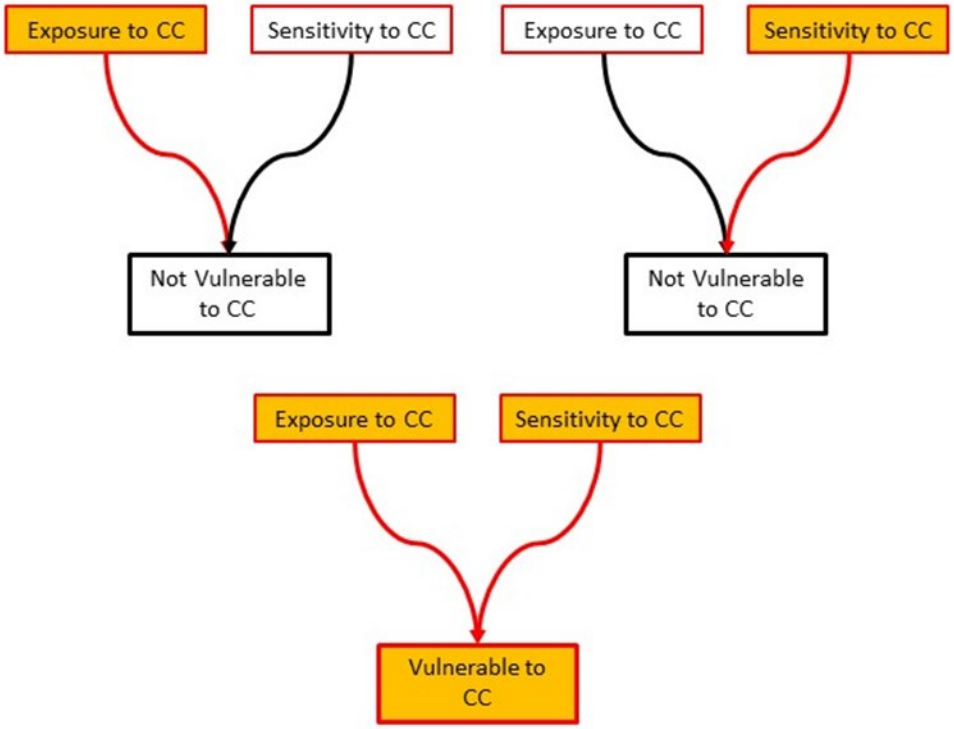

Figure 18. Climate change vulnerability is measured by both the exposure and sensitivity to climate change. The figure is based on work by Williams et al. 2008.

Figure 19. Climate Change Vulnerability Index (CCVI) Assessment

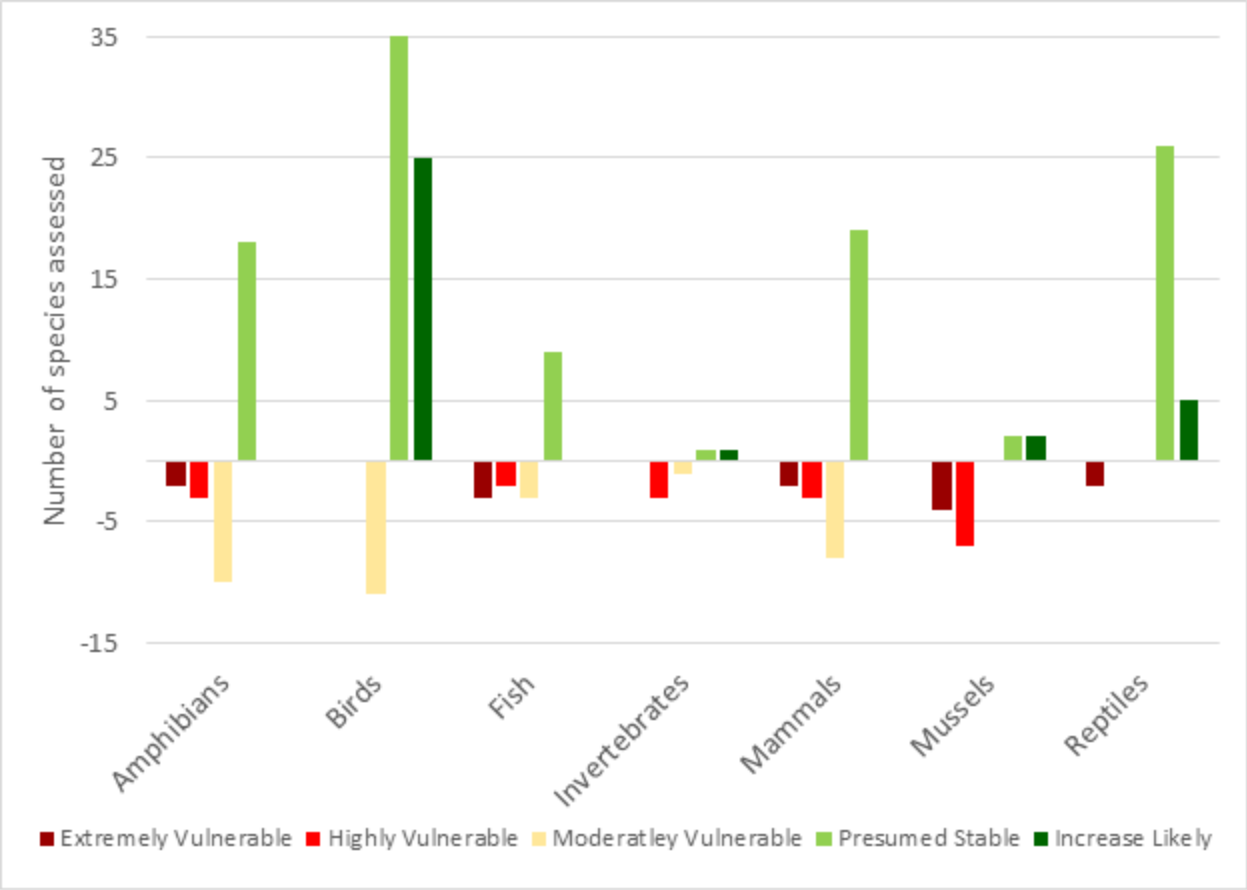

Figure 19. North Carolina SGCN estimated to be vulnerable, stable, or may increase in population based on available CCVI estimates from SEAFWA states (i.e., in their 2015 SWAPs) and other sources compiled by Armsworth et al. (DOI to come).

Figure 20. Summary of SEAFWA States CCVI Estimates

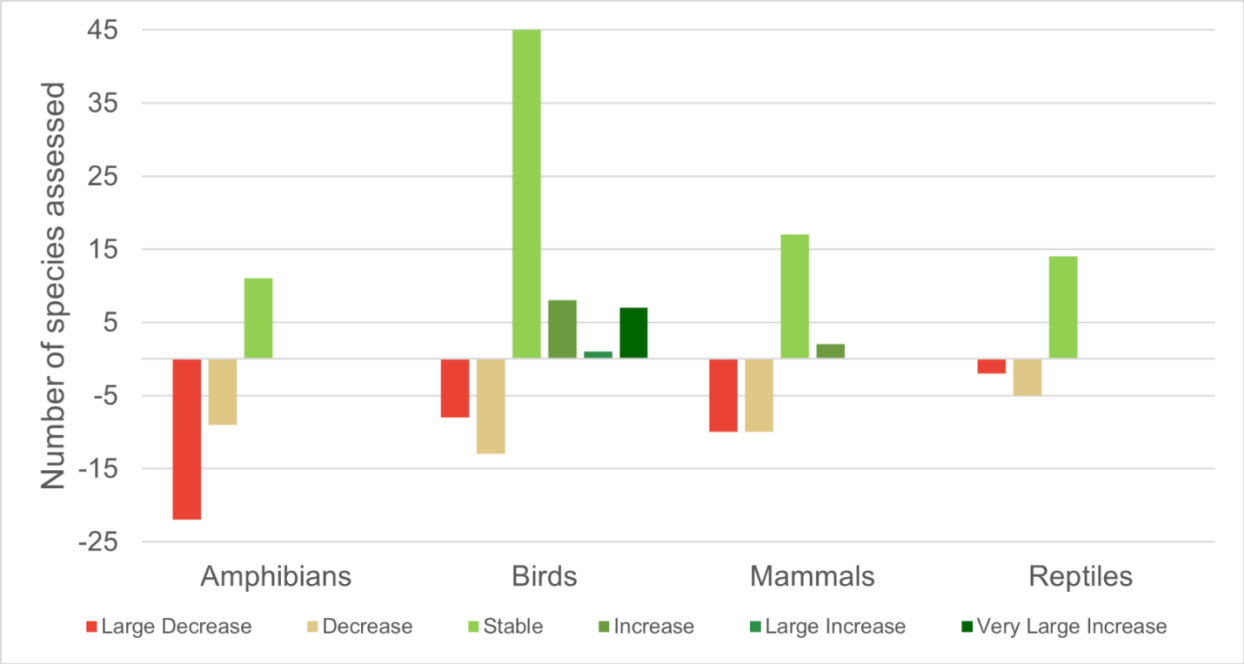

Figure 20. North Carolina SGCN estimated to be vulnerable, stable, or may increase in population based on available CCVI estimates from SEAFWA states (i.e., in their 2015 SWAPs) and other sources compiled by Armsworth et al. (DOI to come)

Figure 22. Historic Fire Return Intervals

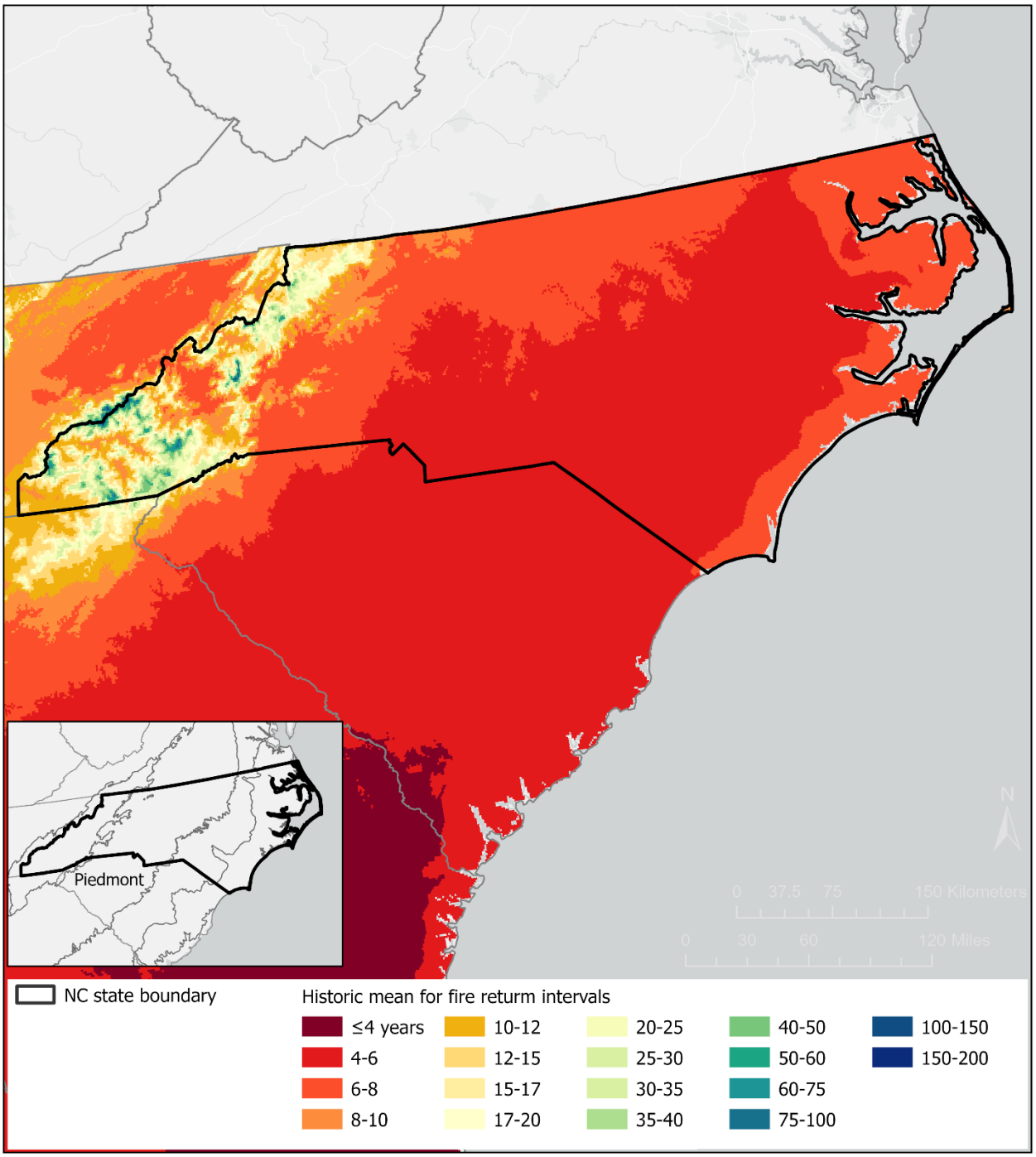

Figure 22. This map depicts likely historic fire return intervals as predicted by the Physical Chemistry Fire Frequency Model (PC2FM) developed by Guyette et al. (2012). This equation relies on theories and data in physical chemistry, ecosystem ecology, and climatology to predict likely historic fire return intervals.

Figure 23. Days Suitable for Prescribed Burning

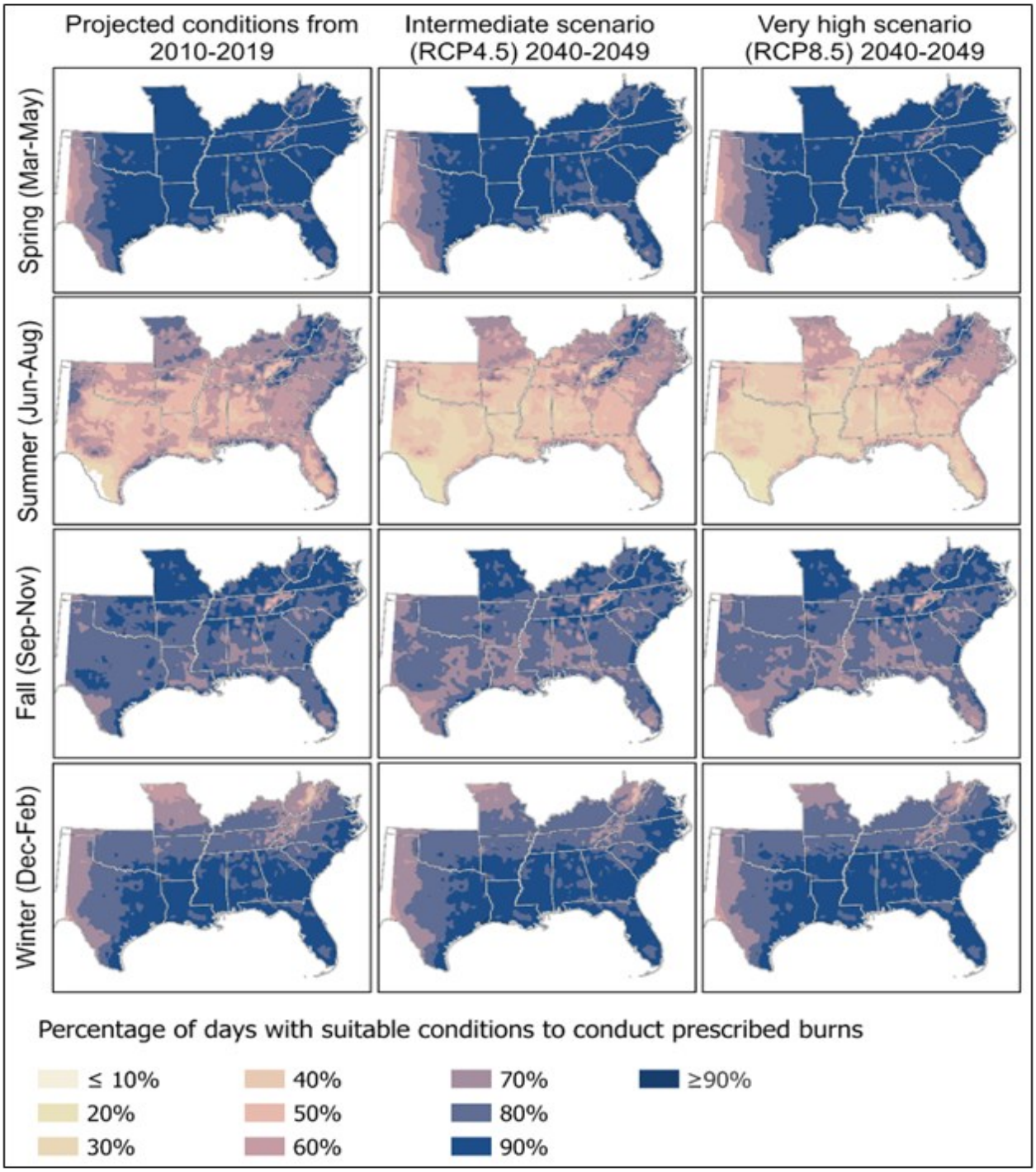

Figure 23. Average percentage of days each season with suitable prescribed burning conditions under different future time periods and emissions scenarios. Projected conditions from 2010-2019 under RCP4.5 was used as a baseline because it most closely aligned with the climate scenario that South Carolina is currently experiencing. This is compared to the forecasted percent of suitable prescribed burning conditions for 2040-2049 under the RCP4.5 and RCP8.5 emissions scenario.

Table 1. Protected Area Acreage

Priority for a connected network	Acres of each Blueprint (v2024) priority category within NC	Acres of conserved lands (PAD-US 4.0) recognized as Blueprint priority and what percentage of the total protected lands are
Highest	3,744,058 (10.9%)	2,024,924 (43%)
High	5,363,472 (16.6%)	1,263,891 (27%)
Medium	6,738,022 (19.6%)	1,041,426 (22%)
Priority connections	2,130,432 (6.2%)	76,518 (2%)
Lower priority	16,467,847 (47.8%)	304,406 (6%)
Total	**34,443,831 (100%)**	**3,964,941 (100%)**

Table 1. Protected areas within NC and how much of those areas that are recognized as priority places within the Southeast Conservation Blueprint 2024. Percentages are provided to show of the total protected lands, what percentage of them fall within Blueprint categories. For example, the Blueprint recognizes about 11% of NC's lands and waters as the highest priority for connecting lands and waters. However, 43% of NC's protected lands and waters are considered highest priority by the Blueprint.

Table 2. Acreage Comparison for Ecoregions

North Carolina ecoregions	Amount of ecoregion identified by the Southeast Blueprint (acres)	Percent of ecoregion within NC identified within the Blueprint
Blue ridge	3,318,741	63%
Piedmont	4,951,731	42%
Southeastern Plains	2,116,624	33%
Middle Atlantic Coastal Plain	4,156,947	51%

(Omernik 1987, 1995)

North Carolina ecoregions	Amount of ecoregion identified by the Southeast Blueprint (acres)	Percent of ecoregion within NC identified within the Blueprint
Blue ridge	3,318,741	63%
Piedmont	4,951,731	42%
Sandhills	2,116,624	33%
Coastal Plains	4,156,947	51%

(Bailey 1995, 1998, 2009)

Table 2. Comparison of land and waters within each ecoregion of North Carolina identified by the Southeast Blueprint. The top table is based on Level III ecoregions (Omernik 1987, 1995). The bottom table is based on the four ecoregions used in the 2015 NC SWAP (Bailey 1995, 1998, 2009).

Table 3. Annual Change in Blueprint Indicator Species

Ecosystem	Type	Indicator	Yearly percent change
Terrestrial			
	Health	Areas without invasive plants	0.33% decline
		Beach birds	1.42% decline
		Caribbean undeveloped land	0.39% decline
		Forested wetland area	0.08% increase
		Forested wetland birds	2.85% increase
		Gopher tortoise (Eastern population)	Increasing but % change unknown
		Grassland & savanna area	0.31% decline
		Grassland & savanna birds	2.2% decline
		Longleaf pine area	4.5% increase
		Prescribed fire in longleaf pine	4.02% increase
		Salt marsh area	0.03% decline
		Upland forest birds	0.98% increase
	Function	Working lands conservation	11% increase
	Connectivity	Landscape condition	0.02% decline
		Undeveloped land in corridors	0.019% decline
Freshwater			
	Health	Natural landcover in floodplains	0.008% decline
	Function	Water quality	0.003% increase
	Connectivity	Aquatic connectivity	16% increase
Marine & Estuarine			
	Health	Coastal condition	0.56% increase
	Function	Fisheries	1.1% increase

Table 3. Overview of recent trends in ecosystem indicators. Indicators shown in green are on track to meet the goal (≥1% increase every 4 years); indicators shown in yellow (<1% increase) and red (declines) are not. Bold indicators were updated in the 2024 report; all others remain unchanged from the previous version.

HOLD FOR 2024 Goal Report.

Table 4. RSGCN Level of Concern

RSGCN taxonomic group	Very high concern	High concern	Moderate concern	Total
Amphibians	30	52	34	116 (11%)
Birds	10	56	18	84 (8%)
Bumblebees	2	1	2	5 (.4%)
Crayfish	53	86	34	173 (17%)
Fishes	101	120	96	317 (30%)
Mammals	18	37	30	85 (8%)
Mussels	69	55	13	139 (13%)
Reptiles	18	58	39	115 (11%)
Total	302	466	266	1,034 (100%)

Table 3. List of RSGCN by taxa and their level of concern (very high, high, or moderate). Fish taxa have the most species categorized as "very high concern" and comprise 30% of all RSGCN within the Southeast region. This list totals 1,034 (versus 960) because it includes subspecies.

Table 5. Plant RSGCN By Association with USNVC

USNVC groups serving as primary habitat	Number of plant RSGCN
Wet-Mesic Longleaf Pine Open Woodland	80
Xeric Longleaf Pine Woodland	43
South Florida Slash Pine Rockland	29
Central Interior Alkaline Open Glade & Barrens	29
Appalachian - South-central Interior Mesic Forest	28
Tamaulipan Dry Mesquite & Thornscrub	28
South Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie	22
Blackland & Coastal Tallgrass Prairie	21
Florida Xeric Scrub	18
South Atlantic & Gulf Coastal Dune & Grassland	17
Atlantic & Gulf Coastal Plain Seep	16
Southern Coastal Plain Mixed Evergreen Swamp	13
Southern Mesic Beech - Oak - Mixed Deciduous Forest	12
Southern Appalachian Rocky Outcrop	11
Southeastern Coastal Plain Barrens & Glade	9
Central Interior-Appalachian Riverscour Barrens & Prairie	9
Caribbean Hardwood Hammock & Coastal Strand Forest	9
Coastal Live Oak - Hickory - Palmetto Forest	9
Appalachian Mafic Barrens	8
Central & Southern Appalachian Seep	8

Table 4. The top 15 U.S. National Vegetation Group Assignments for all Southeast plant RSGCN, showing longleaf ecosystems supporting this highest number of priority plants.

Table 6. Plant RSGCN By USNVC Primary Habitats

USNVC groups serving as primary habitat	Number of plant RSGCN
Wet-Mesic Longleaf Pine Open Woodland (G190)	33
Appalachian - South-central Interior Mesic Forest (G020)	15
South Atlantic & Gulf Coastal Plain Pondshore & Wet Prairie (G915)	10
Xeric Longleaf Pine Woodland (G154)	9
Southern Appalachian Rocky Outcrop (G670)	8
Central & Southern Appalachian Seep (G184)	7
Appalachian Mafic Barrens (G180)	6
Southern Mesic Beech - Oak - Mixed Deciduous Forest (G166)	4
Southeastern Coastal Pocosin & Shrub Bog (G186)	4
North Atlantic Coastal Tidal Freshwater Marsh (G914)	4

Table 5. The USNVC groups serving as primary habitat that support the most plant RSGCN within North Carolina (very high and high concern only).

Table 7. Historical and Projected Number of Extreme Heat Days

Historical & Future Projections: Number of Days with Maximum Temperatures ≥ 95°F			
SSP	**Observed Historical:** 1950-2014	**2025-2049** projections (approximate percent change from historical simulation)	**2050-2074** projections (approximate percent change from historical simulation)
Blue Ridge Ecoregion			
Low (SSP2-4.5)	<1 day/year	3 days/year (650%↑)	5 days/year (1540%↑)
Moderate (SSP3-7.0)		3 days/year (650%↑)	7 days/year (1920%↑)
High (SSP5-8.5)		3 days/year (835%↑)	11 days/year (3070%↑)
Piedmont Ecoregion			
Low (SSP2-4.5)	8 days/year	25 days/year (250%↑)	35 days/year (405%↑)
Moderate (SSP3-7.0)		25 days/year (250%↑)	40 days/year (475%↑)
High (SSP5-8.5)		27 days/year (280%↑)	52 days/year (635%↑)
Southeastern Plains Ecoregion			
Low (SSP2-4.5)	10 days/year	29 days/year (205%↑)	40 days/year (330%↑)
Moderate (SSP3-7.0)		29 days/year (205%↑)	45 days/year (375%↑)
High (SSP5-8.5)		32 days/year (240%↑)	58 days/year (515%↑)
Middle Atlantic Coastal Plain Ecoregion			
Low (SSP2-4.5)	6 days/year	19 days/year (270%↑)	29 days/year (450%↑)
Moderate (SSP3-7.0)		19 days/year (270%↑)	32 days/year (520%↑)
High (SSP5-8.5)		22 days/year (320%↑)	44 days/year (750%↑)

Table 6. Approximate observed historical and the future projected number of extremely hot days per year (i.e., days with afternoon high temperatures of at least 95°F) by EPA Level III ecoregions within North Carolina. The table summarizes projected future number of days for low, moderate, and high SSP emission scenarios using CMIP6-LOCA2 threshold and extreme event metric projections (Alder 2024) summarized at the ecoregion level by the Southeast and South Central Climate Adaptation Science Centers. For each future time period, numbers in parentheses represent the percent change between the models' future projections and the models' historical simulations. Observed historical summaries were generated with data from Pierce et al. (2021).

Table 8. Historical and Projected Number of Extreme Cold Days

Historical & Future Projections: Number of Extremely Cold Days (Min Temperatures ≤ 32°F)			
SSP	**Observed Historical:** 1950-2014	**2025-2049** projections (percent change from historical simulation)	**2050-2074** projections (percent change from historical simulation)
Blue Ridge Ecoregion			
Low (SSP2-4.5)	117 days/year	97 days/year (17%↓)	89 days/year (24%↓)
Moderate (SSP3-7.0)		97 days/year (17%↓)	87 days/year (24%↓)
High (SSP5-8.5)		95 days/year (19%↓)	82 days/year (31%↓)
Piedmont Ecoregion			
Low (SSP2-4.5)	78 days/year	59 days/year (25%↓)	52 days/year (35%↓)
Moderate (SSP3-7.0)		59 days/year (25%↓)	50 days/year (35%↓)
High (SSP5-8.5)		57 days/year (28%↓)	45 days/year (43%↓)
Southeastern Plains Ecoregion			
Low (SSP2-4.5)	64 days/year	46 days/year (29%↓)	39 days/year (39%↓)
Moderate (SSP3-7.0)		46 days/year (29%↓)	39 days/year (39%↓)
High (SSP5-8.5)		44 days/year (32%↓)	33 days/year (49%↓)
Middle Atlantic Plain Ecoregion			
Low (SSP2-4.5)	54 days/year	39 days/year (30%↓)	33 days/year (40%↓)
Moderate (SSP3-7.0)		39 days/year (30%↓)	33 days/year (40%↓)
High (SSP5-8.5)		37 days/year (34%↓)	27 days/year (51%↓)

Table 7. Approximate observed historical and future projected number of extremely cold days per year (days with minimum temperatures that dip below freezing) for EPA Level III ecoregions within North Carolina. The table summarizes projected future number of days for low, moderate, and high SSP emission scenarios using CMIP6-LOCA2 threshold and extreme event metric projections (Alder 2024) summarized at the ecoregion level by the Southeast and South Central Climate Adaptation Science Centers. For each future time period, numbers in parentheses represent the percent change between the models' future projections and the models' historical simulations. Observed historical summaries were generated with data from Pierce et al. (2021)

Table 9. Historical and Projected Number of Extreme Precipitation Events

Historical & Future Projections: Number of Days with Extreme Rainfall (Days with Rainfall > 99th percentile)			
SSP	**Observed Historical:** 1950-2014	**2025-2049** projections (percent change from historical simulation)	**2050-2074** projections (percent change from historical simulation)
Blue Ridge Ecoregion			
Low (SSP2-4.5)	3 days/year	31% increase	43% increase
Moderate (SSP3-7.0)		32% increase	43% increase
High (SSP5-8.5)		34% increase	54% increase
Piedmont Ecoregion			
Low (SSP2-4.5)	3 days/year	30% increase	43% increase
Moderate (SSP3-7.0)		30% increase	45% increase
High (SSP5-8.5)		35% increase	55% increase
Southeastern Plains Ecoregion			
Low (SSP2-4.5)	4 days/year	20% increase	33% increase
Moderate (SSP3-7.0)		20% increase	38% increase
High (SSP5-8.5)		24% increase	46% increase
Middle Atlantic Plain Ecoregion			
Low (SSP2-4.5)	4 days/year	25% increase	32% increase
Moderate (SSP3-7.0)		25% increase	34% increase
High (SSP5-8.5)		25% increase	45% increase

Table 8. Approximate observed historical and future projected chance in the number of days per year with extreme precipitation events (in the top 1% of historical rainfall events) for EPA Level III ecoregions within North Carolina. The table summarizes the projected future percent change in the number of days for low, moderate, and high SSP emission scenarios using CMIP6-LOCA2 threshold and extreme event metric projections (Alder 2024) summarized at the ecoregion level by the Southeast and South Central Climate Adaptation Science Centers. For each future time period, numbers represent the percent change between the models' future projections and the models' historical simulations. Observed historical summaries were generated with data from Pierce et al. (2021)

Table 10. Extent of Flooding from Daily High-Tides

Feet of sea-level rise	Acres	Percent of Area
0 feet	3,031,797	8.8%
1 foot	3,218,091	9.3%
2 feet	3,774,828	11.0%
3 feet	4,109,332	11.9%
4 feet	4,304,195	12.5%
5 feet	4,454,698	12.9%
6 feet	4,609,282	13.4%
7 feet	4,760,701	13.8%
8 feet	4,910,145	14.3%
9 feet	5,040,470	14.6%
10 feet	5,169,379	15.0%
Not projected to be inundated by up to 10 feet	*8,688,365*	*25.2%*
Sea-level rise unlikely to be a threat (inland counties)	*20,586,087*	*59.8%*
Total area	**34,443,831**	**100%**

Table 9. Extent of flooding by projected average highest daily tide due to sea level rise in this area. Values from the NOAA sea-level rise inundation data.

Table 11. Project Sea Level Rise by Decade

SLR Scenario	2020 (ft)	2030 (ft)	2040 (ft)	2050 (ft)	2060 (ft)	2070 (ft)	2080 (ft)	2090 (ft)	2100 (ft)
Low	0.38	0.6	0.83	1	1.2	1.4	1.5	1.6	1.8
Intermediate-low	0.41	0.65	0.91	1.2	1.4	1.6	1.9	2.1	2.3
Intermediate	0.41	0.68	0.96	1.3	1.6	2	2.5	3.1	3.8
Intermediate-high	0.42	0.71	1	1.5	2	2.7	3.4	4.3	5.2
High	0.42	0.72	1.1	1.6	2.4	3.3	4.4	5.5	6.8

Table 10. Projected sea level rise by decade for the state of North Carolina. Values are based on area-weighted averages of decadal projections for 1-degree grid cells that overlap this area based on NOAA's 2022 Sea Level Rise Report.

Executive Summary

Understanding the impacts of climate change on fish and wildlife in North Carolina

A review of climate change science, impacts, and planning options for sensitive species and habitats

Conservation Planning Program, Defenders of Wildlife

Hard copies of the full report are available but limited. Electronic copies can be found at: http://www.defenders.org/climatechange/NC_Wildlife

Executive Summary: Understanding the impacts of climate change on fish and wildlife in North Carolina.

In 2005, the North Carolina Wildlife Resources Commission developed the State Wildlife Action Plan (NCWRC 2005) as a comprehensive blueprint for the conservation of fish and wildlife. In recognition of the potential impacts of climate change on important North Carolina wildlife species and habitats, the Wildlife Resources Commission is preparing for a revision of its Wildlife Action Plan (NC WAP). However, given the complexity of climate change science and the breadth and depth of stakeholder groups who have been involved in the plan, the Wildlife Resources Commission identified a clear need for a review of the state of climate change science and potential impacts on species and habitats specific to North Carolina.

This report, *Understanding the Impacts of Climate Change on Fish and Wildlife in North Carolina*, provides the most comprehensive and up-to-date review for North Carolina of climate change science, the potential vulnerability of wildlife and their habitats, and response options available through conservation planning. In addition to reviewing the fundamental principles of climate change science in the context of understanding impacts on species and habitats, this report highlights a few key messages:

- Even if all greenhouse gas emissions were stopped today, there will still be unavoidable impacts to humans and wildlife as a result of a rapidly changing climate.
- In North Carolina, average yearly temperatures across the state are projected to increase 3.5 to 4.7°F by mid century, with greatest increases in temperature occurring during the summer months and in mountainous regions of the northern and western portions of the state.
- High elevation communities, reptiles, amphibians, and coldwater aquatic species, are expected to be most impacted by increases in temperature across North Carolina.
- Although shifts in precipitation are more challenging to project, summer and winter droughts as well as increases in the frequency of severe weather events are expected.
- Sensitive maritime forest and shrub communities, as well as coastal wetlands are expected to be significantly impacted by sea level rise.
- Safeguarding fish and wildlife from the impacts of climate change will require careful planning that engages diverse stakeholders and coordinates across multiple sectors.

Defenders of Wildlife is a national, nonprofit, membership organization dedicated to the protection of all native wild animals and plants in their natural communities.

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For more information contact Amelie DeWan, Director of Conservation Planning, Defenders of Wildlife, adewan@defenders.org

Climate change will cause unavoidable impacts to humans, wildlife, and habitat.

Given current levels of heat-trapping greenhouse gas emissions, we are expected to experience substantial shifts in local, regional, and national climate patterns. These shifts have the potential to disrupt natural processes, and in some areas may cause significant degradation to ecosystem services such as clean and abundant water, protection from flooding, and sustainable timber production or game management. Even if the most rigorous emission reduction strategies were implemented today at the local, regional, and national level, North Carolina will continue to experience the effects of climate change for many years to come.

Climate change will affect the timing of biological processes, breakup of ecological communities, rate of species invasions, and contribute to the loss of additional habitat.

Ecosystem processes are strongly influenced by climate, and changes in climate will affect ecosystem processes, ecological communities, and individual species. The distribution and abundance of plant, invertebrate, and vertebrate species that occur along the latitude and elevation margins of their range are already strongly influenced by climate change (Lenoir et al. 2008). Potential impacts of climate change on ecosystem processes, ecological communities, and individual species include the following:

- The timing of biological processes is changing, altering relationships between species and decoupling critical species interactions (Walther et al. 2002).
- Ecological communities are disaggregating, and as new and often novel communities assemble, warm-adapted and invasive species may be favored (Parmesan 2006, Hellmann et al. 2008).
- Species are losing more habitat due to sea level rise, changes in fire frequency and intensity, changes in water availability, pest outbreaks, and altered weather patterns.
- Species invasions, as well as pest and disease outbreaks, are becoming more prevalent under climate change.

Projections show increases in annual average temperatures of 5 to 6°F in North Carolina by the end of the century.

Climate models project continued warming across the Southeast, with an increasing rate of warming toward the end of the century. Rates of warming are expected to be more than double those experienced in the Southeast since 1975. The greatest temperature increases are projected to come during already hot summer months, and the number of very hot days is projected to rise rapidly. In North Carolina, the areas of highest temperature increase will be in the north and west of the state and in many of the mountainous regions. By the end of the century, projections using the highest emissions scenario show increases in annual average temperatures of 5 to 6°F, again with the greatest increases in the north and west portions of the state (Figure 1). The increase in very hot days will have consequences for human health, drought and wildfires. Increased temperatures will have a direct physiological impact on species and habitats or an indirect impact on community relationships through competition. As temperatures rise, the number of days below freezing will also decrease. A reduction in freezing days can improve survival for disease vectors and pests, alter growing seasons, and reduce the amount of water available from snow pack for spring thaw.

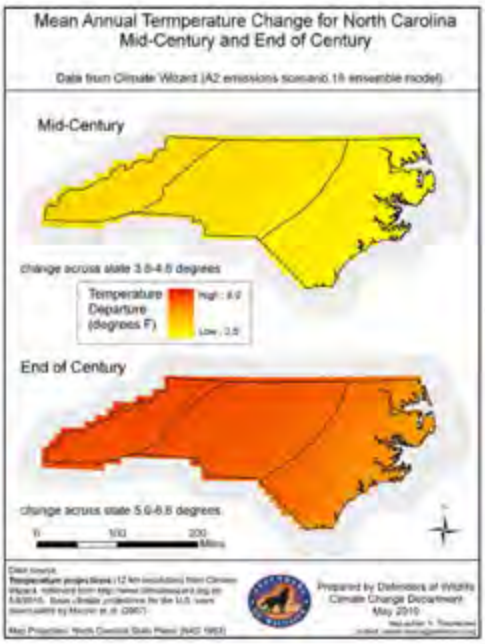

Figure 1. Projected change in mean annual temperature for North Carolina by mid and end of the century. Projections are based on a high emissions scenario (A2) and the ensemble average of 16 GCMs statistically downscaled to 12 km.

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Spruce-fir forests are projected to move northward and could be extirpated from North Carolina as temperatures increase.

In North Carolina, high elevation communities may be particularly at risk given projected climate warming in the region. Spruce-fir forests are projected to move northward as physiological tolerances are exceeded across its southern range, which is limited by summer heat and drought. Research from Iverson and Prasad (2001) suggests that spruce-fir habitat could be easily extirpated from the eastern U.S. as temperatures increase. Spruce-fir habitats provide critical habitat for a number of priority birds, including a subspecies of brown creeper (*Certhia americana*) and northern saw-whet owl (*Aegolius acadicus*), that may be endemic to the high peaks of the Southern Blue Ridge Ecoregion.

Recreational fish species and other cold and cool water habitats and species are expected to be significantly impacted by warming climate trends.

The Southeast has the highest aquatic species diversity in the entire United States, including significant diversity of fishes, mollusks, and crayfish. A significant proportion of these groups are already known to be at risk in North Carolina, with 83 fish species, 43 mussel species, 21 crayfish species, and 10 snail species identified as priorities for conservation in the plan. As the availability of cool water habitat contracts, priority species that inhabit cooler headwaters will be more at risk. Recreationally important fisheries, for example those stocked in cold and cool water hatcheries in the state, such as walleye (*Sander vitreus*), muskellunge (*Esox masquinongy*), and trout species, are likely to be affected.

Average autumn precipitation has already increased by 30 percent while summer and winter precipitation has declined by about 10 percent since 1901.

Changes in precipitation have not already occurred in the Southeast. Average autumn precipitation has increased by 30 percent since 1901, while summer and winter precipitation has declined by approximately 10 percent during this same period (Karl et al. 2009). In addition to the differences in the amount of precipitation, the occurrence of heavy downpours has increased in parts of the Southeast. Increased frequency of extreme rainfall events will likely affect processes such as soil erosion, sedimentation, and stream dynamics. At the same time, many parts of the region are experiencing an increasing number of droughts.

A 1 m sea level rise may result in an average shore retreat 288 feet across the state of North Carolina.

Rising seas are perhaps one of the most immediate and possibly devastating impacts of climate change in coastal areas. Several studies have projected up to 1.4 meters of sea level rise by 2100 when ice sheet contributions are included (e.g., Rahmstorf et al. 2007, Pfeffer et al. 2008). Conservative estimates from the Intergovernmental Panel on Climate Change show that coastal North Carolina has over 145,000 acres of land below one meter of elevation (the third largest low-lying region in the U.S. after Louisiana and Florida) and over 1.4 million acres of land in North Carolina are below 1.5 meters (Titus and Richman 2001). There are between 3.1 and 3.9 million acres of wetland in coastal North Carolina, including marshes, swamps, forested wetlands, pocosins, and other wetland habitats (Street et al. 2005).

Loss of barrier islands, maritime forest communities, and coastal wetlands to sea level rise will adversely affect a number of priority species in North Carolina.

North Carolina's coast is primarily composed of wave-dominated barrier islands consisting of long, thin stretches of sand that buffer shallow estuaries or lagoons and are bisected by widely-space tidal inlets (Gutierrez et al. 2009). Overwash, breaching, and storm surge are already a cause of habitat loss on the Outer Banks in North Carolina (Riggs and Ames 2003, Gutierrez et al. 2009). These habitats are important breeding and migration stopover points for many migratory birds and key breeding areas for declining populations of the eastern painted buntings, as well as for several snake species. Any species associated with coastal habitats may be threatened by direct loss of habitat to sea level rise.

Habitat conversion may create barriers to migration, limiting the ability of wildlife populations to shift as a result of climate change.

Urban development, fragmentation, and other land conversions currently threaten many terrestrial habitat types in North Carolina, and species already sensitive to habitat fragmentation are likely to be further impacted by climate change. In some areas, development may have already destroyed or converted remaining natural habitat in these areas, limiting the ability of populations to shift in response to climate change. For example, the limited range of Mabee's salamander (*Ambystoma mabeei*) has been highly impacted by draining of wetlands and conversion of forest into cropland (Petranka 1988 in NatureServe 2009). Like other ambystomids, which require vernal ponds for breeding, sensitivity to precipitation shifts as well as specific habitat requirements and limited movement will make the species particularly vulnerable to climate change.

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Significant wind energy potential exists in some of North Carolina's most sensitive biological regions.

However, if expansion of wind energy is not carefully planned, wildlife and other natural resources may be harmed. In the Southern Blue Ridge Ecoregion, for example, some of the highest areas of wind potential in the state ("outstanding" and "superb") overlap with, or are adjacent to, high priority biodiversity areas. For example, the NC Wildlife Action Plan has identified 46 avian species in this region as species of greatest conservation need, 16 of which have state listing status. Careful planning to avoid sensitive biological communities will be critical to minimize negative impacts to wildlife.

The unsustainable use of forestlands or the conversion of Conservation Reserve Program lands to use for biofuel production may negatively affect wildlife and habitat.

The sustainable development of renewable biofuels and feedstocks will require an understanding of how associated land-use choices may affect important ecological systems (Dale et al. 2010). Biofuels are combustible materials that are derived from biomass (e.g. plants, micro-organisms, or organic waste) and potentially offer an alternative energy. Rich et al. (2007) suggest that North Carolina could meet at least an additional 10% of its energy consumption needs by including forest (6 %), agricultural (1%), and waste (3 %) biomass resources in the state's energy portfolio. The production potential for these resources is distributed throughout the state and could include lands that are currently being used for timber production and agriculture, or lands in the Conservation Reserve Program (CRP). The CRP land is vital part of grassland bird conservation, and also provides important wildlife benefits for reptiles, amphibians, and pollinators (USDA 2010). North Carolina could see a significant decline in grassland habitat if the almost 60% of the current active acreage in CRP will see contracts expire by the end of 2013 is converted back into cropland (USDA 2010)(Figure 2).

Strategic conservation planning that incorporates adaptive management will be critical for maintaining important wildlife populations and habitats.

Strategic conservation planning offers a framework for agencies to organize available data, prioritize species and habitats based on their vulnerability or other values, and identify appropriate management or conservation strategies. If implemented correctly, adaptive management will provide an opportunity for 'learning by doing' and updating conservation strategies, which will be key to managing in the face of uncertainty.

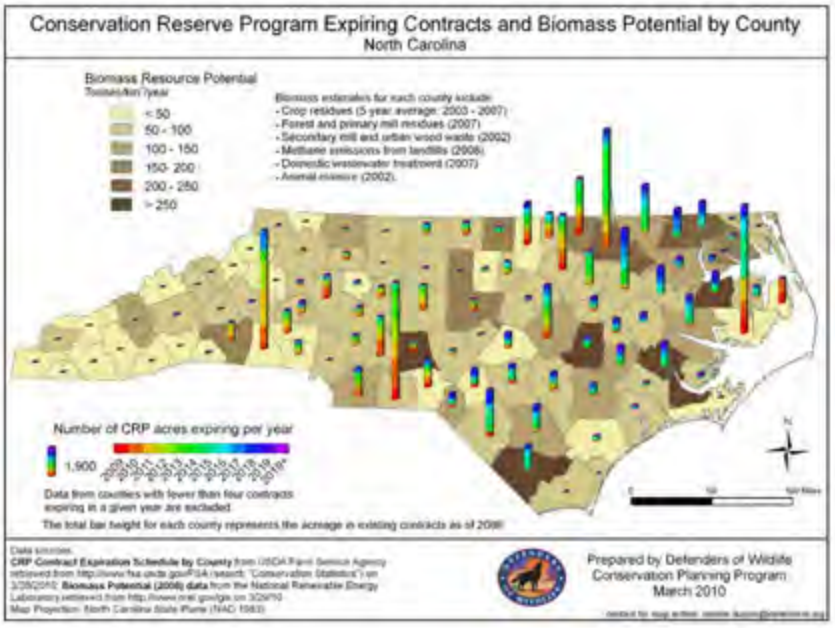

Figure 2. Conservation Reserve Program expiring contracts and biomass potential by county in North Carolina. Dark shaded counties have higher biomass resource potential. The height of the bar in each county indicates the acreage in existing contracts as of 2009 (expiration dates are color coded within the bar).

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Planning for climate change adaptation will require wildlife managers to collaborate beyond traditional boundaries.

The term adaptation is currently used to describe adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects. These adjustments moderate harm or exploit beneficial opportunities in response to climate change. Throughout a conservation planning process to develop adaptation strategies, there are a number of over-arching considerations: engaging partners, coordinating across boundaries, recognizing appropriate spatial and temporal scales, addressing uncertainty, incorporating vulnerability assessments, and implementing an adaptive management framework. The maintenance of biological diversity and a fully connected network of habitats across the landscape require conservation planning at multiple spatial scales (Angelstam et al. 2003). In the future, management decisions will need to be coordinated at a species' range-wide scale with a broader ecological, social, and economic landscape context in mind.

Accepting that the future will be different from both the past and the present forces us to manage in new ways.

To date, managers have relied on trends in historical data or sustainability paradigms to identify management goals and objectives (Lackey 1995, Landres et al. 1999 in Millar et al. 2007). However, rapid shifts in climate may make management actions based on past conditions obsolete, or even create new problems where wildlife or habitat are more susceptible to the impacts of climate change (Millar et al. 2007). Understanding the fundamental principles of climate change science as well as the characteristics that make fish, wildlife, and habitat more sensitive to projected climatic shifts, is a critical first step in adaptation planning. Careful consideration of vulnerability assessments, key uncertainties, planning options, and diverse stakeholder engagement will allow the Wildlife Resources Commission to develop a comprehensive approach for safeguarding wildlife from the impact of climate change in North Carolina.

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For more information contact Amielle DeWan, Director of Conservation Planning, Defenders of Wildlife, adewan@defenders.org

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Blvd
Atlanta, Georgia 30345

In Reply Refer To:
FWS/LR4/WSFR

Mr. Cam Ingram
Executive Director
North Carolina Wildlife Resources Commission
1701 MSC
Raleigh, North Carolina 27699-1701

Dear Mr. Ingram:

This letter acknowledges your correspondence dated April 2021, informing us of the North Carolina Wildlife Resources Commission's (NCWRC) intent to begin the comprehensive review of North Carolina's State Wildlife Action Plan (Plan), as required at a minimum of every 10 years. Thank you for notifying us of your intentions to begin your second comprehensive review of North Carolina's Plan and to submit it by September 30, 2025.

It is evident by your letter that the NCWRC is familiar with and is committed to implementing "5.1 Comprehensive Plan Review/Revision" of the Guidance for Wildlife Action Plan Review and Revision, approved December 2017. As indicated in this guidance, please submit the following with the reviewed Plan:

- Summary of significant changes
- A "Road Map" that provides the locations of the Elements in the Plan, and describes how the current version of the Plan adequately addresses the Elements, including an up-to-date public review process specified in elements 7 and 8. The Road Map should include a table with page numbers noting where each of the Elements has been addressed.

Please contact LeAnne Bonner, Grant Manager, at 404-679-7357, with any questions or concerns about project implementation and the administration of grant funds.

Sincerely,

Digitally signed by PAUL WILKES
Date: 2021.07.21 21:07:09 -04'00'

Paul A. Wilkes, Manager
Wildlife and Sport Fish Restoration Program

Key Participants

SWAP Coordinator

Cindy Simpson, Habitat Conservation Division

SWAP Steering Committee

Shannon Deaton, Habitat Conservation Division
Heather Evans, Executive Director's Office
Rachael Hoch, Inland Fisheries Division
Lane Sauls, Non-game Wildlife Advisory Committee
Sara Schweitzer, Wildlife Management Division

SWAP Technical Team

NCWRC senior staff responsible for developing the technical contents of the Wildlife Action Plan, with a focus on priority species, priority habitats, threats, integrating climate change impacts, and recommended conservation actions. Team members provide peer-review guidance to the SWAP Coordinator and convene special topic work groups as needed.

Greg Batts, Wildlife Management	Philip Lucas, Enforcement
Chris Dawes, Land & Water Access	Jeremy McCargo, Inland Fisheries
Kevin Dockendorf, Inland Fisheries	Allison Medford, Wildlife Management
Luke Etchison, Inland Fisheries	Jake Rash, Inland Fisheries
Michael Fisk, Inland Fisheries	TR Russ, Inland Fisheries
Joe Fuller, Wildlife Management	Nick Shaver, Land & Water Access
Chris Goudreau, Habitat Conservation	Vann Stancil, Habitat Conservation
Jeff Hall, Wildlife Management	Kendrick Weeks, Wildlife Management
Brena Jones, Inland Fisheries	Brent Wilson, Land & Water Access
Chris Jordan, Land & Water Access	

Ranking Criteria Work Group

A Technical Team subcommittee tasked with review and revision of the methodology for identifying Species of Greatest Conservation Need (SGCN) and prioritizing conservation, research, and management efforts on behalf of priority species. The Work Group provides recommendations to the SWAP Coordinator on the taxa evaluation methodology.

Gregg Batts, Wildlife Management	Vann Stancil, Habitat Conservation
Todd Ewing, Inland Fisheries	Kendrick Weeks, Wildlife Management
Allison Medford, Wildlife Management	

Taxa Teams

Eight subcommittees comprised of species experts convened by the Technical Team and tasked with applying the taxa evaluation methodology to establish ranking criteria to select SGCN and develop priority species for conservation, research, and management needs.

Amphibian and Reptile Taxa Teams	
Jeff Beane, NC Museum of Natural Science David Cooper, VHB Engineering Ed Corey, NC Parks and Recreation Sara Finn, NCWRC Wildlife Management Gabrielle Graeter, NCWRC Wildlife Management	Jeff Hall, NCWRC Wildlife Management Aubrey Greene, NCWRC Wildlife Management Kendrick Weeks, NCWRC Wildlife Management Lori Williams, NCWRC Wildlife Management

Bird Taxa Team	
Scott Anderson, NCWRC Wildlife Management John Carpenter, NCWRC Wildlife Management Christine Kelly, NCWRC Wildlife Management Kacey Cook, NCWRC Wildlife Management	Jeff Marcus, The Nature Conservancy Curtis Smalling, Audubon North Carolina Kendrick Weeks, NCWRC Wildlife Management

Crayfish Taxa Team	
Ed Corey, NC Parks & Recreation Zachary Loughman, West Liberty University Michael Perkins, NCWRC Inland Fisheries	Dylan Owensby, NCWRC Inland Fisheries TR Russ, NCWRC Inland Fisheries Bronwyn Williams, NC Museum of Natural Sciences

Freshwater Fish Taxa Team	
Kevin Dockendorf, NCWRC Inland Fisheries Luke Etchison, NCWRC Inland Fisheries Michael Fisk, NCWRC Inland Fisheries Brena Jones, NCWRC Inland Fisheries Sarah McRae, US Fish & Wildlife Service	Jake Rash, NCWRC Inland Fisheries Fritz Rohde, NOAA Fisheries TR Russ, NCWRC Inland Fisheries Bryn Tracy, NCDWR (retired)

Freshwater Mussel Taxa Team	
Michael Fisk, NCWRC Inland Fisheries Sarah McRae, US Fish & Wildlife Service Judy Ratcliffe, NC Natural Heritage Program Chantelle Rondel, NCWRC Inland Fisheries	TR Russ, NCWRC Inland Fisheries Tim Savidge, The Catena Group Tom Wilson, The Catena Group

Mammal Taxa Team	
Michael Cove, NC Museum of Natural Science Katherine Etchison, NCWRC Wildlife Management Lisa Gatens, NC Museum of Natural Science Christine Kelly, NCWRC Wildlife Management Brooke Massa, NCWRC Habitat Conservation	Olivia Munzer, Habitat Conservation Colleen Olfenbuttel, NCWRC Wildlife Management Andrea Shipley, NCWRC Wildlife Management David Webster, UNC-Wilmington Kendrick Weeks, NCWRC Wildlife Management

Snail Taxa Team	
Art Bogan, NC Museum of Natural Science Denise Furr, Schiele Museum Brena Jones, NCWRC Inland Fisheries	Amy Van Devender, Taxonomist Wayne Van Devender, Appalachian State University (Professor Emeritus)

Other Contributing Species Experts	
Gabriela Garrison, NCWRC Habitat Conservation Caleb Hickman, Eastern Band of Cherokee Indians Harry LeGrand, NC Biodiversity Project Elsa Youngblood, NC State University	

Partners and Stakeholder Participants

Individuals representing many different partners and stakeholder organizations assisted with review of species, habitats, spatial data, and priorities and contributed document content.

Federal Agencies and Organizations	
Association of Fish & Wildlife Agencies	USDA NRCS
NOAA Fisheries	US Dept. of Defense
SE Climate Adaptation Science Center	US Fish and Wildlife Service
SE Conservation Adaptation Strategy	US Forest Service
National Park Service	US Geological Survey

State Agencies and Organizations	
Nongame Wildlife Advisory Committee	NC Dept. of Environmental Quality
NC Dept. of Agriculture and Consumer Services, Plant Conservation Program	NC Forest Service
NC Dept. of Cultural and Natural Resources, National Heritage Program	
NC Dept. of Parks and Recreation	Georgia Dept. of Natural Resources

NC Dept. of Transportation	South Carolina Dept. of Natural Resources
NC Zoo	Virginia Dept. of Game and Inland Fisheries
NC Aquariums	

Education Organizations	
Appalachian State University	NCSU Extension Service
NC State University	
University of North Carolina Charlotte	
University of North Carolina Greensboro	
University of North Carolina Wilmington	
West Liberty University	

Other Organizations, Partners, and Stakeholders	
Audubon North Carolina	Partners in Amphibian and Reptile Conservation (PARC), SE and NC Chapters
Conservation Trust for North Carolina (CTNC)	The Nature Conservancy (TNC) NC Chapter
National Wildlife Federation (NWF) NC Chapter	The Xerces Society
Partners in Flight (PIF)	

Draft Review

The draft Wildlife Action Plan was made available through the internet for public, partner, and stakeholder review. An electronic form was provided to submit comments and the telephone number and email address was provided to contact the Wildlife Action Plan Coordinator. This information will be updated after final review and comments have been incorporated before submittal to the USFWS Regional Review Team.

2024 Peer Review

The results of the Taxa Team evaluations were made available to numerous species experts to request peer review and comment, beginning in November 2014 for review and download as Excel files from the NCWRC website. Files were provided for the eight taxonomic groups reviewed by the teams. Comments or requests for additional information were submitted by fewer than 10 individuals since the information was made available and have been incorporated as appropriate. Appendix G contains the information provided in these files.

2025 NCWRC Review

The draft Wildlife Action Plan was made available to NCWRC's Commissioners and members of the Nongame Wildlife Advisory Committee (NWAC) for review and comment. Comments have been incorporated as appropriate into this document.

2025 Public Review

The draft Wildlife Action Plan was made available to the public for review and download as PDF files and Excel files (Taxa Team evaluations) from the NCWRC's SWAP website. The document was available from April to June 1, 2025. An electronic comment form was available on the website and the telephone and email contact information for the Wildlife Action Plan Coordinator was provided for anyone wanting to submit comments or submit questions. Comments will be reviewed and incorporated into the document as appropriate.

Roadmap

Roadmap to the Eight Required Elements and Revisions

Required Element	Where to find it in the Plan	
	2015 Revision	**2025 Revision**
1. Distribution and abundance of **species** of wildlife	Chapter 3 Wildlife Chapter 4 Habitats Appendices E, G, H, I, N	Chapter 3 NC Species Chapter 4 Habitats Appendices 3, 4
2. Descriptions of locations and relative condition of key **habitats** and community types	Chapter 4 Habitats Appendices E, H, J	Chapter 4 Habitats Appendix 4
3. Descriptions of **problems** and priority research and survey **efforts needed**	Chapter 2 Need for Conservation Chapter 3 Wildlife Chapter 4 Habitats Chapter 5 Threats Appendices G,	Chapter 2 Need for Conservation Chapter 3 NC Species Chapter 4 Habitats Chapter 5 Threats Appendices 2, 3, 4, 5
4. Descriptions of **conservation actions** proposed **to conserve species and habitats**	Chapter 3 Wildlife Chapter 4 Habitats Chapter 6 Conservation Priorities Appendices K, L, M, O	Chapter 3 NC Species Chapter 4 Habitats Chapter 6 Conservation Priorities Appendices 3, 4, 6
5. **Monitoring plans** and adaptation of **conservation actions**	Chapter 3 Wildlife Chapter 4 Habitats Chapter 7 Implementation and Monitoring Appendices L, M, O	Chapter 3 NC Species Chapter 4 Habitats Chapter 7 Implementation and Monitoring Appendices 3, 4, 7
6. **Procedures for review** of the Plan at intervals not to exceed 10 years	Chapter 8 Review, Coordination, Revision, and Next Steps	Chapter 8 Review, Coordination, Revision, and Next Steps
7. Plans for **coordinating** the development, implementation, review, and revision of the Plan with federal, state, and local agencies and Indian tribes	Chapter 8 Review, Coordination, Revision, and Next Steps	Chapter 8 Review, Coordination, Revision, and Next Steps
8. Documentation of **public participation** during development and implementation	Chapter 8 Review, Coordination, Revision, and Next Steps Appendix C	Chapter 8 Review, Coordination, Revision, and Next Steps Appendix 8

Acronyms

A		A
ACEP	Agricultural Conservation Easement Program	
ACJV	Atlantic Coast Joint Venture	
ADFPTF	Agricultural Development and Farmland Preservation Trust	
AEC	Areas of Environmental Concern	
AFS	American Fisheries Society	
AFWA	Association of Fish and Wildlife Agencies	
AMJV	Appalachian Mountains Joint Venture	
APGI	Alcoa Power Generating Incorporated	
APHIS	Animal and Plant Health Inspection Service (in USDA)	
ARMI	Amphibian Research and Monitoring Initiative	
ASMFC	Atlantic States Marine Fisheries Commission	

B		B
BaSIC	Biodiversity and Spatial Information Center (at NCSU)	
BBS	Breeding Bird Survey	
Bd	*Batrachochytrium dendrobatidis*	
BHIC	Bald Head Island Conservancy	
BMP	Best Management Practice	
BOW	Becoming an Outdoors Woman program	
BRPP	Blue Ridge Paper Products	
Bsal	*Batrachochytrium salmandrivorans*	

C		C
C	Candidate species (USFWS)	
CAMA	Coastal Areas Management Act	
CASP	Calling Amphibian Survey Program	
CATCH	Caring for Aquatics Through Conservation Habits program	
CBC	Christmas Bird Count	
CCARI	Central Carolina Amphibian and Reptile Initiative	
CCAP	Community Conservation Assistance Program	
CCPI	Cooperative Conservation Partnership Initiative	
CEC	Commission for Environmental Cooperation	
CES	County Extension Service	
CHPP	Coastal Habitat Protection Plan	

CITES	Convention on International Trade in Endangered Species
COA	Conservation Opportunity Area
Commission	North Carolina Wildlife Resources Commission (also NCWRC)
CNAH	Center for North American Herpetology
CNFS	Carolina Northern Flying Squirrel
CRC	Coastal Resources Commission
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
CTNC	Conservation Trust for North Carolina
CURE	Cooperative Upland habitat Restoration and Enhancement Program
CWCS	Comprehensive Wildlife Conservation Strategy (Wildlife Action Plan)
CWMTF	Clean Water Management Trust Fund
CFACC	Cape Fear Arch Conservation Collaborative

D D

DA	Drainage area
DDT	dichloro diphenyl trichloroethane (insecticide)
DMAP	Deer Management Assistance Program
DO	Dissolved oxygen
DOD	U.S. Department of Defense

E E

E	Endangered species
EBCI	Eastern Band of Cherokee Indians
EELE	Environmental Education Learning Experience
EEP	N.C. Ecosystem Enhancement Program
EMC	Environmental Management Commission
ESA	Endangered Species Act
EDC	Endocrine Disrupting Chemicals (or Compounds)
EQIP	Environmental Quality Incentives Program
ESF	Educational State Forests

F		F
FDP	Forest Development Program	
FERC	Federal Energy Regulatory Commission	
FIA	Forest Inventory and Analysis	
FLP	Forest Legacy Program	
FMC	Fisheries Management Council	
FMP	Fisheries Management Plan	
FSC	Federal Species of Concern	

G		G
GIS	Geographic Information Systems	
GAP	Gap Analysis Project	
GBBC	Great Backyard Bird Count	
GICC	Geographic Information Coordinating Council	
GGT	Green Growth Toolbox	
GPS	Global Positioning System	
GSM	Global System for Mobile communications	

H		H
HFRP	Healthy Forests Reserve Program	
HMS	Highly migratory species	
HQW	High quality waters	
HUC	Hydrologic Unit Code	

I		I
IAA	International Association of Astacology	
IAFWA	International Association of Fish and Wildlife Agencies	
IBA	Important Bird Areas (Audubon)	
INRMP	Integrated Natural Resource Management Plan (US DOD)	
IBI	Index of Biotic Integrity	
IUCN	International Union for Conservation of Nature	

L		L
LIDAR	Light Detection and Ranging	
LRMP	Land and Resource Management Plan (in USFS)	

L	L
LTWA	Little Tennessee Watershed Association
LWCF	Land and Water Conservation Fund
LWS	Land and Water Stewardship

M	M
MAFMC	Mid-Atlantic Fisheries Management Council
MAPS	Monitoring Avian Productivity and Survivorship
MFC	Marine Fisheries Commission
MMPA	Marine Mammal Protection Act

N	N
NAAMP	North American Amphibian Monitoring Program
NABat	North American Bat Monitoring Program
NABCI	North American Bird Conservation Initiative
NABCP	North American Bat Conservation Partnership
NAWMP	North American Waterfowl Management Plan
NBII	National Biological Information Infrastructure
NCAC	North Carolina Administrative Code
NCCES	North Carolina Cooperative Extension Service
NCDACS	North Carolina Department of Agriculture and Consumer Services
NCDCM	North Carolina Division of Coastal Management
NCDEMLR	North Carolina Division of Energy, Mineral and Land Resources
NCDENR	North Carolina Department of Environment and Natural Resources
NCDEQ	North Carolina Department of Environmental Quality
NCDFR	North Carolina Division of Forest Resources, now NC Forest Service
NCDMF	North Carolina Division of Marine Fisheries
NCDOT	North Carolina Department of Transportation
NCDPR	North Carolina Division of Parks and Recreation
NCDWQ	North Carolina Division of Water Quality
NCDWR	North Carolina Division of Water Resources
NCEEP	North Carolina Ecosystem Enhancement Program
NCFS	North Carolina Forest Service, formerly NCDFR
NCGAP	North Carolina Gap Analysis Project
NCGS	North Carolina General Statute
NCHS	North Carolina Herpetological Society
NCMNS	North Carolina Museum of Natural Sciences
NCNHP	North Carolina Natural Heritage Program

N		N
NCOBCF	North Carolina Onslow Bight Conservation Forum	
NCPARC	North Carolina Partners in Amphibian and Reptile Conservation	
NCPIF	North Carolina Partners in Flight	
NCSCP	North Carolina Sandhills Conservation Partnership	
NCSU	North Carolina State University	
NCWF	North Carolina Wildlife Federation	
NCWRC	North Carolina Wildlife Resources Commission (Commission)	
NERR	National Estuarine Research Reserve	
NGO	Non-governmental organization	
NMFS	National Marine Fisheries Service (NOAA Fisheries)	
NOAA	National Oceanic and Atmospheric Administration	
NPDES	National Pollution Discharge Elimination System	
NPS	National Parks Service	
NRCS	Natural Resources Conservation Service (in USDA)	
NRI	National Resources Inventory (in NRCS)	
NWAC	Nongame Wildlife Advisory Committee (in NCWRC)	
NWI	National Wetland Inventory	
NWR	National Wildlife Refuge (in USFWS)	

O		O
OPR	Office of Protected Resources (in NOAA Fisheries)	
ORW	Outstanding Resource Waters (NCDWR)	
OSI	Open Space Institute	

P		P
PARC	Partners in Amphibian and Reptile Conservation	
PARTF	Parks and Recreation Trust Fund	
PIF	Partners in Flight	
PNA	Primary Nursery Area	
PUV	Present use value	

R		R
RAWA	Recovering America's Wildlife Act	
RC & D	Resource Conservation and Development Councils	
RCPP	Regional Conservation Partnership Program (in NRCS)	

RRCC	Robust Redhorse Conservation Committee

S S

SA	Shellfishing waters; one of three primary surface water classifications for coastal waters established by the EMC
SAE	Southern Appalachian Ecoregion
SAFMC	South Atlantic Fisheries Management Council
SAIN	Southern Appalachian Information Node
SALCC	South Atlantic Landscape Conservation Cooperative
SAMAB	Southern Appalachian Man and the Biosphere
SAMBI	South Atlantic Migratory Bird Initiative
SARP	Southeast Aquatic Resources Partnership
SARR	Southern Appalachian Raptor Research
SAV	Submerged aquatic vegetation
SBDN	Southeastern Bat Diversity Network
SC	Special Concern (in North Carolina)
SCDNR	South Carolina Department of Natural Resources
SCDPRT	South Carolina Department of Parks, Recreation, and Tourism
SCWF	South Carolina Wildlife Federation
SGCN	Species of Greatest Conservation Need
SLAMM	Sea Level Affecting Marshes Model
SLEUTH	Slope, Land use, Excluded, Urban, Transportation and Hillshade (model)
SNHA	Significant Natural Heritage Area
SREL	Savannah River Ecology Laboratory
Strategy	Comprehensive Wildlife Conservation Strategy, now WAP
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grants program

T T

T	Threatened species
TIMO	Timber Investment Management Organization
TNC	The Nature Conservancy
TNDEC	Tennessee Department of Environment and Conservation
Tr	Trout waters (NCWRC designation)
TRT	Take Reduction Team
TSI	Timber stand improvement
TVA	Tennessee Valley Authority

T		T
TWW	Teaming With Wildlife (part of AFWA)	

U		U
UNC	University of North Carolina	
UNC-C	University of North Carolina at Charlotte	
UNC-G	University of North Carolina at Greensboro	
UNC-W	University of North Carolina at Wilmington	
USACE	United States Army Corps of Engineers	
USCB	United States Census Bureau	
USDA	United States Department of Agriculture	
USDI	United States Department of the Interior	
USFS	United States Forest Service	
USFWS	United States Fish and Wildlife Service	
USGS	United States Geological Survey	
USMC	United States Marine Corps	
UT-K	University of Tennessee at Knoxville	

V		V
VAD	Voluntary Agricultural District	
VOA	Voice of America	

W		W
WAIT	Wildlife and Industry Together	
WAP	Wildlife Action Plan	
WCU	Western Carolina University	
WDCA	Wildlife Damage Control Agent	
WHIP	Wildlife Habitat Incentives Program	
WLCD	Wildlife Land Conservation Program	
WRC	N.C. Wildlife Resources Commission	
WUI	wildlife-urban interface	

Glossary

A

Adaptation - a *process* by which a species or natural system responds to actual or expected stimuli (or their effects) which moderates harm or exploits beneficial opportunities.

Adapted. An organism that has changed its structure or habits to produce better adjustment to the environment; expression of a genetically determined characteristic that enhances the ability of an organism to cope with its environment.

Adaptive management – a process for adjusting management and research decisions to better achieve management objectives, recognizing that knowledge about natural resource systems is uncertain.

Aggregation. A group of organisms of the same or different species living closely together but less integrated than a society.

Anadromous – a fish or fish species that migrates up rivers from the sea to breed in fresh water.

Anadromous fish nursery area (AFNA) - Those areas in the riverine and estuarine systems utilized by postlarval and later juvenile anadromous fish.

Anadromous fish spawning area (AFSA) – Those areas where evidence of spawning of anadromous fish has been documented in Division sampling records through direct observation of spawning, capture of running ripe females, or capture of eggs or early larvae.

Anaerobic soil –Soils that are heavy textured (clay), compacted, wet or flooded tend to be anaerobic because they have little to no oxygenated air in the soil pores to carry out normal oxidative reactions (such as decomposition of organic matter and nutrient cycling). Anaerobic soils are referred to as hydric soils when they are sufficiently wet in the upper part to develop anaerobic conditions during the growing season.

Anthropogenic – relating to, or resulting from, the influences of humans; used to describe an impact caused by humans or human activities.

Aquatic habitat – the wetlands, streams, lakes, ponds, and estuaries where aquatic organisms (*e.g.*, fish, benthic macroinvertebrates) live and reproduce. This habitat includes the water, substrate, aquatic vegetation, and other physical components (*e.g.,* woody debris) upon and within which the organisms occur.

Aquatic. An organism that lives in water at least most of its life.

Area sensitive species - Area sensitive species are animals that are highly sensitive to the conversion of large areas of habitat into collections of smaller patches of habitat.

B

Benthic –associated with the bottom area of bodies of water.

Benthic macroinvertebrates – organisms living in or on the bottom substrate of aquatic habitats and include insect larvae, worms, snails, crayfish and mussels. Macroinvertebrates are often used as indicators of stream water quality and stream habitat condition.

Best Management Practices (BMPs) –any land or stormwater management practice or structure used to mitigate flooding, reduce erosion and sedimentation, improve water quality, or otherwise control water pollution from runoff. Examples of BMPs include retention basins, sediment ponds, agriculture/forestry BMP practices, and alternate watering systems for livestock operations.

Biodiversity – The word "biodiversity" is a contracted version of "biological diversity. It is the variability among living organisms on the earth, including the variability within and between species and within and between ecosystems. Biodiversity includes the genetic variants within a population and transient or migratory species that occur in an ecosystem.

Boreal. Occurring in the temperate and subtemperate zones of the Northern Hemisphere.

Burrow. A hole or tunnel in the ground made by an animal for habitation and refuge.

By-catch – the portion of a fishing catch that is discarded as unwanted or commercially unusable.

C

Cache. A place where some animals store food and other supplies.

Coastal waters - Coastal fishing waters are the Atlantic Ocean; the various coastal sounds; and estuarine waters up to the dividing line between coastal fishing waters and inland fishing waters agreed upon by the Marine Fisheries Commission and the Wildlife Resources Commission. All waters which are tributary to coastal fishing waters and which are not otherwise designated by agreement between the Marine Fisheries Commission and the Wildlife Resources Commission are coastal fishing waters. Internal Coastal Waters are all coastal fishing waters except the Atlantic Ocean. The boundaries between inland waters, coastal waters, and the description of waters that are subject to

joint jurisdiction are described in North Carolina's Administrative Code (15A NCAC 03Q.0201 and 03Q.0202).

Colonial. Animals that live together in groups.

Commensal. Different organisms living in close association with each other; one is benefited and the other is neither benefited nor harmed; in close association with humans.

Critical Habitat. Habitats required for an organism to survive. Designated critical habitat is defined by the USFWS for species listed for protection under the Endangered Species Act. This designated critical habitat includes specific areas within the geographical area occupied by the species with the physical or biological features essential to the conservation of the species and which may require special management considerations or protection. The Secretary of the Interior may also determine specific areas outside the geographical area occupied by the species at the time of listing as being essential for the conservation of the species.

D

Deforestation. Removal of trees from an area without adequate replanting.

Detritus. Fragments of organic material.

Disjunct. A group or population separate from other parts of a group or population.

Dispersal. Movements that occur within the lifetime of the individual, as, for example, when it leaves its natal site.

Disperse. To move away from the place of birth or from centers of population density.

Dissolved Oxygen (DO). The amount of oxygen dissolved in a body of water; measured as a percent of saturation. It is used as an indication of the degree of health of the water and its ability to support a balanced aquatic ecosystem. If more oxygen is consumed than is produced, dissolved oxygen levels decline. DO levels vary with water temperature and with altitude; they fluctuate seasonally and over a 24-hour period. Cold water holds more oxygen than warm water and water holds less oxygen at higher altitudes. Aquatic animals are vulnerable to lowered DO levels.

Distend. To push out.

Diurnal. Active during the daytime.

Dormant. Sleeping or otherwise inactive with some bodily processes such as heart rate and breathing slowed down.

E

Echolocate. Emit high frequency sound pulses and gain information about the surrounding environment from the retuning echoes.

Ecoregion – an area defined by environmental conditions and natural features; a region defined by its ecology. An area of land or water that is characterized by distinct plant communities and geologic features.

Ecosystem – An ecosystem is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (air, water and mineral soil), interacting as a system. It is a system of environmental conditions, habitats, natural communities, and species that interact.

Ecotone. A zone of transition between habitat types.

Emergent. Above the surface; often referring to water but can refer to other situations (eg. canopy).

Endangerment - Refers to a situation in which a species is vulnerable to extinction or extirpation.

Endemic (endemism) – Native or confined to a certain region. Refers to species with a relatively local distribution, sometimes occurring as small populations confined to a single place, such as a particular stream or mountain cove. Endemic species are more vulnerable to extinction than are more widespread species.

Estuarine system - Mixing area of saltwater and freshwater; tidally- and wind-influenced waters that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the ocean, with ocean-derived water at least occasionally diluted by freshwater runoff from the land. The upstream and landward limit is where ocean-derived salts cause the water to have salinity 0.5 ppt during the period of average annual low flow. The seaward limit is an imaginary line closing the mouth of a river, bay, or sound. (NCDMF CHPP).

Evapotranspiration – The combination **of evaporation of water from plant and ground surfaces and transpiration.**

Exotic species (also commonly called *alien, non-indigenous, or non-native*) **–** a species occurring outside of its native range. Exotic species often occur because they have been introduced (either intentionally or accidentally) or they may occur because of opportunistic expansion into habitats where they would not normally occur.

Extinct. Of a species, no longer represented by living individuals.

Extinction – The condition in which all members of a group of organisms have ceased to exist. The loss of a species, which is often a natural process and the ultimate fate for all species.

Extirpate (extirpation) – To eliminate a population from a given area. When a species is eliminated from a specific geographic area of its habitat; to bring a species to extinction within part of its range.

F - G

Forage. To wander in search of food. n. Plants, including grains and grasses, eaten by animals.

Game species - Those animals that are regulated for hunting or harvest; includes big game, furbearers, and small game species. These species are normally regulated by state law or local ordinances.

H

Habitat Fragmentation. A condition in which the continuous area of similar habitat is reduced and divided into smaller sections because of roads, fields, and towns.

Hibernaculum. The case, covering or structure in which an organism remains dormant for the winter.

Hibernate. To go into winter dormancy.

High Quality Waters (HQW) - Supplemental NCDWQ classification intended to protect waters with quality higher than state water quality standards. In general, there are two means by which a water body may be classified as HQW. They may be HQW by definition (*e.g.,* drinking water supply classifications), or they may qualify for HQW by supplemental designation and then be classified as HQW through the rule-making process (*e.g.,* petition for reclassification).

Home range. Area used by an animal in its normal daily activities. Not defended.

Hydrologic Unit Code (HUC) – The USGS developed a hydrologic coding system to delineate the country into uniquely identified watersheds that can be commonly referenced and mapped. North Carolina's 17 river basins, each with a unique 6-digit number, are subdivided into 54 catalog units (8-digit number) and 1,601 hydrologic units (14-digit number). River basin maps in the Wildlife Action Plan have use the 8-digit catalog unit number.

Hydrology – the scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

I

Inbreeding. The mating of individuals who are more closely related than by chance alone.

Indicator species – A species or group of species chosen as an indicator of, or proxy for, the state of an ecosystem or of a certain process within that ecosystem.

Inland waters –All inland waters except private ponds; and all waters connecting with or tributary to coastal sounds or the ocean extending inland from the dividing line between coastal fishing waters and inland fishing waters agreed upon by the Marine Fisheries Commission and the Wildlife Resources Commission. All waters which are tributary to inland fishing waters and which are not otherwise designated by agreement between the Marine Fisheries Commission and the Wildlife Resources Commission are inland fishing waters. Inland waters are found within the area bound by the inland fishing water boundary description and the headwaters of that particular waterbody. The boundaries between inland waters, coastal waters, and the description of waters that are subject to joint jurisdiction are described in North Carolina's Administrative Code (15A NCAC 03Q.0201 and 03Q.0202).

Insectivore. An organism that consumes a diet of insects, other small arthropods, or worms.

Interstices (interstitial). Small spaces between objects; most often referring to the fine pores between soil or sand particles through which water is able to flow.

Introduced species – a species whose existence in a given area is due to human action or activity (e.g., accidental or deliberate release) and has led to its dispersal across natural geographic barriers, and/or has produced conditions favorable to its growth and spread. Introduced species can be native to an area while being nonnative to a specific habitat (as in the case of some aquatic species). Introduced species can become invasive when they exert competitive pressure on native species.

Invasive species – a species occurring outside of its native range and whose introduction does or is likely to cause harm or threaten the survival of native species. They may be referred to as an injurious species when their presence is detrimental to native populations or may generically be referred to as 'pest species.'

Invertebrate. An organism without a backbone.

J - L

Joint waters - Joint fishing waters are those coastal fishing waters, hereinafter set out, denominated by agreement of the Marine Fisheries Commission and the Wildlife Resources Commission pursuant to NC General Statutes [G.S. 113132(e)] as joint fishing waters. All waters which are tributary to joint fishing waters and which are not

otherwise designated by agreement between the Marine Fisheries Commission and the Wildlife Resources Commission are classified as joint fishing waters. The boundaries between inland waters, coastal waters, and the description of waters that are subject to joint jurisdiction are described in North Carolina's Administrative Code (15A NCAC 03Q.0201 and 03Q.0202).

Juvenile. A generalized age category between immature and adult; may or may not be sexually mature.

Keystone species. A species whose impacts on its community or ecosystem are large, and much larger than would be expected from its abundance.

Lacustrine system – Lakes; impounded water bodies with salinity below 0.5 ppt and situated in a topographic depression or dammed river channel. Lakes are generally greater than 8 ha (20 acres) in size and deeper than 2 m (6.6 ft).

M

Marine system - Open ocean overlying the continental shelf and coastline exposed to waves and currents of the open ocean shoreward to extreme high water of spring tides; or the seaward limit of the Estuarine System. Salinities exceed 30 ppt.

Marine. Having to do with the sea, including salt water gulfs and oceans.

Maternity colony. A group of pregnant or nursing animals that gather into a single large colony for the purposed of rearing young.

Migrate. v. The periodic movement of animals from one region of land or water to another.

Molting. The seasonal replacement of hair (in mammals) or feathers (in birds).

Mortality. Death, usually expressed as a rate.

N

Native species – With respect to a particular ecosystem, a species that historically occurred or currently occurs in that ecosystem, other than as a result of an introduction [of a nonnative species].

Natural Community – An interactive assemblage of organisms, their physical environment, and the natural processes that affect them. Natural communities contain a distinct collection of plants and animals (and fungi and bacteria) associated with each other and with their physical environment. The community consists of both biotic (living: plants and animals) and abiotic (non-living: soil and water) factors.

Nocturnal. Active during night hours.

Nonnative species - any species that has been introduced (either intentionally or accidentally) to an area outside its natural past or present distribution. This includes any part (gametes, seeds, eggs, or propagules) of such species that might survive and subsequently reproduce. Nonnative species can be invasive, injurious, or beneficial where it occurs.

Nursery areas - Those areas in which for reasons such as food, cover, bottom type, salinity, temperature and other factors, young finfish and crustaceans spend the major portion of their initial growing season.

O

Objective – a concise statement of intended achievement; something toward which effort is directed.

Omnivorous. Having the ability or natural inclination to use both animal and plants as food.

Optimum sustainable population – (as defined by the Marine Mammal Protection Act) the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the optimum carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element; a population size which falls within a range from the carrying capacity of the ecosystem to the population level that results in maximum net productivity.

Outstanding Resource Waters (ORW) - Supplemental NC DWQ classification intended to protect unique and special waters having excellent water quality and being of exceptional state or national ecological or recreational significance. To qualify, waters must be rated Excellent by DWQ and have one of the following outstanding resource values.

P

Palustrine system – Ponds; isolated water bodies with salinity below 0.5 ppt and situated in a topographic depression or dammed stream channel. Ponds are generally less than 8 ha (20 acres) in size and water depth is no greater than 2 m (6.6 ft).

Parasite. An organism that draws nutrients from another living organism. The second organism, called a host, is often harmed by the relationship.

Patagium. A membrane stretching from the body wall to the limbs or tips of digits; it serves as the airfoil in gliding mammals and the wing in bats.

Pelagic – referring to species that spend the majority of their lives beyond the near-shore coastal zone, either on or in the open ocean and, most often, more than 3 miles offshore.

Plankton. Tiny aquatic plant and animal organisms that drift together in large numbers.

Poaching. The illegal taking of plants, fish or game.

Posterior. Located toward the rear.

Potential biological removal – the maximum number of animals, not including natural mortalities, that may be removed from that stock, while allowing the stock to reach or maintain its optimum sustainable population.

Predator. An organism that preys upon other animals for food or habitat.

Primary nursery area (PNA) - those areas in the estuarine system where initial post-larval development takes place. These are areas where populations are uniformly early juveniles. Primary nursery areas are defined in 15A NCAC 03I .0101 and designated in 15A NCAC 03R .0103, .0104, and .0105. Unless otherwise specified by the rule, primary nursery areas described in 15A NCAC 03R .0103 encompass all waters from the described line in the direction indicated in rule up to the headwaters of the waterbody or InlandCoastal boundary lines, whichever area is first encountered.

Priority species – Any species identified for conservation, research, or management action or need. Priority species will include Species of Greatest Conservation Need (SGCN), state and federal Endangered, Threatened, Candidate, or Special Concern species; animal aggregations considered vulnerable; those species of recreational, commercial, or tribal importance that are vulnerable; and those which are important to ecosystem processes (including those that are pests or injurious species). While priority species are considered a conservation priority, they are not necessarily considered SGCN (see definition below). Priority species may receive funding under programs other than the State Wildlife Grant program.

R

Radiotelemetry. A method for determining the location and movements of an animal by using a transmitter affixed to the individual, the signals from which are monitored with an antenna and a receiver from known points in the study area.

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.

Rhizome. Horrizontal, underground stem, often giving rise to new plants at the tip or at the nodes.

Riparian – pertaining to a river and the corridor adjoining it (i.e., the banks, floodplain); of, on, or relating to the banks of a natural course of water.

Riverine system – Creeks, streams, rivers; all deep water habitats contained within a channel. In coastal areas they may have salinities in excess of 0.5 ppt.

Roost(**ing site**). A place where birds or bats rest or sleep.

Rostrum. The forward extension of the nasal region of the face and upper jaw.

S

Sea Level Rise (SLR) -- Sea level rise is an increase in the level of the world's oceans due to the effects of global warming. Burning fossil fuels is one of the causes of global warming because it releases carbon dioxide and other heat-trapping gasses into the atmosphere. The oceans then absorb the majority of this heat. As water becomes warmer, it expands. This results in ocean levels rising worldwide. Land-based ice, such as glaciers and ice sheets, is greatly affected by global warming, as well. These reserves of ice are located in places like Greenland and Antarctica. Typically, they experience melt during the warmer months of the year and the ice is replenished in colder months. With the average year-round global temperatures rising, however, ice caps and glaciers are experiencing a disproportionate amount of melting at an accelerated rate.

Secondary nursery area (SNA) - those areas in the estuarine system where later juvenile development takes place. Populations are composed of developing sub-adults of similar size which have migrated from an upstream primary nursery area to the secondary nursery area located in the middle portion of the estuarine system. Secondary nursery areas are defined in 15A NCAC 03I .0101 and designated in 15A NCAC 03R .0103, .0104, and .0105. Unless otherwise specified by the rule, permanent and special secondary nursery areas designated in 15A NCAC 03R .0104 and .0105 encompass all waters from the described line in the direction indicated in rule up to the primary nursery area lines, InlandCoastal boundary lines or the headwaters of the waterbody, whichever area is first encountered.

Solitary. An animal that spends the majority of its time alone.

Species. A category of organisms possessing a lineage independent of other lineages, capable of evolving independently and reproducing.

Species of Greatest Conservation Need (SGCN) - In North Carolina, SGCN have been defined as species that are currently rare or have been designated as at-risk of extinction; those for which we have knowledge deficiencies; and those that have not received adequate

conservation attention in the past. In addition to these species for which there is high conservation concern, SGCN may also include those species for which we are unable to determine true status in the state and are therefore a priority for research due to these knowledge gaps.

Spelunker. A person who explores caves.

Sportfish – Fish that are regulated for harvest by angling or other means; includes native and non-native species that may be stocked in surface waters.

Subspecies. A subdivision of a species based on geographic distribution; a subspecies is usually formally named.

Subterranean. Living underground for all activities.

Succession. The orderly process of replacement of one community with another.

Summer resident. An animal which spends only summer in an area before migrating to another place for winter.

T - Z

Telemetry – the science and technology of automatic measurement and transmission of data by wire, radio, or other means from remote sources to receiving stations for recording and analysis.

Vector. An intermediate source of disease transmission. For example, rabies infects raccoons but can be transmitted to foxes. An infected fox acts as a vector to transmit rabies to another mammal through its bite, including domestic pets and humans.

White-nose Syndrome. A fatal disease impacting North American bats likely caused by the fungus *Geomyces destructans*.

Year-round resident. An animal that does not migrate.

Zoonotic. A zoonosis or zoonotic disease is an infectious pathogen that can be passes between wildlife and humans. Pathogens can be bacterium, virus, parasite, or prion and can be passes in either direction, from wildlife to human or in reverse, from human to wildlife. Transmission can occur directly through the air (e.g., influenza virus) or fluids such as saliva (e.g., rabies) or blood.

Recovering Americas Wildlife Act - Bill Summary (HR2773)

- Support proactive fish & wildlife conservation by addressing threats to natural resources
- Directing funds through the NC Wildlife Action Plan so they can be fully implemented
- Provide funds for more than 12,000 species of greatest conservation need (SGCN) across the country and nearly 500 SGCN in North Carolina
- Total annual national funding would be $1.3B
  - **NC's** State & Tribal Wildlife Grant (STWG) annual increase from $1.3M to **$23.42M**
  - annual non-federal **match** for the entire $23.42M **would be $5.86M**.

With the annual allocation of funds from RAWA, the N.C. Wildlife Resources Commission, along with partners, volunteers and others, could:

- **Keep common species common**
- **Manage and restore SGCN**
- **Create, enhance and preserve priority habitats**
- **Connect people with nature**
- **Expand conservation education and stewardship**
- **Consider North Carolina native plants in the SGCN list**
- **Enhanced focus on illegal collection and sale of listed wildlife and plant species**

The bill language states that RAWA funds can be used to:

- Develop and revise state Wildlife Action Plan (WAP)
- Recover state or federally listed species
- Conduct wildlife conservation education and wildlife-associated recreation projects
- Manage a species of greatest conservation need (SGCN) even if they cross state lines/territories
- Manage invasive species, disease, and other risks to SGCN
- Perform law enforcement activities related to the protection and conservation of a SGCN
- Manage native plant species, if included in WAP

NC Wildlife Action Plan serves as a conservation blueprint for our agency and our partners.

www.ncwildlife.org/RAWA NCWRC RAWA video #RecoverWildlife

OurNatureUSA.com

Appendix 2

2

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Success Story 1

How Conservation Actions Help Protect Species: Carolina Northern Flying Squirrel

There are two species of flying squirrels in North Carolina - the Northern (*Glaucomys sabrinus coloratus*) and Southern (*Glaucomys volans*). Carolina Northern Flying Squirrels (CNFS) are found on high mountain peaks in southwest Virginia, western North Carolina, and eastern Tennessee in spruce-fir and northern hardwood forests. Flying squirrels are nocturnal, spending the day denning in tree cavities or dry nests filled with shredded Yellow Birch bark. At night, they forage principally on certain fungi and lichens, supplementing their diet with plant buds, catkins, fruits, sap, insects, small vertebrates, and eggs. The CNFS was federally listed as endangered under the Endangered Species Act in 1985 and has been identified as a priority species for conservation (or SGCN) in NC's State Wildlife Action Plan (SWAP).

North Carolina's SWAP identified the need for surveys to determine the distribution, relative abundance, and status of wildlife species associated with northern hardwood and spruce-fir forests, including CNFS. Recommendations also called for use of monitoring programs to assess current population status and trend information; research studies on the population biology of wildlife species as well as the ecological relationships between the species, their habitats, and the biological, physical, and chemical habitat components; genetic studies to explore the degree of genetic isolation of species restricted to high elevations; and support of collaborative research with colleges and universities. To date, work has involved partnerships with USFWS, USFS, NPS, Eastern Band of Cherokee Indians (EBCI), NCDOT, Duke Energy, Southern Appalachian Spruce Restoration Initiative, Southern Highlands Reserve, Warren Wilson College, WildSouth, and Deltec Homes. Cooperative research efforts have involved NC State University, Auburn University, Virginia Polytechnic Institute and State University (Virginia Tech), and the University of NC at Wilmington.

Carolina Northern Flying Squirrel (NCWRC)

Even before the first SWAP was published, annual survey and monitoring of CNFS populations was conducted within seven of the eight Geographic Recovery Areas identified by USFWS (1990). Monitoring efforts began in 1997with the installation of wooden squirrel boxes

(designed by Dr. Peter Weigl of Wake Forest University) in apparently suitable habitat (Weigl et al.1992;, USFWS 1990, 2001), and includes conducting mark-recapture surveys. The low captures and recaptures from nest boxes do not generate meaningful population estimates. Therefore, nest box data are analyzed using occupancy models and additional monitoring techniques are recommended to better understand population status and trends of this rare and elusive species. Survey sites have since been expanded to include transects within additional areas of suitable habitat. Monitoring efforts now also include using radiotelemetry, acoustic detectors, and trail cameras, and genetic research to improve our understanding of this species.

Conservation and management efforts have focused on addressing the loss of conifer habitat and fragmentation that serves as a barrier to dispersal. Habitat loss has resulted primarily from extensive logging of the spruce-fir forest that occurred primarily between the 1880s and 1930s, followed by mortality of Fraser Fir due to Balsam Woolly Adelgid (*Adelges piceae*) and development (for recreation and second homes). In one recovery area the only extant conifer species, Eastern Hemlock, has been lost due to Hemlock Woolly Adelgid (*Adelges tsugae*). Habitat improvement measures involve enhancing the conifer component in appropriate areas by planting Red Spruce (*Picea rubens*) seedlings or managing the forest canopy around existing spruce trees through timber cuts that 'release' existing spruce trees so the canopy is more open and they get more sunlight. In 2012 a multi-state effort, the Southern Appalachian Spruce Restoration Initiative, was established with the goal of achieving landscape scale restoration to benefit Northern Flying Squirrel populations as well as other priority species (Red Crossbill and Saw-Whet Owl).

Cherohala Skyway crossing structures (NCWRC)

Fragmentation caused by the Cherohala Skyway corridor in the Unicoi Mountains resulted in a barrier to dispersal that impeded genetic mixing of populations. Road width is greater than gliding ability and road shoulders lack mature trees of sufficient height for the squirrels to successfully launch and glide across the corridor. Mitigation measures developed in 2007 and implemented in 2008 involved erecting artificial crossing structures along the Cherohala Skyway to facilitate road crossing and to reconnect populations. Radio telemetry monitoring and trail camera images indicate some flying squirrels have successfully used the crossing structures (Kelly et al. 2013).

Success Story 2

How Conservation Actions Help Protect Species: The Conservation Aquaculture Center (CAC) and Aquatic Species Propagation, Research, and Restocking

Since 2008, the NC Wildlife Resources Commission (NCWRC) has been working to protect and restore aquatic nongame species through propagation. With humble beginnings in a prefabricated shed with a few buckets and water lines, the Conservation Aquaculture Center (CAC) in Marion, NC, has worked to propagate rare and declining freshwater fish, mussels, and aquatic snails for restocking into appropriate habitats where they occurred historically.

The CAC program has grown significantly over the years, moving from the small original shed to an old tractor barn, and now to a new modern facility which makes it one of the nation's largest nongame hatcheries. It is equipped with state-of-the-art aquaculture systems, automated mechanisms that maximize capacity, and lab space for research efforts. Even in an old tractor shed, the CAC propagation efforts helped to produce thousands of individuals of rare species, preventing extinction, developing aquaculture techniques that remain a model for other facilities, and proving the use of captive propagation to be incredibly useful for managing Species of Greatest Conservation Need (SGCN).

New CAC facility hatchery systems in Marion, NC.

Designed with flexibility in mind, the updated facility is versatile in its uses. In addition to propagation efforts, the CAC can also house animals long-term until habitat is available for reintroduction. This capacity allows the CAC to act as an "ark" that sustains a species until a suitable habitat is available for restocking in the wild. An example is when the CAC provides temporary refuge for animals removed from habitats below dam removal sites until they can be restocked post-construction.

The CAC collaborates with partners like Conservation Fisheries, Inc. (CFI), NC State University's College of Veterinary Medicine, and Warm Springs National Fish Hatchery to increase capacity for propagating various species and expanding grow-out space. By increasing the capacity for propagation of various species, not just Species of Greatest Conservation Need (SGCN), fish that serve as important host species for freshwater mussel SGCN can be reproduced instead of removing them from the wild. With fewer spatial constraints and expanded hatchery capacities, the CAC and partners can effectively propagate federally endangered and SGCN species such as the Carolina Madtom and Roanoke Logperch.

Collaboration with other facilities allows for large projects and replication to be completed, including studies to test the biological fitness of propagated mussels prior to their release. , and with o evaluate substrate preferences in juvenile mussels. The CAC has also provided larvae to other hatcheries for studies such as toxicity trials, dichotomous key development, and propagation for student research.

Partnerships allow stocking events to be strategically timed with seasons and field conditions to best ensure the success of the animals upon release, and animals may be held long enough to ensure they have had an adequate 'head start' to survive the juvenile stage in the wild. These stocking events have profound impacts on recovering populations and have even been credited with the proposed delisting of the Roanoke Logperch from the Endangered Species list.

Research is vastly important in this field as well, both to inform the culture and care of the animals themselves and to help ensure management strategies in the field are as informed and effective as possible. The CAC supports biologists with research to help inform management strategies, such as feed studies, microbiome analysis, genetics evaluation, and even juvenile animal responses to changing hydrology. CAC staff have implemented studies to improve culturing techniques and mussel growth and survival, as well as life history studies to aid in species descriptions. The hatchery can also host student interns and support graduate research, helping to train the next generation of aquatic conservationists as well as furthering research goals.

Juvenile mussels tagged and ready for restocking.

In Western NC, the Cheoah River restoration project is an example of how the CAC's conservation efforts have resulted in success. The restoration site was almost void of aquatic life due to inadequate flows from Santeetlah Dam releases that caused intermittent dewatering followed by high-flow flood events. CAC hatchery efforts focused on four SGCN mussel species and one SGCN fish to help reestablish a healthy riverine community following improved flow regulation. The Spotfin Chub was propagated at CFI for grow out at the CAC, and four

mussel species (Appalachian Elktoe, Slippershell, Rainbow, and Wavy-rayed Lampmussel) were propagated at the CAC to support the reintroduction. The Spotfin Chub is federally and state listed as a threatened species. Appalachian Elktoe are state and federally listed as endangered. The Slippershell, Wavy-rayed Lampmussel, and Rainbow mussels are state-protected species, with Slippershell listed as endangered, Wavy-rayed listed as special concern, and Rainbow as threatened. Following improvements to water quality in the Cheoah River and increased flows downstream from Santeetlah Dam, these captive-bred federal and state-listed fish and mussel species were reintroduced to the river.

Wavy-rayed Lampmussels and Rainbow mussels propagated at the CAC utilizing broodstock from the Pigeon and Little Tennessee Rivers have been stocked throughout the French Broad River basin in its mainstem and tributaries. These reintroduction efforts have shown varying levels of success, with the most successful being the Swannanoa River near Asheville, the upper French Broad River near Rosman, NC, and the lower French Broad near Hot Springs, NC. Wavy-rayed Lampmussels and Rainbow mussels have also been stocked into several Little Tennessee River tributaries. Although there is varied success across these stocking sites, the monitoring of sites in upper Tuckasegee near Cullowhee, NC, and Cartoogechaye Creek near Franklin, NC, have consistently shown the most success within the basin aside from the Cheoah River.

Conservation efforts by the CAC, in partnership with NC State's mussel hatchery, to propagate and reintroduce the federally endangered Tar Spinymussel have also shown great success. Endemic to North Carolina and with less than 100 individuals found in the wild, the CAC was able to produce thousands of these extremely rare mussels. Biologists believe that the extinction of this species would very likely be imminent if it were not for the early propagation actions taken when sharp declines began 15 years ago. Following reintroductions, stocked populations are regularly monitored by NCWRC field staff to assess population health and determine if recruitment is recurring in the wild, which is the next step of recovery. In addition to augmenting existing populations, the CAC has worked to develop and maintain an ark population for over 10 years in hopes of preventing extinction if the wild populations are extirpated. Continued propagation by the CAC also enables research, which remains ongoing, to better understand the biology and ecology of this species.

Tar River Spinymussel juveniles

The CAC oversees the conservation of the Magnificent Ramshorn, a freshwater snail species unique to North Carolina. Once residing in a few freshwater ponds along the North Carolina coast, the Magnificent Ramshorn has disappeared from its previous habitats due to saltwater intrusion. As a result, it is now listed as an Endangered species under the Endangered Species Act. Research at the CAC has equipped biologists with key insights into the conditions required for the snails' survival and reproduction.

These successes highlight the significance of the CAC's role in NCWRC's goal of conserving our native rare aquatic species in several ways. First, the hatchery's research efforts have been crucial in understanding the biological and ecological needs of these organisms. Without this knowledge, management practices would not be as informed and likely much less effective. Furthermore, the importance of propagated animals in population restoration efforts has become evident through these projects, as these stocked populations have prevented extirpation and even extinction for several species. Finally, the CAC hatchery acts as a sanctuary for rare animals in distress by providing an ark and preventing extinction while biologists work to identify and restore suitable habitats. The CAC is an invaluable tool for managing aquatic SGCN and will continue to expand on these efforts as the program develops.

Success Story 3

How Conservation Actions Help Protect Species: Wood Stork

According to a USFWS Species Status Assessment (2021), the Wood Stork is the only true stork species that breeds north of Mexico, with breeding populations found in the Southeastern US, Cuba, and Hispaniola, and from Mexico southward through Central and South America. Wood Storks are a wetland-dependent species. They use a wide variety of freshwater and estuarine wetlands for nesting, feeding, and roosting throughout their range. Wood Storks were listed for federal protection as an endangered species in 1984 because of steep population declines and loss of habitat. They are a colonial nesting species, and the loss of suitable wetland foraging habitats and associated colony nesting failures were cited as a primary reason for the declines. (USFWS 2021).

Annual aerial surveys are an important technique for detecting colonial waterbird nesting populations because their nests are located in the tops of mature bald cypress, black gum, and mangroves (USFWS 2021). Since North Carolina's first state wildlife action plan (SWAP) was published in 2005, Wood Storks have been a priority Species of Greatest Conservation Need (SGCN) in North Carolina. Research, survey, and monitoring priorities called for status and distribution surveys to include Wood Storks and NCWRC biologists conduct surveys of colonial nesting waterbirds as part of the agency's annual monitoring efforts.

Wood Storks were first detected in North Carolina in 2005 during an aerial survey by NCWRC biologists for Bald Eagle nests. Since then, NCWRC has been providing annual updates on Wood Stork population trends and colony activities in the state to the national Wood Stork Recovery Working Group. Since 2005, biologists have found additional colonies and monitored the number of active nests.

Wood Storks (Bryant Olsen, Creative Commons)

The number of active colonies differs from year to year. The highest number of colonies found in any one year has been five out of a total seven where they have been observed to nest. The number of Wood Stork nests detected using aerial and ground surveys grew from 32 in 2005 to a peak of 698 nests in 2021. The 2024 survey count was the second-highest recorded: an estimated 639 nests.

NCWRC works closely with private landowners where the colonies are located. Audubon North Carolina, the Coastal Land Trust, North Carolina State Parks, and The Conservation Fund collaborated with NCWRC to permanently conserve over 1,000 acres of Wood Stork breeding habitat with funding provided by the North Carolina Environmental Enhancement Grants Program, NC Land and Water Fund, and generous private support from Fred and Alice Stanback (Audubon NC 2024).

When the USFWS defined Wood Stork recovery criteria, the focus was on breeding success in the southern breeding areas because of its historical importance as the center and core of the breeding population. Since then, the Wood Stork population has continued to grow, expanding its breeding range to include new regions and using new habitat types. They are using human-made wetlands for colony sites and foraging throughout the breeding range, including sites close to developed areas and human activities.

In 2014, the USFWS announced plans for down-listing the Wood Stork from endangered to threatened under the ESA because conservation and recovery efforts over the past three decades were highly successful. The expansion of the Wood Stork's breeding range, novel exploitation of other wetland habitat types to support breeding, and a dispersed population breeding in multiple regions and states, indicate the species is now less reliant upon any one wetland ecosystem for viability.

With the expansion of successful breeding colonies into North Carolina, the overall breeding range extent and population size of Wood Storks has increased significantly since it was first listed for ESA protection. The USFWS reports that "the number of Wood Stork nesting colonies has more than tripled with the most recent survey in 2021 documenting 99 nesting colonies spread from Florida northward into North Carolina" (Bodine 2023).

In early 2023, the USFWS published their intent to remove the Southeast US distinct population segment (DPS) of the Wood Stork from the ESA list (see Federal Register Vol.88, No.31, 2023). This determination was based on evidence that this Wood Stork DPS has recovered and the threats to it are being adequately managed. "The Wood Stork is recovering as the result of protecting its habitat at a large scale," said Assistant Secretary for Fish and Wildlife and Parks Shannon Estenoz**.** " This iconic species has rebounded in part because dedicated partners in the Southeast have worked tirelessly to restore ecosystems that support it" (USFWS 2023).

Success Story 4

How Conservation Actions Help Protect Species: Programmatic Safe Harbor and Candidate Conservation Agreement with Assurances for 21 Aquatic Species

North Carolina is home to over 150 aquatic Species of Greatest Conservation Need (SGCN). As the name implies, these species are prioritized for conservation based on expert review of each species' biological vulnerability, at-risk status, and listing for protection. Because of the imperilment of these species, many of them hold both federal and state protection status. Staff with NCWRC use a variety of management tools to help conserve and restore priority species. One method is to use species reintroductions.

Reintroduction of an aquatic species requires restoring the species to an area where it historically occurred but is no longer found. NCWRC staff often partner with property owners to gain access to the waters on or adjacent to their property while working to reintroduce species.

Propagated Roanoke Logperch release (TR Russ NCWRC)

In November 2022, NCWRC and the USFWS entered into a Programmatic Safe Harbor Agreement (SHA) and a Candidate Conservation Agreement with Assurances (CCAA) for 21 aquatic species in North Carolina. The landmark 50-year agreement allows NCWRC to reintroduce species listed and species proposed for listing under the Endangered Species Act back into targeted historical locations while working with private and non-federal property owners.

The SHA is a voluntary agreement involving private or other non-federal property owners whose actions contribute to the recovery of species listed as endangered or threatened under the ESA. The agreement is between cooperating non-federal property owners and the USFWS.

The CCAA is a formal, voluntary agreement between the Service and one or more parties to address the conservation needs of species that are candidates for ESA protection or species that are candidates for future listing. A CCAA provides participating property owners with a permit containing assurances that if they engage in certain conservation actions for species included in the agreement, they will not be required to implement additional conservation measures beyond those in the CCAA. Participants voluntarily commit to implement specific actions designed to remove or reduce threats to the covered species. The degree of detail in

CCAAs can vary widely, and if the species is subsequently listed for ESA protection, additional land, water, or resource use limitations will not be imposed on the landowner.

In exchange for actions that contribute to the recovery of listed species on nonfederal lands, participating property owners receive formal assurances from USFWS that if they fulfill the conditions of the SHA and/or CCAA, the Service will not require any additional or different management activities by the participants without their consent.

Central to this approach is that the actions taken under these agreements will provide a net conservation benefit that contributes to the recovery of the species included in the agreement. The contribution toward recovery will vary from case to case, and the agreements do not have to provide permanent conservation for the enrolled property. The benefit to the species depends on the nature of the activities to be undertaken, where they are undertaken, and their duration. Associated documents will include a description of the expected net conservation benefit(s) and how the Service reached that conclusion.

Property owners can partner with NCWRC if their property is located within a targeted area and if waters on or adjacent to the property have habitat that will support the species being reintroduced. Participating landowners can enroll their property through a Property Owner Management Agreement (POMA) in which they agree to allow NCWRC and USFWS staff access to conduct stocking and monitoring activities, to not harm the species except incidental to otherwise lawful activities, and to provide notice 60 days in advance of altering the habitat. Property owners will not be required to fulfill any additional or different management activities without consent. Landowners can agree to additional land management activities on their property that would benefit the species. Once the POMA is signed, the property is enrolled into the Programmatic SHA/CCAA through a signed Certificate of Inclusion (COI) that extends the assurance to the property owner.

Roanoke Logperch release (TR Russ, NCWRC)

North Carolina joins Kansas as the only two states enrolled in a Programmatic SHA and CCAA for aquatic species. Because many aquatic species listed under the Endangered Species Act occur in waters on or adjacent to property owned by private individuals and non-federal partners, involving landowners in the species conservation and recovery is critical.

Since the Fall of 2023, in partnerships with Conservation Fisheries, Inc, Piedmont Land Conservancy (https://www.piedmontland.org/) and Mayo River State Park (https://www.ncparks.gov/state-parks/mayo-river-state-park), the NCWRC has released 394 Roanoke Logperch into the upper Mayo River via the Safe Harbor Agreement (https://www.ncwildlife.org/wildlife-habitat/conservation-restoration-programs/restoring-aquatic-species-north-carolina). In 2025, and annually through 2030, more Roanoke Logperch stockings are planned for the Mayo River, furthering the recovery of this rare fish.

The aquatic species included in this SHA and CCAA agreement are listed below. Priorities for additional conservation actions that will benefit aquatic species over the next 10-year planning cycle are outlined in Chapter 3 North Carolina's Species.

Common Name	Scientific Name	Federal Status	State Status
AMPHIBIANS			
Neuse River Waterdog	*Necturus lewisi*	T	T
AQUATIC SNAILS			
Magnificent Ramshorn	*Planorbella magnifica*	E	E
FRESHWATER FISHES			
Cape Fear Shiner	*Notropis mekistocholas*	E	E
Carolina Madtom	*Noturus furiosus*	E	E
Lake Sturgeon	*Acipenser fulvescens*	-	SC
Orangefin Madtom	*Noturus gilberti*	At-Risk	E
Roanoke Logperch	*Percina rex*	E	E
Robust Redhorse	*Moxostoma robustum*	At-Risk	E
Spotfin Chub	*Cyprinella monacha*	T	T
FRESHWATER MUSSELS			
Appalachian Elktoe	*Alasmidonta raveneliana*	E	E
Atlantic Pigtoe	*Fusconaia masoni*	T	T
Carolina Heelsplitter	*Lasmigona decorata*	E	E
Cumberland Moccasinshell	*Medionidus conradicus*	At-Risk	-
Dwarf Wedgemussel	*Alasmidonta heterodon*	E	E
Green Floater	*Lasmigona subviridis*	PT	E
James Spinymussel	*Parvaspina collina*	E	E
Longsolid	*Fusconaia subrotunda*	T	T
Tar River Spinymussel	*Parvaspina steinstansana*	E	E
Tennessee Clubshell	*Pleurobema oviforme*	PE	E
Yellow Lance	*Elliptio lanceolata*	T	T

Federal Listing Status Abbreviations		State Listing Status Abbreviations	
E – Endangered	PE – Proposed Endangered	E – Endangered	SC – Special Concern
T – Threatened	PT – Proposed Threatened	T – Threatened	

Success Story 5

How Conservation Actions Help Protect Species: Magnificent Ramshorn

The Magnificent Ramshorn snail is a large air-breathing snail that lives in fresh water; they have lungs that allow them to extract oxygen from both air and water. They can grow up to 35 mm (1.4 in) wide and 20 mm (0.8 in) tall and have tan to brown shells with leopard-like spots. Their shells are relatively thin, and the fleshy bodies found beneath the shells are usually maroon in color. This snail is an imperiled species (federally listed as Endangered) found nowhere else in the world (e.g., endemic) outside of the lower Cape fear River Basin in North Carolina. Much of their native habitat has been degraded by human development, including contaminants carried by stormwater and other pollutants.

Magnificent Ramshorn (NCWRC)

In 1996 Hurricane Fran blasted North Carolina's coast and the subsequent salt-water intrusion and flood waters put the snail at risk of extinction. At that time, there were two distinct wild populations known from Orton Pond and Big Pond in Brunswick County. Andy Wood, formerly a member of the NCWRC's Non-game Wildlife Advisory Committee (NWAC), was holding some individuals in captivity at his home and braved the storm to rescue as many snails as possible from the hurricane. He was able to save 25 snails and bring them inside until the storm passed. Over the next couple of years, Wood's conservation efforts included setting up several 300-gallon tank ecosystems that functioned as a preserve for the snails and contributed to an increase in the captive population.

Unfortunately, the small remaining wild population continued to decline, mostly due to continued loss of their limited habitat and degradation of water quality. Until recently, Magnificent Ramshorn was extirpated from the wild, with the last wild individual being observed in 2004.

Captive populations now exist at the Conservation Aquaculture Center at NCWRC's Marion Fish Hatchery and at the NCSU Yates Mill Aquatic Conservation Center. Commission biologists were able to study their feeding and reproductive requirements. Magnificent Ramshorn snails are hermaphroditic (individuals have both male and female sex organs) and they reproduce year-

round when in captivity with consistent temperatures. In outdoor environments, they will spawn from April to October, producing egg clutches of 20-30 eggs. The eggs hatch in 14-25 days, depending on temperature. They are mature at 4 to 6 months of age and have a lifespan of 2-3 years. Biologists used this new knowledge to successfully propagate and increase the number of captive snails.

The NCWRC, in partnership with the US Fish and Wildlife Service (USFWS) and other cooperators, successfully reintroduced the species to a freshwater pond in the wild in the fall of 2024. Those animals immediately laid eggs and the first wild hatchlings in 20 years were seen crawling free. Additional stocking efforts will boost this newly established location, paired with monitoring to determine when the population can sustain itself. In addition, WRC is continuing to survey additional locations in the lower Cape Fear River basin looking for possible locations for secondary reintroductions, to establish additional wild populations and secure the species' future.

A new study is underway at the recently established Yates Mill Aquatic Conservation Center in Raleigh to study the development of Magnificent Ramshorn snail eggs and embryos. Trials were run at room temperature as well as experimental cold treatments at (a) a constant 4°C (39°F) and (b) fluctuating outdoor winter temperatures for 2, 4, 8 and 10 weeks' exposure. Photos of each egg clutch as well as individual eggs were photographed weekly for the duration of the project and measurements will be taken of embryo growth rates, hatch rates, and juvenile survival.

Priorities for additional conservation actions that will benefit Magnificent Ramshorn over the next 10-year planning cycle are outlined in Chapter 3 North Carolina's Species.

Appendix 3

3

3-1 Amphibian SGCN
3-2 Bird SGCN
3-3 Crayfish SGCN
3-4 Freshwater Fish SGCN
3-5 Freshwater Mussel SGCN
3-6 Mammal SGCN
3-7 Reptile SGCN
3-8 Aquatic Snail SGCN
3-9 Land Snail SGCN
3-10 Insect SGCN
3-11 Plant SGCN
3-12 Eastern Band of Cherokee Indians, SGCN and Culturally Important Species
3-13 Federal and State listing status abbreviations and definitions
3-14 Invasive and nonnative species common and scientific names and native plant species common and scientific names
3-15 Selected Federal and North Carolina laws that protect wildlife
3-16 Selected Federal and North Carolina laws that protect plants
3-17 SGCN Terrestrial Habitat Associations (abbreviated)*
3-18 SGCN Aquatic Habitat Associations (abbreviated)*
3-19 Population targets included in recovery, conservation, and management plans
3-20 Pelagic Seabird SGCN
3-21 Marine SGCN
3-22 Plant SGCN Habitat Associations (abbreviated)*

Reference 3-1 White Paper, Ranking Critieria for Prioritizing Wildlife (Taxa Team Evaluation Methodology)
Reference 3-2 White Paper, Protected Plant Species Evaluation Methodology
Reference 3-3 Eastern Band of Cherokee Indians Wildlife Action Plan

*Download an Excel file with the complete data from
https://www.ncwildlife.gov/wildlife-habitat/wildlife-action-plan

Table 3-1
AMPHIBIANS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibiulity for State Listed Species	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Indigenous Tribes SGCN and Culturally Important Priority Species	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
		X	Northern Cricket Frog	*Acris crepitans*	Anura	Hylidae							
			Southern Cricket Frog	*Acris gryllus*	Anura	Hylidae							
X, N	X	X	Mabee's Salamander	*Ambystoma mabeei*	Caudata	Ambystomatidae			N	H			T
	X	X	Spotted Salamander	*Ambystoma maculatum*	Caudata	Ambystomatidae					X		
	X	X	Marbled Salamander	*Ambystoma opacum*	Caudata	Ambystomatidae					X		
X, N	X	X	Mole Salamander	*Ambystoma talpoideum*	Caudata	Ambystomatidae			N		X		SC
X, N		X	Eastern tiger salamander	*Ambystoma tigrinum tigrinum*	Caudata	Ambystomatidae			N		X		T
	X	X	Two-toed Amphiuma	*Amphiuma means*	Caudata	Amphiumidae							
X, N		X	Green Salamander	*Aneides aeneus*	Caudata	Plethodontidae			N	H			E
X		X	Hickory Nut Gorge Green Salamander	*Aneides caryaensis*	Caudata	Plethodontidae	Y					At-Risk	
		X	Eastern American Toad	*Bufo americanus americanus*	Anura	Bufonidae							
		X	Fowler's Toad	*Bufo fowleri*	Anura	Bufonidae							
X		X	Oak Toad	*Bufo quercicus*	Anura	Bufonidae				M			
		X	Southern Toad	*Bufo terrestris*	Anura	Bufonidae							
X		X	Eastern Hellbender	*Cryptobranchus alleganiensis allaganiens*	Caudata	Cryptobranchidae				VH		PE	
			Great Smokies Mountain Dusky Salaman	*Desmognathus adatsihi*	Caudata	Plethodontidae	Y				X		
X	X		Seepage Salamander	*Desmognathus aeneus*	Caudata	Plethodontidae				M	X		
			Nantahala Black-bellied Salamander	*Desmognathus amphileucas*	Caudata	Plethodontidae	Y				X		
			Nantahala Black-bellied Salamander	*Desmognathus aureatus*	Caudata	Plethodontidae	Y				X		
X	X		Southern Dusky Salamander	*Desmognathus auriculatus*	Caudata	Plethodontidae				H			
			Great Balsams Mountain Dusky Salaman	*Desmognathis balsameus*	Caudata	Plethodontidae	Y				X		
			Camp's Dusky Salamander	*Desmognathus campi*	Caudata	Plethodontidae	Y				X		
		X	Carolina Mountain Dusky Salamander	*Desmognathus carolinensis*	Caudata	Plethodontidae					X		
X	X	X	Spotted Dusky Salamander	*Desmognathus conanti*	Caudata	Plethodontidae					X		
X, N	X		Dwarf Black-bellied Salamander	*Desmognathus folkertsi*	Caudata	Plethodontidae			N	M			SC
			Northern Dusky Salamander	*Desmognathus fuscus*	Caudata	Plethodontidae							
			Cherokee Black-bellied Salamander	*Desmognathus gvnigeusgwotli*	Caudata	Plethodontidae	Y				X		
X		X	Imitator Salamander	*Desmognathus imitator*	Caudata	Plethodontidae				H	X		
X	X	X	Imitator Salamander - Waterrock Knob p	*Desmognathus imitator pop.1*	Caudata	Plethodontidae				H			
	X	X	Shovel-nosed Salamander	*Desmognathus marmoratus*	Caudata	Plethodontidae				H	X		
		X	Appalachian Seal Salamander	*Desmognathus monticola*	Caudata	Plethodontidae							
			Alleghany Mountain Dusky Salamander	*Desmognathus ochrophaeus*	Caudata	Plethodontidae					X		
		X	Ocoee Salamander	*Desmognathus ocoee*	Caudata	Plethodontidae							
		X	Blue Ridge Dusky Salamander	*Desmognathus orestes*	Caudata	Plethodontidae				M			
X	X	X	Northern Pygmy Salamander	*Desmognathus organi*	Caudata	Plethodontidae				H	X		
			Tallulah Salamander	*Desmognathus perlapsus*	Caudata	Plethodontidae	Y				X		
			Virginia Dusky Salamander, Flat-headed S	*Desmognathus planiceps*	Caudata	Plethodontidae	Y				X		
		X	Black-bellied Salamander	*Desmognathus quadramaculatus*	Caudata	Plethodontidae							
X	X	X	Santeetlah Dusky Salamander	*Desmognathus santeetlah*	Caudata	Plethodontidae				H	X		
X	X	X	Southern Pygmy Salamander	*Desmognathus wrighti*	Caudata	Plethodontidae				H	X		
	X	X	Northern Two-lined Salamander	*Eurycea bislineata*	Caudata	Plethodontidae							
X	X		Chamberlain's Dwarf Salamander	*Eurycea chamberlaini*	Caudata	Plethodontidae				M	X	At-Risk	
		X	Southern Two-lined Salamander	*Eurycea cirrigera*	Caudata	Plethodontidae							
			Three-lined Salamander	*Eurycea guttolineata*	Caudata	Plethodontidae							
X, N	X		Junaluska Salamander	*Eurycea junaluska*	Caudata	Plethodontidae			N	H	X		T
X, N			Eastern Long-tailed Salamander	*Eurycea longicauda longicauda*	Caudata	Plethodontidae			N		X		T
			Cave Salamander	*Eurycea lucifuga*	Caudata	Plethodontidae					X		
X, N	X	X	Dwarf Salamander	*Eurycea quadridigitata*	Caudata	Plethodontidae			N				SC
X			Sandhills Salamander	*Eurycea sp. 9*	Caudata	Plethodontidae							
		X	Blue Ridge Two-lined Salamander	*Eurycea wilderae*	Caudata	Plethodontidae				M			
			Eastern Narrow-mouthed Toad	*Gastrophryne carolinensis*	Anura	Microhylidae							
			Spring Salamander	*Gyrinophilus porphyriticus*	Caudata	Plethodontidae							
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*	Caudata	Plethodontidae			N		X		SC
X, N	X	X	Pine Barrens Treefrog	*Hyla andersonii*	Anura	Hylidae			N	VH			T
	X	X	Cope's Gray Treefrog	*Hyla chrysoscelis*	Anura	Hylidae							
		X	Green Treefrog	*Hyla cinerea*	Anura	Hylidae							
			Pine Woods Treefrog	*Hyla femoralis*	Anura	Hylidae							
X	X	X	Barking Treefrog	*Hyla gratiosa*	Anura	Hylidae				M			
		X	Squirrel Treefrog	*Hyla squirella*	Anura	Hylidae							
X, N	X	X	Northern Gray Treefrog	*Hyla versicolor*	Anura	Hylidae			N				SC
X	X	X	Neuse River Waterdog	*Necturus lewisi*	Caudata	Proteidae				VH		T	
X, N	X	X	Common Mudpuppy	*Necturus maculosus maculosus*	Caudata	Proteidae			N		X		SC
	X		Dwarf Waterdog	*Necturus punctatus*	Caudata	Proteidae				M			

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AMPHIBIANS

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2025	2025	2025											
		X	Eastern Newt	*Notophthalmus viridescens*	Caudata	Salamandridae							
X	X	X	Blue Ridge Gray-cheeked Salamander	*Plethodon amplus*	Caudata	Plethodontidae				H	X		
X	X		Tellico Salamander	*Plethodon aureolus*	Caudata	Plethodontidae				H	X		
X	X	X	Chattahoochee Slimy Salamander	*Plethodon chattahoochee*	Caudata	Plethodontidae				M	X		
X	X		Cheoah Bald Salamander	*Plethodon cheoah*	Caudata	Plethodontidae				M	X		
	X	X	Atlantic Coast Slimy Salamander	*Plethodon chlorobryonis*	Caudata	Plethodontidae							
	X	X	Eastern Red-backed Salamander	*Plethodon cinereus*	Caudata	Plethodontidae					X		
	X	X	White-spotted Slimy Salamander	*Plethodon cylindraceus*	Caudata	Plethodontidae							
X	X	X	Northern Slimy Salamander	*Plethodon glutinosus*	Caudata	Plethodontidae							
X	X		Jordan's Salamander	*Plethodon jordani*	Caudata	Plethodontidae				M	X		
X, N	X	X	Crevice Salamander	*Plethodon longicrus*	Caudata	Plethodontidae			N				SC
X	X		South Mountain Gray-cheeked Salamand	*Plethodon meridianus*	Caudata	Plethodontidae				M	X		
			Southern Gray-cheeked Salamander	*Plethodon metcalfi*	Caudata	Plethodontidae					X		
			Northern Gray-cheeked Salamander	*Plethodon montanus*	Caudata	Plethodontidae							
X	X		Southern Ravine Salamander	*Plethodon richmondi*	Caudata	Plethodontidae				M	X		
X	X		Southern Red-backed Salamander	*Plethodon serratus*	Caudata	Plethodontidae				H			
X			Red-legged Salamander	*Plethodon shermani*	Caudata	Plethodontidae				H	X		
X	X		Southern Appalachian Salamander	*Plethodon teyahalee*	Caudata	Plethodontidae				M			
X, N	X	X	Southern Zigzag Salamander	*Plethodon ventralis*	Caudata	Plethodontidae			N	M	X		SC
X, N	X	X	Wehrle's Salamander	*Plethodon wehrlei*	Caudata	Plethodontidae			N	H	X		T
X, N	X	X	Weller's Salamander	*Plethodon welleri*	Caudata	Plethodontidae			N	H			SC
X	X		Yonahlossee Salamander	*Plethodon yonahlossee*	Caudata	Plethodontidae				M	X		
	X	X	Brimley's Chorus Frog	*Pseudacris brimleyi*	Anura	Hylidae							
X, N	X	X	Collinses' Mountain Chorus Frog	*Pseudacris collinsorum*	Anura	Hylidae			N				SC
		X	Northern Spring Peeper	*Pseudacris crucifer*	Anura	Hylidae							
		X	Upland Chorus Frog	*Pseudacris feriarum*	Anura	Hylidae							
X	X	X	Southern Chorus Frog	*Pseudacris nigrita*	Anura	Hylidae							
			Little Grass Frog	*Pseudacris ocularis*	Anura	Hylidae				M			
X, N	X		Ornate Chorus Frog	*Pseudacris ornata*	Anura	Hylidae			N	H			E
	X	X	Eastern Mud Salamander	*Pseudotriton montanus montanus*	Caudata	Plethodontidae				M	X		
	X	X	Red Salamander	*Pseudotriton ruber*	Caudata	Plethodontidae							
X		X	Gopher Frog	*Rana capito*	Anura	Ranidae				VH		At-Risk	
		X	American Bullfrog	*Rana catesbeianus*	Anura	Ranidae		Y					
		X	Green Frog	*Rana clamitans*	Anura	Ranidae							
X, N	X		River Frog	*Rana heckscheri*	Anura	Ranidae			N	H			E
X	X		Atlantic Coast Leopard Frog	*Rana Kauffeldi*	Anura	Ranidae							
			Pickerel Frog	*Rana palustris*	Anura	Ranidae							
		X	Southern Leopard Frog	*Rana sphenocephalus utricularius*	Anura	Ranidae							
		X	Wood Frog	*Rana sylvaticus*	Anura	Ranidae							
X	X	X	Wood Frog - Coastal Plain Pop.	*Rana sylvaticus pop.3*	Anura	Ranidae	Y*						
	X		Carpenter Frog	*Rana virgatipes*	Anura	Ranidae							
	X		Eastern Spadefoot	*Scaphiopus holbrookii*	Anura	Scaphiopodidae							
X	X		Eastern Lesser Siren	*Siren intermedia intermedia*	Caudata	Sirenidae							
X	X	X	Greater Siren	*Siren lacertina*	Caudata	Sirenidae				M			
X	X	X	Many-lined Salamander	*Stereochilus marginatus*	Caudata	Plethodontidae				M			
Species Counts											Species Counts		
53	58	65	108				10	1	19	42	41	5	19

Table 3-2
BIRDS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
X,N			Acadian Flycatcher	*Empidonax virescens*	Passeriformes	Tyrannidae	Breeding			Y			
			Alder Flycatcher	*Empidonax alnorum*	Passeriformes	Tyrannidae	Breeding						
X			American Avocet	*Recurvirostra americana*	Charadriiformes	Recurvirostridae	Non-Breeding						
X	X		American Bittern	*Botaurus lentiginosus*	Ciconiiformes	Ardeidae	Both						
X		X	American Black Duck	*Anas rubripes*	Anseriformes	Anatidae	Both						
		X	American Coot	*Fulica americana*	Gruiformes	Rallidae	Both						
			American Crow	*Corvus brachyrhynchos*	Passeriformes	Corvidae	Both						
			American Goldfinch	*Spinus tristis*	Passeriformes	Fringillidae	Both						
			American Kestrel	*Falco sparverius*	Falconiformes	Falconidae	Both						
X		X	American Oystercatcher	*Haematopus palliatus*	Charadriiformes	Haematopodidae	Both				H		SC
	X		American Pipit	*Anthus rubescens*	Passeriformes	Motacillidae	Non-Breeding						
			American Redstart	*Setophaga ruticilla*	Passeriformes	Parulidae	Breeding						
			American Robin	*Turdus migratorius*	Passeriformes	Turdidae	Both						
		X	American Wigeon	*Anas americana*	Anseriformes	Anatidae	Non-Breeding						
		X	American Woodcock	*Scolopax minor*	Charadriiformes	Scolopacidae	Both				M		
			Anhinga	*Anhinga anhinga*	Pelecaniformes	Anhingidae	Breeding						
X		X	Bachman's Sparrow	*Peucaea aestivalis*	Passeriformes	Emberizidae	Both				VH		SC
X		X	Bald Eagle	*Haliaeetus leucocephalus*	Falconiformes	Accipitridae	Both					BGPA	T
			Baltimore Oriole	*Icterus galbula*	Passeriformes	Icteridae	Both						
X	X		Bank Swallow	*Riparia riparia*	Passeriformes	Hirundinidae	Breeding						
X	X		Barn Owl	*Tyto alba*	Strigiformes	Tytonidae	Both						SC
			Barn Swallow	*Hirundo rustica*	Passeriformes	Hirundinidae	Breeding						
			Barred Owl	*Strix varia*	Strigiformes	Strigidae	Both						
	X		Bay-breasted Warbler	*Setophaga castanea*	Passeriformes	Parulidae	Non-Breeding						
			Belted Kingfisher	*Ceryle alcyon*	Coraciiformes	Alcedinidae	Both						
X	X		Black Rail, Eastern Black Rail	*Laterallus jamaicensis*	Gruiformes	Rallidae	Both				VH	T	T
		X	Black Scoter	*Melanitta americana*	Anseriformes	Anatidae	Non-Breeding						
X		X	Black Skimmer	*Rynchops niger*	Charadriiformes	Laridae	Both				H		SC
			Black Vulture	*Coragyps atratus*	Falconiformes	Cathartidae	Both						
			Black-and-white Warbler	*Mniotilta varia*	Passeriformes	Parulidae	Breeding						
X	X	X	Black-bellied Plover	*Pluvialis squatarola*	Charadriiformes	Charadriidae	Non-Breeding						
	X		Black-billed Cuckoo	*Coccyzus erythropthalmus*	Cuculiformes	Cuculidae	Breeding						
	X		Blackburnian Warbler	*Setophaga fusca*	Passeriformes	Parulidae	Breeding						
	X		Black-capped Chickadee	*Poecile atricapillus*	Passeriformes	Paridae	Both						SC
X	X		Black-crowned Night-Heron	*Nycticorax nycticorax*	Passeriformes	Ardeidae	Both						
X	X	X	Black-necked Stilt	*Himantopus mexicanus*	Ciconiiformes	Recurvirostridae	Breeding						
			Blackpoll Warbler	*Setophaga striata*	Passeriformes	Parulidae	Non-Breeding						
			Black-throated Blue Warbler	*Setophaga caerulescens*	Charadriiformes	Parulidae	Breeding						
			Black-throated Green Warbler	*Setophaga virens*	Passeriformes	Parulidae	Breeding						
			Blue Grosbeak	*Passerina caerulea*	Passeriformes	Cardinalidae	Breeding						
			Blue Jay	*Cyanocitta cristata*	Passeriformes	Corvidae	Both						
			Blue-gray Gnatcatcher	*Polioptila caerulea*	Passeriformes	Sylviidae	Both						
			Blue-headed Vireo	*Vireo solitarius*	Passeriformes	Vireonidae	Both						
		X	Blue-winged Teal	*Anas discors*	Anseriformes	Anatidae	Non-Breeding						
	X		Blue-winged Warbler	*Vermivora cyanoptera*	Passeriformes	Parulidae	Breeding						
			Boat-tailed Grackle	*Quiscalus major*	Passeriformes	Icteridae	Both						
X	X		Bobolink	*Dolichonyx oryzivorus*	Passeriformes	Icteridae	Breeding						
			Bonaparte's Gull	*Chroicocephalus philadelphia*	Charadriiformes	Laridae	Non-Breeding						
X		X	Brant	*Branta bernicla*	Anseriformes	Anatidae	Non-Breeding						
			Brewer's Blackbird	*Euphagus cyanocephalus*	Passeriformes	Icteridae	Non-Breeding						
			Broad-winged Hawk	*Buteo platypterus*	Falconiformes	Accipitridae	Breeding						
X			Brown Creeper	*Certhia americana*	Passeriformes	Certhiidae	Both						SC
		X	Brown Pelican	*Pelecanus occidentalis*	Pelecaniformes	Pelecanidae	Both						
			Brown Thrasher	*Toxostoma rufum*	Passeriformes	Mimidae	Both						
			Brown-headed Cowbird	*Molothrus ater*	Passeriformes	Icteridae	Both		Y				
X,N			Brown-headed Nuthatch	*Sitta pusilla*	Passeriformes	Sittidae	Both			Y	M		
			Bufflehead	*Bucephala albeola*	Anseriformes	Anatidae	Non-Breeding						
			Canada Goose	*Branta canadensis*	Anseriformes	Anatidae	Both						
	X		Canada Warbler	*Cardellina canadensis*	Passeriformes	Parulidae	Breeding						
X		X	Canvasback	*Aythya valisineria*	Anseriformes	Anatidae	Non-Breeding						

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BIRDS

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Taxa Team Evaluations

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2025	2025	2025											
	X		Cape May Warbler	*Setophaga tigrina*	Passeriformes	Parulidae	Non-Breeding						
			Carolina Chickadee	*Poecile carolinensis*	Passeriformes	Paridae	Both						
			Carolina Wren	*Thryothorus ludovicianus*	Passeriformes	Troglodytidae	Both						
X		X	Caspian Tern	*Hydroprogne caspia*	Charadriiformes	Laridae	Both						T
			Cattle Egret	*Bubulcus ibis*	Ciconiiformes	Ardeidae	Breeding		Y				
			Cedar Waxwing	*Bombycilla cedrorum*	Passeriformes	Bombycillidae	Both						
X			Cerulean Warbler	*Setophaga cerulea*	Passeriformes	Parulidae	Breeding				H		SC
	X	X	Chestnut-sided Warbler	*Setophaga pensylvanica*	Passeriformes	Parulidae	Breeding						
X,N			Chimney Swift	*Chaetura pelagica*	Apodiformes	Apodidae	Breeding			Y	M		
			Chipping Sparrow	*Spizella passerina*	Passeriformes	Emberizidae	Both						
X,N			Chuck-will's-widow	*Antrostomus carolinensis*	Caprimulgiformes	Caprimulgidae	Breeding			Y	M		
X	X		Clapper Rail	*Rallus longirostris*	Gruiformes	Rallidae	Both				M		
			Clay-colored Sparrow	*Spizella pallida*	Passeriformes	Emberizidae	Non-Breeding						
			Cliff Swallow	*Petrochelidon pyrrhonota*	Passeriformes	Hirundinidae	Breeding						
X	X		Common Gallinule	*Gallinula galeata*	Gruiformes	Rallidae	Both						
			Common Goldeneye	*Bucephala clangula*	Anseriformes	Anatidae	Non-Breeding						
			Common Grackle	*Quiscalus quiscula*	Passeriformes	Icteridae	Both						
	X	X	Common Loon	*Gavia immer*	Gaviiformes	Gaviidae	Non-Breeding						
	X		Common Merganser	*Mergus merganser*	Anseriformes	Anatidae	Non-Breeding						
	X		Common Nighthawk	*Chordeiles minor*	Caprimulgiformes	Caprimulgidae	Breeding						
	X		Common Raven	*Corvus corax*	Passeriformes	Corvidae	Both						
X		X	Common Tern	*Sterna hirundo*	Charadriiformes	Laridae	Breeding						E
			Common Yellowthroat	*Geothlypis trichas*	Passeriformes	Parulidae	Both						
			Connecticut Warbler	*Oporornis agilis*	Passeriformes	Parulidae	Non-Breeding						
			Cooper's Hawk	*Accipiter cooperii*	Falconiformes	Accipitridae	Both						
			Dark-eyed Junco	*Junco hyemalis*	Passeriformes	Emberizidae	Both						
X	X		Dickcissel	*Spiza americana*	Passeriformes	Cardinalidae	Breeding						
		X	Double-crested Cormorant	*Phalacrocorax auritus*	Pelecaniformes	Phalacrocoracidae	Both						
			Downy Woodpecker	*Picoides pubescens*	Piciformes	Picidae	Both						
			Dunlin	*Calidris alpina*	Charadriiformes	Scolopacidae	Non-Breeding						
			Eastern Bluebird	*Sialia sialis*	Passeriformes	Turdidae	Both						
			Eastern Kingbird	*Tyrannus tyrannus*	Passeriformes	Tyrannidae	Breeding						
			Eastern Meadowlark	*Sturnella magna*	Passeriformes	Icteridae	Both				H		
X			Eastern Painted Bunting	*Passerina ciris*	Passeriformes	Cardinalidae	Breeding				H		SC
			Eastern Phoebe	*Sayornis phoebe*	Passeriformes	Tyrannidae	Both						
			Eastern Screech-Owl	*Megascops asio*	Strigiformes	Strigidae	Both						
			Eastern Towhee	*Pipilo erythrophthalmus*	Passeriformes	Emberizidae	Both						
			Eastern Wood-Pewee	*Contopus virens*	Passeriformes	Tyrannidae	Breeding						
			European Starling	*Sturnus vulgaris*	Passeriformes	Sturnidae	Both		Y				
			Evening Grosbeak	*Coccothraustes vespertinus*	Passeriformes	Fringillidae	Non-Breeding						
			Field Sparrow	*Spizella pusilla*	Passeriformes	Emberizidae	Both						
			Fish Crow	*Corvus ossifragus*	Passeriformes	Corvidae	Both						
X	X	X	Forster's Tern	*Sterna forsteri*	Charadriiformes	Laridae	Both						
			Fox Sparrow	*Passerella iliaca*	Passeriformes	Emberizidae	Non-Breeding						
X		X	Gadwall	*Anas strepera*	Anseriformes	Anatidae	Both						
X		X	Glossy Ibis	*Plegadis falcinellus*	Ciconiiformes	Threskiornithidae	Both						SC
X	X		Golden Eagle, Eastern Golden Eagle	*Aquila chrysaetos*	Accipitriformes	Accipitridae	Non-Breeding					At-Risk	
	X		Golden-crowned Kinglet	*Regulus satrapa*	Passeriformes	Regulidae	Both						
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	Passeriformes	Parulidae	Breeding				H	At-Risk	SC
X			Grasshopper Sparrow	*Ammodramus savannarum*	Passeriformes	Emberizidae	Both				H		
			Gray Catbird	*Dumetella carolinensis*	Passeriformes	Mimidae	Both						
	X		Gray-cheeked Thrush	*Catharus minimus*	Passeriformes	Turdidae	Non-Breeding						
X		X	Great Black-backed Gull	*Larus marinus*	Charadriiformes	Laridae	Both						
			Great Blue Heron	*Ardea herodias*	Ciconiiformes	Ardeidae	Both						
			Great Crested Flycatcher	*Myiarchus crinitus*	Passeriformes	Tyrannidae	Breeding						
			Great Egret	*Ardea alba*	Ciconiiformes	Ardeidae	Both						
			Great Horned Owl	*Bubo virginianus*	Strigiformes	Strigidae	Both						
		X	Greater Scaup	*Aythya marila*	Anseriformes	Anatidae	Non-Breeding						
			Greater Yellowlegs	*Tringa melanoleuca*	Charadriiformes	Scolopacidae	Non-Breeding						
			Green Heron	*Butorides virescens*	Ciconiiformes	Ardeidae	Breeding						

Table 3-2
BIRDS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
		X	Green-winged Teal	*Anas crecca*	Anseriformes	Anatidae	Non-Breeding						
X		X	Gull-billed Tern	*Gelochelidon nilotica*	Charadriiformes	Laridae	Breeding				H		T
	X		Hairy woodpecker	*Picoides villosus*	Piciformes	Picidae	Both						
X			Henslow's Sparrow	*Ammodramus henslowii*	Passeriformes	Emberizidae	Breeding				H		E
	X		Hermit Thrush	*Catharus guttatus*	Passeriformes	Turdidae	Both						
		X	Herring Gull	*Larus argentatus*	Charadriiformes	Laridae	Both						
		X	Hooded Merganser	*Lophodytes cucullatus*	Anseriformes	Anatidae	Both						
			Hooded Warbler	*Setophaga citrina*	Passeriformes	Parulidae	Breeding						
	X		Horned Grebe	*Podiceps auritus*	Podicipediformes	Podicipedidae	Non-Breeding						
			Horned Lark	*Eremophila alpestris*	Passeriformes	Alaudidae	Both						
			House Wren	*Troglodytes aedon*	Passeriformes	Troglodytidae	Both						
			Indigo Bunting	*Passerina cyanea*	Passeriformes	Cardinalidae	Breeding						
X			Kentucky Warbler	*Geothlypis formosa*	Passeriformes	Parulidae	Breeding				M		
			Killdeer	*Charadrius vociferus*	Charadriiformes	Charadriidae	Both						
X	X	X	King Rail	*Rallus elegans*	Gruiformes	Rallidae	Both				H		
			Laughing Gull	*Leucophaeus atricilla*	Charadriiformes	Laridae	Both						
	X		Le Conte's Sparrow	*Ammodramus leconteii*	Passeriformes	Emberizidae	Non-Breeding				H		
X	X		Least Bittern	*Ixobrychus exilis*	Ciconiiformes	Ardeidae	Breeding				M		SC
	X		Least Flycatcher	*Empidonax minimus*	Passeriformes	Tyrannidae	Breeding						
			Least Sandpiper	*Calidris minutilla*	Charadriiformes	Scolopacidae	Non-Breeding						
X		X	Least Tern	*Sterna antillarum*	Charadriiformes	Laridae	Breeding				H		SC
		X	Lesser Scaup	*Aythya affinis*	Anseriformes	Anatidae	Non-Breeding						
			Lesser Yellowlegs	*Tringa flavipes*	Charadriiformes	Scolopacidae	Non-Breeding						
			Lincoln's Sparrow	*Melospiza lincolnii*	Passeriformes	Emberizidae	Non-Breeding						
X		X	Little Blue Heron	*Egretta caerulea*	Ciconiiformes	Ardeidae	Both				M		SC
X			Loggerhead Shrike	*Lanius ludovicianus*	Passeriformes	Laniidae	Both				H		SC
	X	X	Long-billed Dowitcher	*Limnodromus scolopaceus*	Charadriiformes	Scolopacidae	Non-Breeding						
X		X	Long-tailed Duck	*Clangula hyemalis*	Anseriformes	Anatidae	Non-Breeding						
			Louisiana Waterthrush	*Parkesia motacilla*	Passeriformes	Parulidae	Breeding				M		
	X		Magnolia Warbler	*Setophaga magnolia*	Passeriformes	Parulidae	Breeding						
X	X	X	Marbled Godwit	*Limosa fedoa*	Charadriiformes	Scolopacidae	Non-Breeding						
	X		Marsh Wren	*Cistothorus palustris*	Passeriformes	Troglodytidae	Both						
			Merlin	*Falco columbarius*	Falconiformes	Falconidae	Non-Breeding						
	X		Mississippi Kite	*Ictinia mississippiensis*	Falconiformes	Accipitridae	Breeding						
		X	Mourning Dove	*Zenaida macroura*	Columbiformes	Columbidae	Both						
			Nashville Warbler	*Oreothlypis ruficapilla*	Passeriformes	Parulidae	Non-Breeding						
X	X		Nelson's Sparrow	*Ammodramus nelsoni*	Passeriformes	Emberizidae	Non-Breeding				H		
X		X	Northern Bobwhite	*Colinus virginianus*	Galliformes	Odontophoridae	Both				H		
			Northern Cardinal	*Cardinalis cardinalis*	Passeriformes	Cardinalidae	Both						
			Northern Flicker	*Colaptes auratus*	Piciformes	Picidae	Both						
	X		Northern Gannet	*Morus bassanus*	Suliformes	Sulidae	Non-Breeding						
	X		Northern Harrier	*Circus cyaneus*	Falconiformes	Accipitridae	Both						
			Northern Mockingbird	*Mimus polyglottos*	Passeriformes	Mimidae	Both						
	X		Northern Parula	*Setophaga americana*	Passeriformes	Parulidae	Breeding						
		X	Northern Pintail	*Anas acuta*	Anseriformes	Anatidae	Non-Breeding						
			Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Passeriformes	Hirundinidae	Breeding						
X			Northern Saw-whet Owl	*Aegolius acadicus*	Strigiformes	Strigidae	Both						T
		X	Northern Shoveler	*Anas clypeata*	Anseriformes	Anatidae	Non-Breeding						
			Northern Waterthrush	*Parkesia noveboracensis*	Passeriformes	Parulidae	Non-Breeding						
	X		Olive-sided Flycatcher	*Contopus cooperi*	Passeriformes	Tyrannidae	Non-Breeding						
			Orange-crowned Warbler	*Oreothlypis celata*	Passeriformes	Parulidae	Non-Breeding						
			Orchard Oriole	*Icterus spurius*	Passeriformes	Icteridae	Breeding						
X			Osprey	*Pandion haliaetus*	Falconiformes	Accipitridae	Breeding						
			Ovenbird	*Seiurus aurocapillus*	Passeriformes	Parulidae	Breeding						
			Palm Warbler	*Setophaga palmarum*	Passeriformes	Parulidae	Non-Breeding						
			Pectoral Sandpiper	*Calidris melanotos*	Charadriiformes	Scolopacidae	Non-Breeding						
X		X	Peregrine Falcon, American Peregrine	*Falco peregrinus*	Falconiformes	Falconidae	Both						E
	X		Philadelphia Vireo	*Vireo philadelphicus*	Passeriformes	Vireonidae	Non-Breeding						
	X		Pied-billed Grebe	*Podilymbus podiceps*	Podicipediformes	Podicipedidae	Both						
			Pileated Woodpecker	*Dryocopus pileatus*	Piciformes	Picidae	Both						

Table 3-2
BIRDS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
	X		Pine Siskin	*Spinus pinus*	Passeriformes	Fringillidae	Both						
			Pine Warbler	*Setophaga pinus*	Passeriformes	Parulidae	Both						
X		X	Piping Plover (Atlantic Coast pop'n)	*Charadrius melodus*	Charadriiformes	Charadriidae	Both				H	T	T
X,N	X		Prairie Warbler	*Setophaga discolor*	Passeriformes	Parulidae	Breeding			Y	M		
X,N			Prothonotary Warbler	*Protonotaria citrea*	Passeriformes	Parulidae	Breeding			Y	M		
			Purple Finch	*Haemorhous purpureus*	Passeriformes	Fringillidae	Non-Breeding						
			Purple Martin	*Progne subis*	Passeriformes	Hirundinidae	Breeding						
X			Purple Sandpiper	*Calidris maritima*	Charadriiformes	Scolopacidae	Non-Breeding						
X	X		Red Crossbill	*Loxia curvirostra*	Passeriformes	Fringillidae	Both						SC
X		X	Red Knot	*Calidris canutus*	Charadriiformes	Scolopacidae	Non-Breeding				H	T	T
			Red-bellied Woodpecker	*Melanerpes carolinus*	Piciformes	Picidae	Both						
			Red-breasted Merganser	*Mergus serrator*	Anseriformes	Anatidae	Non-Breeding						
	X		Red-breasted Nuthatch	*Sitta canadensis*	Passeriformes	Sittidae	Both						
X		X	Red-cockaded Woodpecker	*Picoides borealis*	Piciformes	Picidae	Both				VH	T	T
			Reddish Egret	*Egretta rufescens*	Ciconiiformes	Ardeidae	Non-Breeding						
			Red-eyed Vireo	*Vireo olivaceus*	Passeriformes	Vireonidae	Breeding						
		X	Redhead	*Aythya americana*	Anseriformes	Anatidae	Non-Breeding						
	X		Red-headed Woodpecker	*Melanerpes erythrocephalus*	Piciformes	Picidae	Both						
			Red-necked Phalarope	*Phalaropus lobatus*	Charadriiformes	Scolopacidae	Non-Breeding						
			Red-shouldered Hawk	*Buteo lineatus*	Falconiformes	Accipitridae	Both						
			Red-tailed Hawk	*Buteo jamaicensis*	Falconiformes	Accipitridae	Both						
	X	X	Red-throated Loon	*Gavia stellata*	Gaviiformes	Gaviidae	Non-Breeding						
			Red-winged Blackbird	*Agelaius phoeniceus*	Passeriformes	Icteridae	Both						
			Ring-billed Gull	*Larus delawarensis*	Charadriiformes	Laridae	Non-Breeding						
		X	Ring-necked Duck	*Aythya collaris*	Anseriformes	Anatidae	Non-Breeding						
			Rock Pigeon	*Columba livia*	Columbiformes	Columbidae	Both		Y				
	X		Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Passeriformes	Cardinalidae	Breeding						
X		X	Royal Tern	*Thalasseus maximus*	Charadriiformes	Laridae	Both				M		
			Ruby-crowned Kinglet	*Regulus calendula*	Passeriformes	Regulidae	Non-Breeding						
		X	Ruby-throated Hummingbird	*Archilochus colubris*	Apodiformes	Trochilidae	Both						
		X	Ruddy Duck	*Oxyura jamaicensis*	Anseriformes	Anatidae	Non-Breeding						
		X	Ruddy Turnstone	*Arenaria interpres*	Charadriiformes	Scolopacidae	Non-Breeding						
X		X	Ruffed Grouse	*Bonasa umbellus*	Galliformes	Phasianidae	Both						
			Rufous Hummingbird	*Selasphorus rufus*	Apodiformes	Trochilidae	Non-Breeding						
	X		Rusty Blackbird	*Euphagus carolinus*	Passeriformes	Icteridae	Non-Breeding				H		T
X	X		Saltmarsh Sparrow	*Ammodramus caudacutus*	Passeriformes	Emberizidae	Non-Breeding				VH	At-Risk	
X			Sanderling	*Calidris alba*	Charadriiformes	Scolopacidae	Non-Breeding						
X		X	Sandwich Tern	*Thalasseus sandvicensis*	Charadriiformes	Laridae	Breeding				H		
X			Savannah Sparrow	*Passerculus sandwichensis*	Passeriformes	Emberizidae	Both						
			Scarlet Tanager	*Piranga olivacea*	Passeriformes	Cardinalidae	Breeding						
X	X		Seaside Sparrow	*Ammodramus maritimus*	Passeriformes	Emberizidae	Both				H		
	X		Sedge Wren	*Cistothorus platensis*	Passeriformes	Troglodytidae	Non-Breeding						
	X		Semipalmated Plover	*Charadrius semipalmatus*	Charadriiformes	Charadriidae	Non-Breeding						
			Semipalmated Sandpiper	*Calidris pusilla*	Charadriiformes	Scolopacidae	Non-Breeding						
X	X		Sharp-shinned Hawk	*Accipiter striatus*	Falconiformes	Accipitridae	Both						
	X	X	Short-billed Dowitcher	*Limnodromus griseus*	Charadriiformes	Scolopacidae	Non-Breeding						
	X		Short-eared Owl	*Asio flammeus*	Strigiformes	Strigidae	Non-Breeding						
		X	Snow Goose	*Chen caerulescens*	Anseriformes	Anatidae	Non-Breeding						
X		X	Snowy Egret	*Egretta thula*	Ciconiiformes	Ardeidae	Both				M		SC
			Solitary Sandpiper	*Tringa solitaria*	Charadriiformes	Scolopacidae	Non-Breeding						
			Song Sparrow	*Melospiza melodia*	Passeriformes	Emberizidae	Both						
	X		Sora	*Porzana carolina*	Gruiformes	Rallidae	Non-Breeding						
	X		Spotted Sandpiper	*Actitis macularia*	Charadriiformes	Scolopacidae	Non-Breeding						
			Stilt Sandpiper	*Calidris himantopus*	Charadriiformes	Scolopacidae	Non-Breeding						
			Summer Tanager	*Piranga rubra*	Passeriformes	Cardinalidae	Breeding						
X		X	Surf Scoter	*Melanitta perspicillata*	Anseriformes	Anatidae	Non-Breeding						
			Swainson's Thrush	*Catharus ustulatus*	Passeriformes	Turdidae	Breeding						
	X		Swainson's Warbler	*Limnothlypis swainsonii*	Passeriformes	Parulidae	Breeding				H		
X	X		Swallow-tailed Kite	*Elanoides forficatus*	Accipitriformes	Accipitridae	Breeding				VH		
			Swamp Sparrow	*Melospiza georgiana*	Passeriformes	Emberizidae	Non-Breeding						

Table 3-2
BIRDS

2025 WAP Revision
Taxa Team Evaluations

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SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
	X		Tennessee Warbler	*Oreothlypis peregrina*	Passeriformes	Parulidae	Non-Breeding						
	X		Tree Swallow	*Tachycineta bicolor*	Passeriformes	Hirundinidae	Both						
X		X	Tricolored Heron	*Egretta tricolor*	Ciconiiformes	Ardeidae	Both						SC
			Tufted Titmouse	*Baeolophus bicolor*	Passeriformes	Paridae	Both						
		X	Tundra Swan	*Cygnus columbianus*	Anseriformes	Anatidae	Non-Breeding						
			Turkey Vulture	*Cathartes aura*	Falconiformes	Cathartidae	Both						
			Upland Sandpiper	*Bartramia longicauda*	Charadriiformes	Scolopacidae	Non-Breeding						
			Veery	*Catharus fuscescens*	Passeriformes	Turdidae	Breeding						
X	X		Vesper Sparrow	*Pooecetes gramineus*	Passeriformes	Emberizidae	Both						SC
X	X		Virginia Rail	*Rallus limicola*	Gruiformes	Rallidae	Both						
		X	Warbling Vireo	*Vireo gilvus*	Passeriformes	Vireonidae	Breeding						
X	X		Wayne's Black-throated Green Warble	*Setophaga virens waynei*	Passeriformes	Parulidae	Breeding				H		E
			Western Sandpiper	*Calidris mauri*	Charadriiformes	Scolopacidae	Non-Breeding						
X		X	Whimbrel	*Numenius phaeopus*	Charadriiformes	Scolopacidae	Non-Breeding				H		
X			Whip-poor-will, Eastern Whip-poor-w	*Antrostomus vociferus*	Caprimulgiformes	Caprimulgidae	Breeding				H		
X		X	White Ibis	*Eudocimus albus*	Ciconiiformes	Threskiornithidae	Both						
			White-breasted Nuthatch	*Sitta carolinensis*	Passeriformes	Sittidae	Both						
			White-crowned Sparrow	*Zonotrichia leucophrys*	Passeriformes	Emberizidae	Non-Breeding						
			White-eyed Vireo	*Vireo griseus*	Passeriformes	Vireonidae	Both						
			White-rumped Sandpiper	*Calidris fuscicollis*	Charadriiformes	Scolopacidae	Non-Breeding						
			White-throated Sparrow	*Zonotrichia albicollis*	Passeriformes	Emberizidae	Non-Breeding						
X		X	White-winged Scoter	*Melanitta fusca*	Anseriformes	Anatidae	Non-Breeding						
		X	Wild Turkey	*Meleagris gallopavo*	Galliformes	Phasianidae	Both						
X		X	Willet	*Tringa semipalmata*	Charadriiformes	Scolopacidae	Both				H		
	X		Willow Flycatcher	*Empidonax traillii*	Passeriformes	Tyrannidae	Breeding						
X		X	Wilson's Plover	*Charadrius wilsonia*	Charadriiformes	Charadriidae	Breeding				H		SC
			Wilson's Snipe	*Gallinago delicata*	Charadriiformes	Scolopacidae	Non-Breeding						
			Winter Wren	*Troglodytes troglodytes*	Passeriformes	Troglodytidae	Both						
		X	Wood Duck	*Aix sponsa*	Anseriformes	Anatidae	Both						
X			Wood Stork	*Mycteria americana*	Ciconiiformes	Ciconiidae	Breeding				H	T	T
X			Wood Thrush	*Hylocichla mustelina*	Passeriformes	Turdidae	Breeding				M		
X,N	X	X	Worm-eating Warbler	*Helmitheros vermivorum pop.1*	Passeriformes	Parulidae	Breeding			Y	M		
X	X		Yellow Rail	*Coturnicops noveboracensis*	Gruiformes	Rallidae	Non-Breeding				H		
X			Yellow Warbler	*Setophaga petechia*	Passeriformes	Parulidae	Breeding						
			Yellow-bellied Sapsucker	*Sphyrapicus varius*	Piciformes	Picidae	Both						
			Yellow-billed Cuckoo	*Coccyzus americanus*	Cuculiformes	Cuculidae	Breeding				H		
			Yellow-breasted Chat	*Icteria virens*	Passeriformes	Parulidae	Breeding						
X	X		Yellow-crowned Night-Heron	*Nyctanassa violacea*	Ciconiiformes	Ardeidae	Breeding						
			Yellow-rumped Warbler	*Setophaga coronata*	Passeriformes	Parulidae	Both						
			Yellow-throated Vireo	*Vireo flavifrons*	Passeriformes	Vireonidae	Breeding						
X,N	X		Yellow-throated Warbler	*Setophaga dominica*	Passeriformes	Parulidae	Breeding			Y	H		

Table 3-3
CRAYFISH

2025 WAP Revision
Taxa Team Evaluations

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SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025										
X	X	X	Carolina Needlenose Crayfish	*Cambarus aldermanorum*	Decapoda	Cambaridae						
	X	X	Mitten Crayfish	*Cambarus asperimanus*	Decapoda	Cambaridae						
	X	X	Appalachian Brook Crayfish	*Cambarus bartonii*	Decapoda	Cambaridae						
X	X	X	Valley River Crayfish	*Cambarus brimleyorum*	Decapoda	Cambaridae	Y			M		
X	X	X	Red Burrowing Crayfish	*Cambarus carolinus*	Decapoda	Cambaridae						
X	X	X	Greensboro Burrowing Crayfish	*Cambarus catagius*	Decapoda	Cambaridae	Y			H		SC
X	X	X	Moravian Crayfish	*Cambarus cf. howardi sp. 1*	Decapoda	Cambaridae						
	X	X	Roaring River Crayfish	*Cambarus cf. robustus sp. 1*	Decapoda	Cambaridae						
	X	X	Carolina Ladle Crayfish	*Cambarus davidi*	Decapoda	Cambaridae						
	X	X	Upland Burrowing Crayfish	*Cambarus dubius*	Decapoda	Cambaridae						
	X	X	Cataloochee Crawdad	*Cambarus ectopistes*	Decapoda	Cambaridae						
X	X	X	Grandfather Mountain Crayfish	*Cambarus eeseeohensis*	Decapoda	Cambaridae	Y			H		
X	X	X	Little Tennessee River Crayfish	*Cambarus georgiae*	Decapoda	Cambaridae				H		SC
	X	X	Hiwassee Crayfish	*Cambarus hiwasseensis*	Decapoda	Cambaridae				M		
	X	X	Rocky River Crayfish	*Cambarus hobbsorum*	Decapoda	Cambaridae						
	X	X	Chattahoochee Crayfish	*Cambarus howardi*	Decapoda	Cambaridae				H		
X	X	X	Sandhills Spiny Crayfish	*Cambarus hystricosus*	Decapoda	Cambaridae	Y					
X	X	X	Carolina Foothills Crayfish	*Cambarus johni*	Decapoda	Cambaridae	Y					
	X	X	Longnose Crayfish	*Cambarus longirostris*	Decapoda	Cambaridae						
	X	X	Atlantic Slope Crayfish	*Cambarus longulus*	Decapoda	Cambaridae						
X	X	X	Knotty Burrowing Crayfish	*Cambarus nodosus*	Decapoda	Cambaridae						
X	X	X	Hiwassee Headwater Crayfish	*Cambarus parrishi*	Decapoda	Cambaridae				VH		SC
	X	X	Sickle Crayfish	*Cambarus reduncus*	Decapoda	Cambaridae						
	X	X	Big Water Crayfish	*Cambarus robustus*	Decapoda	Cambaridae						
X	X	X	An undescribed crayfish	*Cambarus* sp. A	Decapoda	Cambaridae						
	X	X	*Cambarus acuminatus* complex	*Cambarus* sp. C	Decapoda	Cambaridae						
X		X	Broad River Spiny Crayfish	*Cambarus spicatus*	Decapoda	Cambaridae				M	At-Risk	T
X	X	X	Tuckaseegee Stream Crayfish	*Cambarus tuckasegee*	Decapoda	Cambaridae	Y			VH		
	X	X	Digger Crayfish	*Fallicambarus fodiens*	Decapoda	Cambaridae						
	X	X	North Carolina Spiny Crayfish	*Faxonius carolinensis*	Decapoda	Cambaridae	Y					SC
	X	X	Spiny Stream Crayfish	*Faxonius cristavarius*	Decapoda	Cambaridae		Y				
	X	X	Reticulate Crayfish	*Faxonius erichsonianus*	Decapoda	Cambaridae						
	X	X	Surgeon Crayfish	*Faxonius forceps*	Decapoda	Cambaridae						
	X	X	Kentucky River Crayfish	*Faxonius juvenilis*	Decapoda	Cambaridae		Y				
	X	X	Rusty Crayfish	*Faxonius rusticus*	Decapoda	Cambaridae		Y				
	X	X	Virile Crayfish	*Faxonius virilis*	Decapoda	Cambaridae		Y				
X	X	X	Thornytail Crayfish	*Lacunicambarus acanthura*	Decapoda	Cambaridae						
	X	X	Devil Crawfish	*Lacunicambarus diogenes*	Decapoda	Cambaridae						
	X	X	White River Crawfish	*Procambarus acutus*	Decapoda	Cambaridae						
X	X	X	Coastal Plain Crayfish	*Procambarus ancylus*	Decapoda	Cambaridae						
X	X	X	Santee Crayfish	*Procambarus blandingii*	Decapoda	Cambaridae						
X	X	X	Cedar Creek Crayfish [= Waccamaw Crayf	*Procambarus chacei [= P. braswelli]*	Decapoda	Cambaridae				H		E
	X	X	Red Swamp Crawfish	*Procambarus clarkii*	Decapoda	Cambaridae		Y				
X	X	X	Pamlico Crayfish	*Procambarus medialis*	Decapoda	Cambaridae	Y			M		T
X	X	X	Carolina Sandhills Crayfish	*Procambarus pearsei*	Decapoda	Cambaridae				M		T
X	X	X	Croatan Crayfish	*Procambarus plumimanus*	Decapoda	Cambaridae	Y					

Table 3-4
FRESHWATER FISH

2025 WAP Revision
Taxa Team Evaluations

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SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
		X	Alabama Bass	*Micropterus henshalli*	Perciformes	Centrarchidae			Y				
		X	Alewife	*Alosa pseudoharengus*	Clupeiformes	Alosidae	Native						
X			American Brook Lamprey [M]	*Lethenteron appendix*	Petromyzontiformes	Petromyzontidae	Mountain pops.	Y*			H		SC
X			American Brook Lamprey [P]	*Lethenteron appendix*	Petromyzontiformes	Petromyzontidae	Piedmont pops.				H		SC
X		X	American Eel	*Anguilla rostrata*	Anguilliformes	Anguillidae					VH		
X		X	American Shad	*Alosa sapidissima*	Clupeiformes	Alosidae					VH		
X	X		Appalachia Darter	*Percina gymnocephala*	Perciformes	Percidae		Y			M		
			Atlantic Highfin Carpsucker	*Carpiodes sp.*	Cypriniformes	Catostomidae					M		SC
X		X	Atlantic Sturgeon	*Acipenser oxyrinchus*	Acipenseriformes	Acipenseridae					H	E	E
			Banded Darter	*Etheostoma zonale*	Perciformes	Percidae							
	X		Banded Killifish	*Fundulus diaphanus*	Cyprinodontiformes	Fundulidae							
X			Banded Pygmy Sunfish	*Elassoma zonatum*	Perciformes	Elassomatidae							
X	X		Banded Sculpin	*Cottus carolinae*	Scorpaeniformes	Cottidae							SC
X			Banded Sunfish	*Enneacanthus obesus*	Perciformes	Centrarchidae					M		
		X	Bartram's Bass	*Micropterus sp.*	Perciformes	Centrarchidae					VH		
	X		Bigeye Chub	*Hybopsis amblops*	Cypriniformes	Leuciscidae							
X			Bigeye Jumprock	*Moxostoma ariommum*	Cypriniformes	Catostomidae		Y*			M		T
	X		Bigmouth Buffalo	*Ictiobus cyprinellus*	Cypriniformes	Catostomidae							
	X		Bigmouth Chub	*Nocomis platyrhynchus*	Cypriniformes	Leuciscidae		Y					
X	X		Black Buffalo	*Ictiobus niger*	Cypriniformes	Catostomidae							
	X		Black Crappie	*Pomoxis nigromaculatus*	Perciformes	Centrarchidae							
			Black Redhorse	*Moxostoma duquesnei*	Cypriniformes	Catostomidae							
X			Blackbanded Sunfish	*Enneacanthus chaetodon*	Perciformes	Centrarchidae					H		
	X		Blacknose Dace	*Rhinichthys atratulus*	Cypriniformes	Leuciscidae							
			Blackstripe Pirate Perch	*Aphredoderus ornatus*	Atheriniformes	Aphredoderidae							
X	X		Blacktip Jumprock	*Moxostoma cervinum*	Cypriniformes	Catostomidae							
X	X		Blotched Chub	*Erimystax insignis*	Cypriniformes	Leuciscidae					M		T
X	X		Blotchside Logperch	*Percina burtoni*	Perciformes	Percidae					M		E
	X	X	Blue Catfish	*Ictalurus furcatus*	Siluriformes	Ictaluridae	Native, Introduced		Y				
X			Blue Ridge Sculpin	*Cottus caeruleomentum*	Scorpaeniformes	Cottidae							SC
X		X	Blueback Herring (native)	*Alosa aestivalis*	Clupeiformes	Alosidae	Native						
			Bluegill	*Lepomis macrochirus*	Perciformes	Centrarchidae							
			Bluehead Chub	*Nocomis leptocephalus*	Cypriniformes	Leuciscidae							
			Bluespotted Sunfish	*Enneacanthus gloriosus*	Perciformes	Centrarchidae							
	X		Bluntnose Minnow	*Pimephales notatus*	Cypriniformes	Leuciscidae							
		X	Bodie Bass	*Morone saxatilis x chrysops*	Perciformes	Moronidae			Y				
			Bowfin	*Amia calva*	Amiiformes	Amiidae							
X	X	X	Brassy Jumprock	*Moxostoma sp.*	Cypriniformes	Catostomidae					M		
X	X		Bridle Shiner	*Notropis bifrenatus*	Cypriniformes	Leuciscidae					H		E
X		X	Broadtail Madtom	*Noturus sp.*	Siluriformes	Ictaluridae	Cape Fear, Lake Waccamaw	Y*			VH		SC
	X		Brook Silverside	*Labidesthes sicculus*	Atheriniformes	Atherinopsidae							
X		X	Brook Trout (Native)	*Salvelinus fontinalis*	Salmoniformes	Salmonidae	Native				H		
X		X	Brown Bullhead	*Ameiurus nebulosus*	Siluriformes	Ictaluridae							
		X	Brown Trout (Naturalized)	*Salmo trutta*	Salmoniformes	Salmonidae	Naturalized		Y				
X	X		Bull Chub	*Nocomis raneyi*	Cypriniformes	Leuciscidae							
X		X	Cape Fear Shiner	*Miniellus mekistocholas*	Cypriniformes	Leuciscidae		Y*			H	E	E
X	X		Carolina Darter	*Etheostoma collis*	Perciformes	Percidae					H		SC
			Carolina Fantail Darter	*Etheostoma brevispinum*	Perciformes	Percidae					H		
X		X	Carolina Madtom	*Noturus furiosus*	Siluriformes	Ictaluridae					VH	E	E
X		X	Carolina Pygmy Sunfish	*Elassoma boehlkei*	Perciformes	Elassomatidae		Y*			VH		T
X	X		Carolina Quillback	*Carpiodes sp.*	Cypriniformes	Catostomidae					H		
X		X	Carolina Redhorse	*Moxostoma sp.*	Cypriniformes	Catostomidae					VH		T
			Central Stoneroller	*Campostoma anomalum*	Cypriniformes	Leuciscidae					M		
			Chain Pickerel	*Esox niger*	Esociformes	Esocidae							
	X		Chainback Darter	*Percina nevisense*	Perciformes	Percidae							
		X	Channel Catfish	*Ictalurus punctatus*	Siluriformes	Ictaluridae			Y				
			Coastal Shiner	*Alburnops petersoni*	Cypriniformes	Leuciscidae							
			Comely Shiner	*Notropis amoenus*	Cypriniformes	Leuciscidae							
		X	Common Carp	*Cyprinus carpio*	Cypriniformes	Cyprinidae			Y				
			Creek Chub	*Semotilus atromaculatus*	Cypriniformes	Leuciscidae							
			Crescent Shiner	*Luxilus cerasinus*	Cypriniformes	Leuciscidae							
X	X		Cutlip Minnow	*Exoglossum maxillingua*	Cypriniformes	Leuciscidae							SC

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X	X	X	Dollar Sunfish	*Lepomis marginatus*	Perciformes	Centrarchidae							
			Dusky Shiner	*Pteronotropis cummingsae*	Cypriniformes	Leuciscidae							
			Eastern Creek Chubsucker	*Erimyzon oblongus*	Cypriniformes	Catostomidae							
			Eastern Mosquitofish	*Gambusia holbrooki*	Cyprinodontiformes	Poeciliidae							
			Eastern Mudminnow	*Umbra pygmaea*	Esociformes	Umbridae							
			Eastern Silvery Minnow	*Hybognathus regius*	Cypriniformes	Leuciscidae							
X			Everglades Pygmy Sunfish	*Elassoma evergladei*	Perciformes	Elassomatidae							
		X	Fantail Darter	*Etheostoma flabellare*	Perciformes	Percidae							
			Fathead Minnow	*Pimephales promelas*	Cypriniformes	Leuciscidae			Y				
	X		Fatlips Minnow	*Phenacobius crassilabrum*	Cypriniformes	Leuciscidae					M		
			Fieryblack Shiner	*Cyprinella pyrrhomelas*	Cypriniformes	Leuciscidae					M		
X		X	Flat Bullhead	*Ameiurus platycephalus*	Siluriformes	Ictaluridae							
		X	Flier	*Centrarchus macropterus*	Perciformes	Centrarchidae							
X	X		Freshwater Drum	*Aplodinotus grunniens*	Perciformes	Sciaenidae							SC
	X		Gilt Darter	*Percina evides*	Perciformes	Percidae							
			Gizzard Shad	*Dorosoma cepedianum*	Clupeiformes	Dorosomatidae							
	X		Glassy Darter	*Etheostoma vitreum*	Perciformes	Percidae							
			Golden Redhorse	*Moxostoma erythrurum*	Cypriniformes	Catostomidae							
			Golden Shiner	*Notemigonus crysoleucas*	Cypriniformes	Leuciscidae							
	X		Golden Topminnow	*Fundulus chrysotus*	Cyprinodontiformes	Fundulidae							
		X	Goldfish	*Carassius auratus*	Cypriniformes	Cyprinidae			Y				
		X	Grass Carp	*Ctenopharyngodon idella*	Cypriniformes	Xenocyprididae			Y				
	X		Green Silverside	*Labidesthes vanhyningi*	Atheriniformes	Atherinopsidae							
		X	Green Sunfish	*Lepomis cyanellus*	Perciformes	Centrarchidae			Y				
	X		Greenfin Darter	*Nothonotus chlorobranchius*	Perciformes	Percidae					H		
			Greenfin Shiner	*Cyprinella chloristia*	Cypriniformes	Leuciscidae							
			Greenhead Shiner	*Hydrophlox chlorocephalus*	Cypriniformes	Leuciscidae		Y					
	X		Greenside Darter	*Etheostoma blennioides*	Perciformes	Percidae							
X		X	Hickory Shad	*Alosa mediocris*	Clupeiformes	Alosidae					H		
			Highback Chub	*Hybopsis hypsinotus*	Cypriniformes	Leuciscidae					M		
			Highfin Shiner	*Hudsonius altipinnis*	Cypriniformes	Leuciscidae							
X	X		Highland Shiner	*Notropis micropteryx*	Cypriniformes	Leuciscidae							
X	X		Ironcolor Shiner	*Alburnops chalybaeus*	Cypriniformes	Leuciscidae					H		T
X	X		Kanawha Darter	*Etheostoma kanawhae*	Perciformes	Percidae		Y*					
	X		Kanawha Minnow	*Phenacobius teretulus*	Cypriniformes	Leuciscidae		Y*			M		SC
	X		Kanawha Rosyface Shiner	*Notropis sp.*	Cypriniformes	Leuciscidae		Y					
		X	Kokanee/Sockeye Salmon	*Oncorhynchus nerka*	Salmoniformes	Salmonidae			Y				
X		X	Lake Chubsucker	*Erimyzon sucetta*	Cypriniformes	Catostomidae							
X			Lake Phelps Killifish	*Fundulus sp.*	Cyprinodontiformes	Fundulidae		Y*			VH		
X		X	Lake Sturgeon	*Acipenser fulvescens*	Acipenseriformes	Acipenseridae	Reintroduced				H		SC
		X	Largemouth Bass	*Micropterus salmoides*	Perciformes	Centrarchidae							
	X		Least Brook Lamprey	*Lampetra aepyptera*	Petromyzontiformes	Petromyzontidae							T
X			Least Killifish	*Heterandria formosa*	Cyprinodontiformes	Poeciliidae							SC
			Lined Topminnow	*Fundulus lineolatus*	Cyprinodontiformes	Fundulidae							
X	X		Logperch	*Percina caprodes*	Perciformes	Percidae							T
			Longnose Dace	*Rhinichthys cataractae*	Cypriniformes	Leuciscidae							
	X		Longnose Gar	*Lepisosteus osseus*	Lepisosteiformes	Lepisosteidae							
		X	Margined Madtom	*Noturus insignis*	Siluriformes	Ictaluridae							
	X		Mimic Shiner	*Paranotropis volucellus*	Cypriniformes	Leuciscidae							T
			Mirror Shiner	*Paranotropis spectrunculus*	Cypriniformes	Leuciscidae							
X	X		Mooneye	*Hiodon tergisus*	Osteoglossiformes	Hiodontidae					M		SC
			Mottled Sculpin	*Cottus bairdi*	Scorpaeniformes	Cottidae					H		
	X		Mountain Brook Lamprey	*Ichthyomyzon greeleyi*	Petromyzontiformes	Petromyzontidae					M		
X	X		Mountain Madtom	*Noturus eleutherus*	Siluriformes	Ictaluridae					H		SC
	X		Mountain Redbelly Dace	*Chrosomus oreas*	Cypriniformes	Leuciscidae							
X			Mud Sunfish	*Acantharchus pomotis*	Perciformes	Centrarchidae							
		X	Muskellunge (Naturalized)	*Esox masquinongy*	Esociformes	Esocidae	Naturalized						
X	X		New River Shiner	*Miniellus scabriceps*	Cypriniformes	Leuciscidae		Y			M		
			Northern Hog Sucker	*Hypentelium nigricans*	Cypriniformes	Catostomidae							
X		X	Notchlip Redhorse	*Moxostoma collapsum*	Cypriniformes	Catostomidae							
	X		Ohio Lamprey	*Ichthyomyzon bdellium*	Petromyzontiformes	Petromyzontidae					H		SC
	X		Olive Darter	*Percina squamata*	Perciformes	Percidae					M		SC

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X		X	Orangefin Madtom	*Noturus gilberti*	Siluriformes	Ictaluridae		Y*			H	At-Risk	E
		X	Piedmont Darter	*Percina crassa*	Perciformes	Percidae					M		
			Piedmont Shiner	*Hydrophlox sp.*	Cypriniformes	Leuciscidae		Y*					
X			Pinewoods Darter	*Etheostoma mariae*	Perciformes	Percidae		Y*			H		SC
			Pinewoods Shiner	*Lythrurus matutinus*	Cypriniformes	Leuciscidae							
		X	Pumpkinseed	*Lepomis gibbosus*	Perciformes	Centrarchidae							
X		X	Quillback	*Carpiodes cyprinus*	Cypriniformes	Catostomidae							
		X	Rainbow Trout	*Oncorhynchus mykiss*	Salmoniformes	Salmonidae			Y				
			Red Shiner	*Cyprinella lutrensis*	Cypriniformes	Leuciscidae			Y				
		X	Redbreast Sunfish	*Lepomis auritus*	Perciformes	Centrarchidae							
		X	Redear Sunfish	*Lepomis microlophus*	Perciformes	Centrarchidae			Y				
X	X	X	Redeye Bass	*Micropterus coosae*	Perciformes	Centrarchidae	Hiwassee RB		Y				
			Redfin Pickerel	*Esox americanus*	Esociformes	Esocidae							
	X		Redline Darter	*Nothonotus rufilineatus*	Perciformes	Percidae							
			Redlip Shiner	*Hydrophlox chiliticus*	Cypriniformes	Leuciscidae							
X			Redside Daces (Hiwassee, Smoky Dace)	*Clinostomus sp.*	Cypriniformes	Leuciscidae					M		SC
	X		River Carpsucker	*Carpiodes carpio*	Cypriniformes	Catostomidae							SC
			River Chub	*Nocomis micropogon*	Cypriniformes	Leuciscidae							
X	X		River Redhorse	*Moxostoma carinatum*	Cypriniformes	Catostomidae							
	X		Riverweed Darter	*Etheostoma podostemone*	Perciformes	Percidae		Y*					
X		X	Roanoke Bass	*Ambloplites cavifrons*	Perciformes	Centrarchidae					M		
	X		Roanoke Darter	*Percina roanoka*	Perciformes	Percidae							
X			Roanoke Hog Sucker	*Hypentelium roanokense*	Cypriniformes	Catostomidae							
X	X		Roanoke Logperch	*Percina rex*	Perciformes	Percidae		Y*			H	E	E
X		X	Robust Redhorse	*Moxostoma robustum*	Cypriniformes	Catostomidae					VH	At-Risk	E
		X	Rock Bass	*Ambloplites rupestris*	Perciformes	Centrarchidae							
			Rosefin Shiner	*Lythrurus ardens*	Cypriniformes	Leuciscidae							
X	X		Rosyface Chub	*Hybopsis rubrifrons*	Cypriniformes	Leuciscidae					M		T
			Rosyside Dace	*Clinostomus funduloides*	Cypriniformes	Leuciscidae							
X	X	X	Rustyside Sucker	*Thoburnia hamiltoni*	Cypriniformes	Catostomidae		Y*			H		E
	X		Saffron Shiner	*Hydrophlox rubricroceus*	Cypriniformes	Leuciscidae							
X			Sandbar Shiner	*Notropis scepticus*	Cypriniformes	Leuciscidae							
X		X	Sandhills Chub	*Semotilus lumbee*	Cypriniformes	Leuciscidae					H		SC
X	X		Santee Chub	*Cyprinella zanema*	Cypriniformes	Leuciscidae					H		T
			Satinfin Shiner	*Cyprinella analostana*	Cypriniformes	Leuciscidae					M		
	X		Sauger	*Sander canadensis*	Perciformes	Percidae							
		X	Sawcheek Darter	*Etheostoma serrifer*	Perciformes	Percidae							
	X		Sea Lamprey	*Petromyzon marinus*	Petromyzontiformes	Petromyzontidae							
X	X		Seagreen Darter	*Etheostoma thalassinum*	Perciformes	Percidae					M		SC
X			Sharphead Darter	*Nothonotus acuticeps*	Perciformes	Percidae					M		T
X	X		Sharpnose Darter	*Percina oxyrhynchus*	Perciformes	Percidae							E
			Shorthead Redhorse	*Moxostoma macrolepidotum*	Cypriniformes	Catostomidae							
X		X	Shortnose Sturgeon	*Acipenser brevirostrum*	Acipenseriformes	Acipenseridae					VH	E	E
X		X	Sicklefin Redhorse	*Moxostoma sp.*	Cypriniformes	Catostomidae					H		T
			Silver Redhorse	*Moxostoma anisurum*	Cypriniformes	Catostomidae							
	X		Silver Shiner	*Notropis photogenis*	Cypriniformes	Leuciscidae							
X		X	Siouan Thinlip Chub	*Cyprinella leptocheilus*	Cypriniformes	Leuciscidae					H		SC
		X	Smallmouth Bass	*Micropterus dolomieu*	Perciformes	Centrarchidae							
	X	X	Smallmouth Buffalo	*Ictiobus bubalus*	Cypriniformes	Catostomidae	Native, Introduced						
X	X		Smallmouth Redhorse	*Moxostoma breviceps*	Cypriniformes	Catostomidae							
X		X	Snail Bullhead	*Ameiurus brunneus*	Siluriformes	Ictaluridae							
	X		Snubnose Darter	*Etheostoma simoterum*	Perciformes	Percidae							SC
X			Sooty-banded [Westfall's] Darter	*Percina nigrofasciata*	Perciformes	Percidae							SC
	X		Southern Tessellated Darter	*Etheostoma maculaticeps*	Perciformes	Percidae							
X			Speckled Killifish	*Fundulus rathbuni*	Cyprinodontiformes	Fundulidae					M		
X			Spotfin Chub	*Erimonax monachus*	Cypriniformes	Leuciscidae					H	T	T
	X		Spotfin Shiner	*Cyprinella spiloptera*	Cypriniformes	Leuciscidae							
			Spottail Shiner	*Hudsonius hudsonius*	Cypriniformes	Leuciscidae							
		X	Spotted Bass	*Micropterus punctulatus*	Perciformes	Centrarchidae							
			Spotted Sucker	*Minytrema melanops*	Cypriniformes	Catostomidae							
X			Spotted Sunfish	*Lepomis punctatus*	Perciformes	Centrarchidae							
X	X	X	Stonecat	*Noturus flavus*	Siluriformes	Ictaluridae							E

Table 3-4
FRESHWATER FISH

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025	**Common Name**	***Scientific Name***	**Order**	**Family**	Population	**Endemic to NC?**	**Exotic? Introduced?**	**NC Responsibility Species for State Listed Species = N**	**SEAFWA Regional SGCN** VH = very high, H = high, M = moderate	**Federal ESA Protection Status**	**NC State Protection Status**
X		X	Striped Bass (native)	*Morone saxatilis*	Perciformes	Moronidae	Native						
X			Striped Jumprock	*Moxostoma rupiscartes*	Cypriniformes	Catostomidae							
		X	Striped Mullet	*Mugil cephalus*	Mugiliformes	Mugilidae							
	X		Striped Shiner	*Luxilus chrysocephalus*	Cypriniformes	Leuciscidae							SC
			Swallowtail Shiner	*Miniellus procne*	Cypriniformes	Leuciscidae					M		
		X	Swamp Darter	*Etheostoma fusiforme*	Perciformes	Percidae							
X			Swampfish	*Chologaster cornuta*	Percopsiformes	Amblyopsidae					M		
	X		Swannanoa Darter	*Etheostoma swannanoa*	Perciformes	Percidae					M		
X		X	Tadpole Madtom	*Noturus gyrinus*	Siluriformes	Ictaluridae							
X			Taillight Shiner	*Notropis maculatus*	Cypriniformes	Leuciscidae							
	X		Tangerine Darter	*Percina aurantiaca*	Perciformes	Percidae					M		
	X		Telescope Shiner	*Notropis telescopus*	Cypriniformes	Leuciscidae							
			Tennessee Shiner	*Paranotropis leuciodus*	Cypriniformes	Leuciscidae							
	X		Tessellated Darter	*Etheostoma sp. cf. olmstedi*	Perciformes	Percidae							
X	X		Thicklip Chub	*Cyprinella labrosa*	Cypriniformes	Leuciscidae					m		T
			Threadfin Shad	*Dorosoma petenense*	Clupeiformes	Dorosomatidae			Y				
X	X		Tonguetied Minnow	*Exoglossum laurae*	Cypriniformes	Leuciscidae							
	X		Tuckasegee Darter	*Etheostoma gutselli*	Perciformes	Percidae					H		
X			Turquoise Darter	*Etheostoma inscriptum*	Perciformes	Percidae					M		T
X			V-lip Redhorse	*Moxostoma pappillosum*	Cypriniformes	Catostomidae					M		
X		X	Waccamaw Darter	*Etheostoma perlongum*	Perciformes	Percidae		Y*			M		T
X		X	Waccamaw Killifish	*Fundulus waccamensis*	Cyprinodontiformes	Fundulidae		Y*			VH		
X		X	Waccamaw Silverside	*Menidia extensa*	Atheriniformes	Atherinopsidae		Y*			M	T	T
		X	Walleye	*Sander vitreus*	Perciformes	Percidae							
		X	Warmouth	*Lepomis gulosus*	Perciformes	Centrarchidae							
			Warpaint Shiner	*Coccotis coccogenis*	Cypriniformes	Leuciscidae							
			Western Blacknose Dace	*Rhinichthys obtusus*	Cypriniformes	Leuciscidae							
	X		Western Mosquitofish	*Gambusia affinis*	Cyprinodontiformes	Poeciliidae							
		X	White Bass	*Morone chrysops*	Perciformes	Moronidae			Y				
		X	White Catfish	*Ameiurus catus*	Siluriformes	Ictaluridae							
		X	White Crappie	*Pomoxis annularis*	Perciformes	Centrarchidae							
		X	White Perch	*Morone americana*	Perciformes	Moronidae	Native						
			White Shiner	*Luxilus albeolus*	Cypriniformes	Leuciscidae							
			White Sucker	*Catostomus commersonii*	Cypriniformes	Catostomidae							
			Whitefin Shiner	*Cyprinella nivea*	Cypriniformes	Leuciscidae							
			Whitemouth Shiner	*Miniellus alborus*	Cypriniformes	Leuciscidae					M		
			Whitetail Shiner	*Cyprinella galactura*	Cypriniformes	Leuciscidae							
X			Wounded Darter	*Nothonotus vulneratus*	Perciformes	Percidae					H		SC
		X	Yellow Bullhead	*Ameiurus natalis*	Siluriformes	Ictaluridae							
		X	Yellow Perch	*Perca flavescens*	Perciformes	Percidae							
X	X		Yellowfin Shiner	*Hydrophlox lutipinnis*	Cypriniformes	Leuciscidae							SC

Table 3-5
FRESHWATER MUSSELS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025										
X	X		Alewife Floater	*Utterbackiana implicata*	Unionidae							T
X		X	Appalachian Elktoe	*Alasmidonta raveneliana*	Unionidae					H	E	E
X		X	Atlantic Pigtoe	*Fusconaia masoni*	Unionidae					VH	T	T
X	X	X	Barrel Floater	*Anodonta couperiana*	Unionidae					H		E
X	X	X	Brook Floater	*Alasmidonta varicosa*	Unionidae					H		E
X	X	X	Cape Fear Spike	*Elliptio marsupiobesa*	Unionidae		Y					SC
X		X	Carolina Creekshell	*Sagittunio vaughanianus*	Unionidae					H		E
X		X	Carolina Heelsplitter	*Lasmigona decorata*	Unionidae					VH	E	E
X	X		Chameleon lampmussel	*Lampsilis sp. 2*	Unionidae							
X	X		Creeper	*Strophitus undulatus*	Unionidae							T
X		X	Dwarf Wedgemussel	*Alasmidonta heterodon*	Unionidae						E	E
X	X	X	Eastern Creekshell	*Villosa delumbis*	Unionidae							
X	X		Eastern Lampmussel	*Lampsilis radiata*	Unionidae							T
X	X		Eastern Pondmussel	*Sagittunio nasutus*	Unionidae							T
X	X	X	Green Floater	*Lasmigona subviridis*	Unionidae					M	PT	E
X	X		James Spinymussel	*Parvaspina collina*	Unionidae					H	E	E
X		X	Littlewing Pearlymussel	*Pegias fabula*	Unionidae					VH	E	E
X		X	Longsolid	*Fusconaia subrotunda*	Unionidae					H	T	T
X	X		Notched Rainbow	*Venustaconcha constricta*	Unionidae							T
X		X	Pink heelsplitter	*Potamilus alatus*	Unionidae							SC
X		X	Pod Lance	*Elliptio folliculata*	Unionidae					H		SC
X	X	X	Purple Wartyback	*Cyclonaias tuberculata*	Unionidae							E
X		X	Rainbow	*Cambarunio iris*	Unionidae							T
X		X	Rayed Pink Fatmucket	*Lampsilis splendida*	Unionidae					H		
			Roanoke Slabshell	*Elliptio roanokensis*	Unionidae							SC
X	X	X	Savannah Lilliput	*Toxolasma pullus*	Unionidae					H		E
X		X	Slippershell Mussel	*Alasmidonta viridis*	Unionidae					H		E
X	X		Southern Rainbow	*Villosa vibex*	Unionidae	Neuse R. pop.						
X			Spike	*Eurynia dilatata*	Unionidae							SC
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	Unionidae		Y			VH	E	E
X			Tennessee Clubshell	*Pleurobema oviforme*	Unionidae					H	PE	E
X			Tennessee Pigtoe	*Pleuronaia barnesiana*	Unionidae					H	PE	E
X			Tidewater Mucket	*Atlanticoncha ochracea*	Unionidae							T
X	X		Triangle Floater	*Alasmidonta undulata*	Unionidae							T
X	X		Uwharrie Elktoe	*Alasmidonta uwharriensis*	Unionidae		Y					
X			Waccamaw Fatmucket	*Lampsilis fullerkati*	Unionidae							
X			Waccamaw Spike	*Elliptio waccamawensis*	Unionidae	Lake Waccamaw form						
X		X	Wavyrayed Lampmussel	*Lampsilis fasciola*	Unionidae							SC
X	X		Yellow Lampmussel	*Lampsilis cariosa*	Unionidae							E
X	X	X	Yellow Lance	*Elliptio lanceolata*	Unionidae					VH	T	T

Table 3-6
MAMMALS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
X	X		Allegheny Woodrat	*Neotoma magister*	Rodentia	Cricetidae					H		SC
		X	American Beaver	*Castor canadensis*	Rodentia	Castoridae							
		X	American Black Bear	*Ursus americanus*	Carnivora	Ursidae							
			American Mink	*Neovison vison*	Carnivora	Mustelidae							
X	X		an undescribed Shrew	*Sorex sp. 1*	Soricomorpha	Soricidae							
X	X	X	Appalachian Cottontail	*Sylvilagus obscurus*	Lagomorpha	Leporidae					M		
		X	Big Brown Bat	*Eptesicus fuscus*	Chiroptera	Vespertilionidae							
		X	Bobcat	*Lynx rufus*	Carnivora	Felidae							
		X	Brazilian Free-tailed Bat	*Tadarida brasiliensis*	Chiroptera	Molossidae							
			Brown Rat	*Rattus norvegicus*	Rodentia	Muridae			Y				
X	X		Buxton Woods White-footed Deermouse	*Peromyscus leucopus buxtoni*	Rodentia	Cricetidae					VH		SC
X			Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	Rodentia	Sciuridae					VH	E	E
			Common Muskrat	*Ondatra zibethicus*	Rodentia	Cricetidae							
		X	Common Raccoon	*Procyon lotor*	Carnivora	Procyonidae							
	X		Cotton Deermouse	*Peromyscus gossypinus*	Rodentia	Cricetidae							
		X	Coyote	*Canis latrans*	Carnivora	Canidae			Y				
	X		Dismal Swamp Meadow Vole	*Microtus pennsylvanicus nigrans*	Rodentia	Cricetidae							
			Dismal Swamp Southeastern Shrew	*Sorex longirostris fisheri*	Soricomorpha	Soricidae							
X	X		Dismal Swamp Southern Bog Lemming	*Synaptomys cooperi helaletes*	Rodentia	Cricetidae							
	X		Eastern Chipmunk	*Tamias striatus*	Rodentia	Sciuridae							
			Eastern Cottontail	*Sylvilagus floridanus*	Lagomorpha	Leporidae							
			Eastern Fox Squirrel	*Sciurus niger niger*	Rodentia	Sciuridae	Eastern NC						
			Eastern Fox Squirrel	*Sciurus niger pop. 1*	Rodentia	Sciuridae	NW Mtn NC						
			Eastern Gray Squirrel	*Sciurus carolinensis*	Rodentia	Sciuridae							
	X		Eastern Harvest Mouse	*Reithrodontomys humulis*	Rodentia	Cricetidae							
			Eastern Mole	*Scalopus aquaticus*	Soricomorpha	Talpidae							
	X	X	Eastern Red Bat	*Lasiurus borealis*	Chiroptera	Vespertilionidae							
X		X	Eastern Small-footed Bat	*Myotis leibii*	Chiroptera	Vespertilionidae					H		SC
X			Eastern Spotted Skunk	*Spilogale putorius*	Carnivora	Mephitidae					H		
X	X		Eastern Woodrat	*Neotoma floridana*	Rodentia	Cricetidae	CP pop.						T
		X	Elk	*Cervus canadensis*	Artiodactyla	Cervidae							
		X	Evening Bat	*Nycticeius humeralis*	Chiroptera	Vespertilionidae							
		X	Feral Hog	*Sus scrofa*	Artiodactyla	Suidae			Y				
	X		Golden Mouse	*Ochrotomys nuttalli*	Rodentia	Cricetidae							
X		X	Gray Bat	*Myotis grisescens*	Chiroptera	Vespertilionidae					M	E	E
		X	Gray Fox	*Urocyon cinereoargenteus*	Carnivora	Canidae							
	X		Hairy-Tailed Mole	*Parascalops breweri*	Eulipotyphla	Talpidae							
			Hispid Cotton Rat	*Sigmodon hispidus*	Rodentia	Cricetidae							
X		X	Hoary Bat	*Lasiurus cinereus*	Chiroptera	Vespertilionidae					H	At-Risk	
			House Mouse	*Mus musculus*	Rodentia	Muridae			Y				
X		X	Indiana Bat	*Myotis sodalis*	Chiroptera	Vespertilionidae					VH	E	E
			Least Shrew	*Cryptotis parva*	Soricomorpha	Soricidae							
	X		Least Weasel	*Mustela nivalis*	Carnivora	Mustelidae							
X		X	Little Brown Bat	*Myotis lucifugus*	Chiroptera	Vespertilionidae					VH	At-Risk	E
	X		Long-tailed Weasel	*Neogale frenata*	Carnivora	Mustelidae							
			Marsh Rabbit	*Sylvilagus palustris*	Lagomorpha	Leporidae							
	X		Marsh Rice Rat	*Oryzomys palustris*	Rodentia	Cricetidae							
			Masked Shrew	*Sorex cinereus*	Soricomorpha	Soricidae							
	X		Meadow Jumping Mouse	*Zapus hudsonius*	Rodentia	Dipodidae							
	X		Meadow Vole	*Microtus pennsylvanicus pennsylvanicus*	Rodentia	Cricetidae							
			Nine Banded Armadillo	*Dasypus novemcinctus*	Cingulata	Dasypodidae			Y				
			North American Deermouse	*Peromyscus maniculatus*	Rodentia	Cricetidae							
		X	North American River Otter	*Lontra canadensis*	Carnivora	Mustelidae							
X		X	Northern Long-eared Bat	*Myotis septentrionalis*	Chiroptera	Vespertilionidae					VH	E	E
			Northern Short-tailed Shrew	*Blarina brevicauda*	Soricomorpha	Soricidae							
X	X	X	Northern Yellow Bat (incl Florida Yellow Ba	*Lasiurus intermedius (incl L.i. floridanus)*	Chiroptera	Vespertilionidae					H		SC
X		X	Rafinesque's Big-eared Bat - CP Pop	*Corynorhinus rafinesquii macrotis*	Chiroptera	Vespertilionidae	CP pop				H		SC
X		X	Rafinesque's Big-eared Bat - Mtn Pop	*Corynorhinus rafinesquii rafinesquii*	Chiroptera	Vespertilionidae	Mtn pop				H		T
		X	Red Fox	*Vulpes vulpes*	Carnivora	Canidae			Y				
	X		Red Squirrel	*Tamiasciurus hudsonicus*	Rodentia	Sciuridae							
X		X	Red Wolf	*Canis rufus*	Carnivora	Canidae					VH	E (Expn)	T
X	X		Rock Shrew	*Sorex dispar*	Soricomorpha	Soricidae					H		
			Roof Rat	*Rattus rattus*	Rodentia	Muridae			Y				
		X	Seminole Bat	*Lasiurus seminolus*	Chiroptera	Vespertilionidae							
	X	X	Silver-haired Bat	*Lasionycteris noctivagans*	Chiroptera	Vespertilionidae							
			Smoky Shrew	*Sorex fumeus*	Soricomorpha	Soricidae							
X		X	Southeastern Bat	*Myotis austroriparius*	Chiroptera	Vespertilionidae					M		SC
			Southeastern Shrew	*Sorex longirostris longirostris*	Soricomorpha	Soricidae							
X	X		Southern Appalachian Woodrat	*Neotoma floridana haematoreia*	Rodentia	Cricetidae					M		

Table 3-6
MAMMALS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
X			Southern Bog Lemming	*Synaptomys cooperi stonei*	Rodentia	Cricetidae							
		X	Southern Flying Squirrel	*Glaucomys volans*	Rodentia	Sciuridae							
X	X		Southern Pygmy Shrew	*Sorex hoyi winnemana*	Soricomorpha	Soricidae							
	X		Southern Red-backed Vole	*Myodes gapperi*	Rodentia	Cricetidae							
X			Southern Rock Vole	*Microtus chrotorrhinus carolinensis*	Rodentia	Cricetidae					H		SC
			Southern Short-tailed Shrew	*Blarina carolinensis*	Soricomorpha	Soricidae	Piedmont & SE CP						
			Southern Water Shrew	*Sorex palustris punctulatus*	Soricomorpha	Soricidae							
X	X		Star-nosed Mole	*Condylura cristata (incl C.c. parva)*	Soricomorpha	Talpidae	Mtn pop						SC
X	X		Star-nosed Mole	*Condylura cristata pop. 1*	Soricomorpha	Talpidae	CP pop.						
		X	Striped Skunk	*Mephitis mephitis*	Carnivora	Mephitidae							
X		X	Tricolored Bat	*Perimyotis subflavus*	Chiroptera	Vespertilionidae					H	PE	E
X		X	Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	Chiroptera	Vespertilionidae					VH	E	E
			Virginia Opossum	*Didelphis virginiana*	Didelphimorphia	Didelphidae							
X			West Indian Manatee	*Trichechus manatus*	Sirenia	Trichechidae						T	T
	X		White-footed Deermouse	*Peromyscus leucopus*	Rodentia	Cricetidae							
		X	White-tailed Deer	*Odocoileus virginianus*	Artiodactyla	Cervidae							
			Woodchuck	*Marmota monax*	Rodentia	Sciuridae							
	X		Woodland Jumping Mouse	*Napaeozapus insignis*	Rodentia	Dipodidae							
	X		Woodland Vole	*Microtus pinetorum*	Rodentia	Cricetidae							

Table 3-7
REPTILES

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
X		X	American alligator	*Alligator mississippiensis*	Alligatoria	Alligatoridae						T(S/A)	T
X	X		Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata imbricata*	Testudines	Cheloniidae						E	E
	X	X	Banded Water Snake	*Nerodia fasciata fasciata*	Squamata	Colubridae							
X		X	Bog Turtle	*Glyptemys muhlenbergii*	Testudines	Emydidae					VH	T(S/A)	T
	X		Broadhead Skink	*Plestiodon laticeps*	Squamata	Scincidae							
	X		Brown Anole	*Anolis sagrei*	Squamata	Polychrotidae			Y				
	X		Brown Water Snake	*Nerodia taxispilota*	Squamata	Colubridae							
X, N	X		Carolina (Black) Swamp Snake	*Seminatrix pygaea paludis*	Squamata	Colubridae				N	M		SC
X, N	X	X	Carolina Pygmy Rattlesnake	*Sistrurus miliarius miliarius*	Squamata	Viperidae				N	M		SC
X, N	X		Carolina Saltmarsh (Water) Snake	*Nerodia sipedon williamengelsi*	Squamata	Colubridae		Y		N	M		SC
X, N	X	X	Coachwhip	*Masticophis flagellum flagellum*	Squamata	Colubridae				N			SC
X	X		Coal Skink	*Plestiodon anthracinus*	Squamata	Scincidae					H		
X	X		Coastal Plain Milk Snake	*Lampropeltis triangulum temporalis*	Squamata	Colubridae							
		X	Copperhead	*Agkistrodon contortrix*	Squamata	Viperidae							
	X		Corn Snake	*Elaphe guttata*	Squamata	Colubridae							
X, N	X		Cumberland Slider	*Trachemys scripta troostii*	Testudines	Emydidae				N	M		SC
X, N	X		Diamondback Terrapin	*Malaclemys terrapin*	Testudines	Emydidae				N	H		SC
X		X	Eastern Box Turtle	*Terrapene carolina carolina*	Cryptodeira	Emydidae					M		
X, N		X	Eastern Chicken Turtle	*Deirochelys reticularia reticularia*	Testudines	Emydidae				N	H		SC
X, N	X	X	Eastern Coral Snake	*Micrurus fulvius*	Squamata	Elapidae				N	H		E
	X	X	Eastern Cottonmouth	*Agkistrodon piscivorus*	Squamata	Viperidae							
X, N	X	X	Eastern Diamondback Rattlesnake	*Crotalus adamanteus*	Squamata	Viperidae				N	H	At-Risk	E
	X		Eastern Fence Lizard	*Sceloporus undulatus*	Squamata	Phrynosomatidae							
			Eastern Garter Snake	*Thamnophis sirtalis sirtalis*	Squamata	Colubridae							
X	X		Eastern Glass Lizard	*Ophisaurus ventralis*	Squamata	Anguidae					H		
X	X		Eastern Hognose Snake	*Heterodon platirhinos*	Squamata	Colubridae							
X	X	X	Eastern Kingsnake	*Lampropeltis getula*	Squamata	Colubridae							
X	X		Eastern Milk Snake	*Lampropeltis triangulum*	Squamata	Colubridae							
	X		Eastern Mud Turtle	*Kinsternon subrubrum subrubrum*	Cryptodeira	Kinosternidae							
	X		Eastern Mudsnake	*Farancia abacura abacura*	Squamata	Colubridae					M		
	X		Eastern Musk Turtle	*Sternotherus odoratus*	Testudines	Kinosternidae							
	X		Eastern Painted Turtle	*Chrysemys picta picta*	Cryptodeira	Emydidae							
X	X		Eastern Ribbon Snake	*Thamnophis sauritus sauritus*	Squamata	Colubridae							
	X		Eastern River Cooter	*Pseudemys concinna concinna*	Testudines	Emydidae							
	X		Eastern Six-lined Racerunner	*Cnemidophorus sexlineatus sexlineatus*	Squamata	Teiidae							
X, N	X		Eastern Slender Glass Lizard	*Ophisaurus attenuatus longicaudus*	Squamata	Anguidae				N	H		SC
X	X		Eastern Smooth Earth Snake	*Virginia valeriae valeriae*	Squamata	Colubridae							
X, N	X		Eastern Spiny Softshell	*Apalone spinifera spinifera*	Testudines	Trionychidae				N			SC
			Eastern Worm Snake	*Carphophis amoenus amoenus*	Squamata	Colubridae							
	X	X	Five-lined Skink	*Plestiodon fasciatus*	Squamata	Scincidae							
X	X		Glossy Crayfish Snake	*Regina rigida rigida*	Squamata	Colubridae							
			Green Anole	*Anolis carolinensis*	Squamata	Polychrotidae							
X		X	Green Sea Turtle	*Chelonia mydas*	Testudines	Cheloniidae						T	T
			Ground Skink	*Scincella lateralis*	Squamata	Scincidae							
	X		Gulf Coast Spiny Softshell	*Apalone spinifera aspera*	Testudines	Trionychidae							
X		X	Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Testudines	Cheloniidae						E	E
X		X	Leatherback Sea Turtle	*Dermochelys coriacea*	Testudines	Dermochelyidae						E	E
X		X	Loggerhead Sea Turtle	*Caretta caretta*	Testudines	Cheloniidae						T	T
	X		Mediterranean Gecko	*Hemidactylus turcicus*	Squamata	Gekkonidae			Y				
X, N	X		Mimic Glass Lizard	*Ophisaurus mimicus*	Squamata	Anguidae				N	H		E
	X		Mississippi Map Turtle	*Graptemys pseudogeographica kohnii*	Cryptodeira	Emydidae			Y				
X	X		Mole Kingsnake	*Lampropeltis rhombomaculata*	Squamata	Colubridae							
		X	Northern Black Racer	*Coluber constrictor constrictor*	Squamata	Colubridae							
			Northern Brown Snake	*Storeria dekayi*	Squamata	Colubridae							
X, N	X		Northern Map Turtle	*Graptemys geographica*	Testudines	Emydidae				N			SC
X, N	X	X	Northern Pine Snake	*Pituophis melanoleucus melanoleucus*	Squamata	Colubridae				N	H		T
X	X		Northern Red-bellied Cooter	*Pseudemys rubriventris*	Testudines	Emydidae					M		
	X	X	Northern Ringneck Snake	*Diadophis punctatus edwardsii*	Squamata	Colubridae							
	X		Northern Rough Green Snake	*Opheodrys aestivus aestivus*	Squamata	Colubridae							
X	X		Northern Scarlet Snake	*Cemophora coccinea copei*	Squamata	Colubridae							
	X		Northern Water Snake	*Nerodia sipedon sipedon*	Squamata	Colubridae							
X, N	X		Outer Banks Kingsnake	*Lampropeltis getula sticticeps*	Squamata	Colubridae		Y		N			SC
X	X		Pine Woods Snake	*Rhadinaea flavilata*	Squamata	Colubridae					H		
X	X		Queen Snake	*Regina septemvittata*	Squamata	Colubridae							
X	X		Rainbow Snake	*Farancia erytrogramma erytrogramma*	Squamata	Colubridae					H		
	X		Ratsnake	*Elaphe obsoleta*	Squamata	Colubridae							
			Red-bellied Snake	*Storeria occipitomaculata*	Squamata	Colubridae							
X	X	X	Red-bellied Water Snake	*Nerodia erythrogaster*	Squamata	Colubridae							

Table 3-7
REPTILES

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Population	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025											
	X	X	Red-eared Slider	*Trachemys scripta elegans*	Testudines	Emydidae			Y				
	X		Rough Earth Snake	*Virginia striatula*	Squamata	Colubridae							
X	X		Scarlet Kingsnake	*Lampropeltis elapsoides*	Squamata	Colubridae							
		X	Snapping Turtle	*Chelydra serpentina*	Cryptodeira	Chelydridae							
X	X		Southeastern Crowned Snake	*Tantilla coronata*	Squamata	Colubridae							
	X		Southeastern Five-lined Skink	*Plestiodon inexpectatus*	Squamata	Scincidae							
X, N	X	X	Southern Hognose Snake	*Heterodon simus*	Squamata	Colubridae				N	H		T
X	X	X	Spotted Turtle	*Clemmys guttata*	Testudines	Emydidae					H		
X	X		Striped Mud Turtle	*Kinosternon baurii*	Testudines	Kinosternidae					M		
X, N	X		Stripe-necked Musk Turtle	*Sternotherus peltifer*	Testudines	Kinosternidae				N	H		SC
			Texas Horned Lizard	*Phrynosoma cornutum*	Squamata	Phrynosomatidae			Y				
X, N	X	X	Timber Rattlesnake	*Crotalus horridus*	Squamata	Viperidae				N	M		SC
			Yellow-bellied Slider	*Trachemys scripta scripta*	Testudines	Emydidae							

Table 3-8
AQUATIC SNAILS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025										
	X	X	Mud Amnicola	*Amnicola limosus*	Littorinimorpha	Amnicolidae						
X	X		Waccamaw Snail	*Amnicola sp. 1*	Littorinimorpha	Amnicolidae	Y					SC
	X	X	Banded Mysterysnail	*Callinina georgiana*	Architaenioglossa	Viviparidae		Y				
	X		Rotund Mysterysnail	*Callinina intertexta*	Architaenioglossa	Viviparidae						
	X		Pointed Campeloma	*Campeloma decisum*	Architaenioglossa	Viviparidae						
	X		File Campeloma	*Campeloma lima*	Architaenioglossa	Viviparidae						
	X	X	Chinese Mystery Snail	*Cipangopaludina chinensis*	Architaenioglossa	Viviparidae		Y				
	X		Gravel Elimia	*Elimia catenaria*	Caenogastropoda	Pleuroceridae						
X	X	X	Christy's Elimia, Knotty Elimia	*Elimia christyi*	Caenogastropoda	Pleuroceridae						E
	X	X	Club Elimia	*Elimia clavaeformis*	Caenogastropoda	Pleuroceridae						
	X		Lapped Elimia	*Elimia dislocata*	Caenogastropoda	Pleuroceridae						
	X		Sprite Elimia	*Elimia proxima*	Caenogastropoda	Pleuroceridae						
	X	X	Fine-ridged Elimia	*Elimia semicarinata*	Caenogastropoda	Pleuroceridae						
	X	X	Smooth Elimia	*Elimia simplex*	Caenogastropoda	Pleuroceridae						
	X		Symmetrical Elimia	*Elimia symmetrica*	Caenogastropoda	Pleuroceridae						
	X		Piedmont Elimia	*Elimia virginica*	Caenogastropoda	Pleuroceridae						
	X	X	Fragile Ancylid	*Ferrisia californica*	Hygrophila	Planorbidae						
	X		Creeping Ancylid	*Ferrisia rivularis*	Hygrophila	Planorbidae						
X	X		Waccamaw Siltsnail	*Floridobia sp.*	Littorinimorpha	Hydrobiidae	Y					SC
X	X	X	Carib Fossaria	*Galba cubensis*	Hygrophila	Lymnaeidae						
	X	X	Golden Fossaria	*Galba obrussa*	Hygrophila	Lymnaeidae						
	X	X	Buffalo Pebblesnail	*Gillia altilis*	Littorinimorpha	Lithoglyphidae						
	X	X	Flexed Gyro	*Gyraulus deflectus*	Hygrophila	Planorbidae						
	X	X	Ash Gyro	*Gyraulus parvus*	Hygrophila	Planorbidae						
	X	X	Excentric Ancylid	*Hebetancylus excentricus*	Hygrophila	Planorbidae						
	X		Two-ridged Ramshorn	*Helisoma anceps*	Hygrophila	Planorbidae						
X	X	X	Greenfield Ramshorn	*Helisoma eucosmium*	Hygrophila	Planorbidae	Y					E
	X	X	Japanese Mysterysnail	*Heterogn japonica*	Architaenioglossa	Viviparidae		Y				
X	X	X	Dusky Ancylid	*Laevapex fuscus*	Hygrophila	Planorbidae						
	X		Crested Mudalia	*Leptoxis carinata*	Caenogastropoda	Pleuroceridae						
X	X	X	Seep Mudalia	*Leptoxis dilatata*	Caenogastropoda	Pleuroceridae						SC
X	X	X	Smooth Mudalia	*Leptoxis virgata*	Caenogastropoda	Pleuroceridae						
	X		Ridged Lioplax	*Lioplax subcarinata*	Architaenioglossa	Viviparidae						SC
	X	X	Henscomb Hydrobe	*Littoridinops tenuipes*	Littorinimorpha	Cochliopidae						
	X	X	Squat Duskysnail	*Lyogyrus granum*	Littorinimorpha	Amnicolidae						
	X	X	Giant Ramshorn	*Marisa cornuarietis*	Architaenioglossa	Ampullariidae		Y				
	X	X	Red-rim Melania	*Melanoides tuberculata*	Caenogastropoda	Thiaridae		Y				
	X	X	Bugle Sprite	*Menetus dilatatus*	Hygrophila	Planorbidae						
	X		Wandering Physa	*Physa acuta*	Hygrophila	Physidae						
	X		Carolina Physa	*Physella carolinae*	Hygrophila	Physidae						
	X	X	Tadpole Physa	*Physella gyrina*	Hygrophila	Physidae						
	X		Bayou Physa	*Physella hedersoni*	Hygrophila	Physidae						
	X		Claiborne Physa	*Physella pomila*	Hygrophila	Physidae						
X	X	X	Magnificent Ramshorn	*Planorbella magnifica*	Hygrophila	Planorbidae	Y				E	E
	X		Marsh Ramshorn	*Planorbella trivolvis*	Hygrophila	Planorbidae						
	X		Thicklip Ramshorn	*Planorbula armgera*	Hygrophila	Planobidae						
	X		Dainty Hornsnail	*Pleurocera parva*	Caenogastropoda	Pleuroceridae						
	X		Pagoda Hornsnail	*Pleurocera uncialis*	Caenogastropoda	Pleuroceridae						
	X	X	Giant Applesnail	*Pomacea maculata*	Architaenioglossa	Ampullariidae		Y				
X	X	X	Slender Walker	*Pomatiopsis lapidaria*	Littorinimorpha	Pomatiopsidae						
	X		Sharp Sprite	*Promenetus exacuous*	Hygrophila	Planorbidae						
	X		Mimic Lymnaea	*Pseudosuccinea columella*	Hygrophila	Lymnaeidae						
X	X		A Hydrobid Snail	*Somatogyrus sp. 1*	Littorinimorpha	Lithoglyphidae	Y?					
X	X		Panhandle Pebblesnail	*Somatogyrus virginicus*	Littorinimorpha	Lithoglyphidae						
	X		Two-ridge Valvata	*Valvata bicarinata*	Heterostropha	Valvatidae						
	X	X	Olive Nerite	*Vitta usnea*	Cycloneritida	Neritidae						

Table 3-9
LAND SNAILS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025										
	X		Broad-banded Forestsnail	*Allogona profunda*	Stylommatophora	Polygyridae						
	X	X	Flamed Tigersnail	*Anguispira alternata*	Stylommatophora	Discidae						
	X	X	Coastal-plain Tigersnail	*Anguispira fergusoni*	Stylommatophora	Discidae						
	X	X	Mountain Disc	*Anguispira jessica*	Stylommatophora	Discidae						
	X	X	Appalachian Tigersnail	*Anguispira mordax*	Stylommatophora	Discidae						
	X	X	Southeastern Tigersnail	*Anguispira strongylodes*	Stylommatophora	Discidae						
X	X		Queen Crater	*Appalachina chilhoweensis*	Stylommatophora	Polygyridae						SC
	X		Spike-lip Crater	*Appalachina sayanus*	Stylommatophora	Polygyridae						
	X	X	Brown-banded Arion	*Arion circumscriptus*	Stylommatophora	Arionidae		Y				
	X		Orange-banded Arion	*Arion fasciatus*	Stylommatophora	Arionidae		Y				
	X	X	Dusky Arion	*Arion subfuscus*	Stylommatophora	Arionidae		Y				
X	X		Tree thorn	*Carychium arboreum*	Ellobiida	Ellobiidae	Y					
			Appalachian Thorn	*Carychium clappi*	Ellobiida	Ellobiidae						
X			Obese Thorn	*Carychium exiguum*	Ellobiida	Ellobiidae						
			Ice Thorn	*Carychium exile*	Ellobiida	Ellobiidae						
			File Thorn	*Carychium nannodes*	Ellobiida	Ellobiidae						
	X	X	Glossy Pillar	*Cochlicopa lubrica*	Stylommatophora	Cochlicopidae		Y				
		X	Appalachian Pillar	*Cochlicopa morseana*	Stylommatophora	Cochlicopidae						
	X		High-spire Column Snail	*Columella simplex*	Stylommatophora	Truncatellinidae						
	X		Coastal Liptooth	*Daedalochila postelliana*	Stylommatophora	Polygyridae						
		X	Meadow Slug	*Deroceras laeve*	Stylommatophora	Agriolimacidae		Y				
			Gray Fieldslug	*Deroceras reticulatum*	Stylommatophora	Agriolimacidae		Y				
		X	Sawtooth Disc	*Discus bryanti*	Stylommatophora	Discidae						SC
	X	X	Black Mountain Disc	*Discus nigrimontanus*	Stylommatophora	Discidae						
	X	X	Domed Disc	*Discus patulus*	Stylommatophora	Discidae						
	X	X	Forest Disc	*Discus whitneyi*	Stylommatophora	Discidae						
	X		Carrot Glass	*Dryachloa dauca*	Stylommatophora	Euconulidae						
	X		Mountain Pillsnail	*Euchemotrema fasciatum*	Stylommatophora	Polygyridae						
	X		Upland Pillsnail	*Euchemotrema fraternum*	Stylommatophora	Polygyridae						
	X		Wild Hive	*Euconulus chersinus*	Stylommatophora	Euconulidae						
	X		Toothed Hive	*Euconulus dentatus*	Stylommatophora	Euconulidae						
	X		Brown Hive	*Euconulus fulvus*	Stylommatophora	Euconulidae						
	X		Silk Hive	*Euconulus trochulus*	Stylommatophora	Euconulidae						
	X	X	Rosy Wolfsnail	*Euglandina rosea*	Stylommatophora	Spiraxidae		Y				
X	X		Roan Covert	*Fumonelix cherohalaensis*	Stylommatophora	Polygyridae						
	X		Glossy Covert	*Fumonelix christyi*	Stylommatophora	Polygyridae						
X	X		Clingman Covert	*Fumonelix clingmanica*	Stylommatophora	Polygyridae						SC
X	X		Big-tooth Covert	*Fumonelix jonesiana*	Stylommatophora	Polygyridae						T
X	X		Talus covert	*Fumonelix langdoni*	Stylommatophora	Polygyridae						
X	X		Engraved Covert	*Fumonelix orestes*	Stylommatophora	Polygyridae						T
	X		Cinnamon Covert	*Fumonelix wheatleyi*	Stylommatophora	Polygyridae						
			Bottleneck Snaggletooth	*Gastrocopta contracta*	Stylommatophora	Gastrocoptidae						
		X	Bark Snaggletooth	*Gastrocopta corticaria*	Stylommatophora	Gastrocoptidae						
	X		Comb Snaggletooth	*Gastrocopta pentodon*	Stylommatophora	Gastrocoptidae						
	X		Wing Snaggletooth	*Gastrocopta procera*	Stylommatophora	Gastrocoptidae						
	X		Gulf Coast Snaggletooth	*Gastrocopta riparia*	Stylommatophora	Gastrocoptidae						
	X		Tapered Snaggletooth	*Gastrocopta rupicola*	Stylommatophora	Gastrocoptidae						
	X		White Snaggletooth	*Gastrocopta tappaniana*	Stylommatophora	Gastrocoptidae						
	X		Brown Bellytooth	*Gastrodonta interna*	Stylommatophora	Gastro**don**tidae						
	X		Spiral Mountain Glyph	*Glyphyalinia carolinensis*	Stylommatophora	Gastrodontidae						
	X		Hill Glyph	*Glyphyalinia cumberlandiana*	Stylommatophora	Gastrodontidae						
		X	Carved Glyph	*Glyphyalinia indentata*	Stylommatophora	Gastrodontidae						
X	X		Dark Glyph	*Glyphyalinia junaluskana*	Stylommatophora	Gastrodontidae						SC
	X		Furrowed Glyph	*Glyphyalinia luticola*	Stylommatophora	Gastrodontidae						
X	X		Pink Glyph	*Glyphyalinia pentadelphia*	Stylommatophora	Gastrodontidae						SC

Table 3-9
LAND SNAILS

2025 WAP Revision
Taxa Team Evaluations

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SGCN Species of Greatest Conservation Need Priority 2025	Knowledge Gap Research Priority 2025	Management Needs/Concerns Priority 2025	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
	X		Brilliant Glyph	*Glyphyalinia praecox*	Stylommatophora	Gastrodontidae						
	X		Sculpted Glyph	*Glyphyalinia rhoadsi*	Stylommatophora	Gastrodontidae						
	X		Suborb Glyph	*Glyphyalinia sculptilis*	Stylommatophora	Gastrodontidae						
	X		A Glyph	*Glyphyalinia solida*	Stylommatophora	Gastrodontidae						
	X		Texas Glyph	*Glyphyalinia umbilicata*	Stylommatophora	Gastrodontidae						
	X		Bright Glyph	*Glyphyalinia wheatleyi*	Stylommatophora	Gastrodontidae						
	X		Sterki's Granule	*Guppya sterkii*	Stylommatophora	Euconulidae						
			Gray-foot Lancetooth	*Haplotrema concavum*	Stylommatophora	Haplotrematidae						
X	X		Blue-footed Lancetooth	*Haplotrema kendeighi*	Stylommatophora	Haplotrematidae						SC
	X	X	Southeastern Gem	*Hawaiia alachuana*	Stylommatophora	Pristilomatidae						
	X		Minute Gem	*Hawaiia minuscula*	Stylommatophora	Pristilomatidae						
X	X		Spiral Coil	*Helicodiscus bonamicus*	Stylommatophora	Helicodiscidae						SC
X	X		Twilight Coil	*Helicodiscus multidens*	Stylommatophora	Helicodiscidae						
	X		Tight Coil	*Helicodiscus notius*	Stylommatophora	Helicodiscidae						
	X		Compound Coil	*Helicodiscus parallelus*	Stylommatophora	Helicodiscidae		Y				
X	X		Corncob Snail	*Helicodiscus saludensis*	Stylommatophora	Helicodiscidae						
	X		Cherrystone Drop	*Hendersonia occulta*	Cycloneritida	Helicinidae						
X	X		Dwarf Globelet	*Inflectarius downieanus*	Stylommatophora	Polygyridae						
X	X		Smoky Mountain Covert	*Inflectarius ferrissi*	Stylommatophora	Polygyridae						T
	X		Shagreen	*Inflectarius inflectus*	Stylommatophora	Polygyridae						
X	X	X	Brown Globelet	*Inflectarius kalmianus*	Stylommatophora	Polygyridae						
	X		Deep-tooth Shagreen	*Inflectarius rugeli*	Stylommatophora	Polygyridae						
X	X		Velvet Covert	*Inflectarius subpalliatus*	Stylommatophora	Polygyridae						SC
			Threeband Gardenslug	*Lehmannia valentiana*	Stylommatophora	Limacidae		Y				
			Giant Gardenslug	*Limax maximus*	Stylommatophora	Limacidae		Y				
	X		Tiny Liptooth	*Loboscolum pustuloides*	Stylommatophora	Polygyridae						
X	X	X	Oldfield Coil	*Lucilla inermis*	Stylommatophora	Helicodiscidae						
	X		Smooth Coil	*Lucilla singleyana*	Stylommatophora	Helicodiscidae						
X	X		Snowhill Ambersnail	*Mediappendix hubrichti*	Stylommatophora	Succineidae						
	X		Detritus Ambersnail	*Mediappendix oklahomarum*	Stylommatophora	Succineidae						
X	X		Weedpatch Ambersnail	*Mediappendix pugilator*	Stylommatophora	Succineidae						
	X		Suboval Ambersnail	*Mediappendix vermeta*	Stylommatophora	Succineidae						
X	X		Waccamaw Ambersnail	*Mediappendix waccamawensis*	Stylommatophora	Succineidae						T
			Changeable Mantleslug	*Megapallifera mutabilis*	Stylommatophora	Philomycidae						
X	X		Wandering Globe	*Mesodon altivagus*	Stylommatophora	Polygyridae						
	X		Balsam Globe	*Mesodon andrewsae*	Stylommatophora	Polygyridae						
	X		Yellow Globelet	*Mesodon clausus*	Stylommatophora	Polygyridae						
	X		Proud Globe	*Mesodon elevatus*	Stylommatophora	Polygyridae						
	X		Sealed Globelet	*Mesodon mitchellianus*	Stylommatophora	Polygyridae						
	X		Grand Globe	*Mesodon normalis*	Stylommatophora	Polygyridae						
	X		White-lip Globe	*Mesodon thyroidus*	Stylommatophora	Polygyridae						
	X		Toothed Globe	*Mesodon zaletus*	Stylommatophora	Polygyridae						
	X		Mountain Button	*Mesomphix andrewsae*	Stylommatophora	Gastrodontidae						
	X		Copper Button	*Mesomphix cupreus*	Stylommatophora	Gastrodontidae						
X	X		Broad Button	*Mesomphix latior*	Stylommatophora	Gastrodontidae						
X	X		Striate Button	*Mesomphix pilsbryi*	Stylommatophora	Gastrodontidae						
	X		Wrinkled Button	*Mesomphix rugeli*	Stylommatophora	Gastrodontidae						
	X		Flat Button	*Mesomphix subplanus*	Stylommatophora	Gastrodontidae						
	X		Whitelip	*Neohelix albolabris*	Stylommatophora	Polygyridae						
	X		Big-tooth Whitelip	*Neohelix dentifera*	Stylommatophora	Polygyridae						
	X		Southeastern Whitelip	*Neohelix major*	Stylommatophora	Polygyridae						
	X		Coastal Whitelip	*Neohelix solemi*	Stylommatophora	Polygyridae						
	X		Oval Ambersnail	*Novisuccinea ovalis*	Stylommatophora	Succineidae						
	X		Dwarf Awlsnail	*Opeas hannense*	Stylommatophora	Achatinidae		Y				
	X		Sharp Awlsnail	*Opeas pyrgula*	Stylommatophora	Achatinidae		Y				

Table 3-9
LAND SNAILS

2025 WAP Revision
Taxa Team Evaluations

Red Text indicates Taxonomic Updates

SGCN Species of Greatest Conservation Need Priority 2025	Knowledge Gap Research Priority 2025	Management Needs/Concerns Priority 2025	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
	X	X	Garlic Glass-snail	*Oxychilus alliarius*	Stylommatophora	Oxychilidae		Y				
	X		Coastal-plain Ambersnail	*Oxyloma effusum*	Stylommatophora	Succineidae						
		X	Pale Mantleslug	*Pallifera dorsalis*	Stylommatophora	Philomycidae						
			Foster Mantleslug	*Pallifera fosteri*	Stylommatophora	Philomycidae						
X	X		Black Mantleslug	*Pallifera hemphilli*	Stylommatophora	Philomycidae						SC
			Severed Mantleslug	*Pallifera secreta*	Stylommatophora	Philomycidae						
X	X	X	High Mountain Supercoil	*Paravitrea andrewsae*	Stylommatophora	Pristilomatidae						SC
	X	X	Dimple Supercoil	*Paravitrea capsella*	Stylommatophora	Pristilomatidae						
X	X	X	Mirey Ridge Supercoil	*Paravitrea clappi*	Stylommatophora	Pristilomatidae						SC
X	X	X	Ramp Cove Supercoil	*Paravitrea lacteodens*	Stylommatophora	Pristilomatidae						SC
	X	X	Lamellate Supercoil	*Paravitrea lamellidens*	Stylommatophora	Pristilomatidae						SC
	X	X	Dentate Supercoil	*Paravitrea multidentata*	Stylommatophora	Pristilomatidae						
X			Broad River Supercoil	*Paravitrea nunnehi*	Stylommatophora	Pristilomatidae						
X	X	X	Glossy Supercoil	*Paravitrea placentula*	Stylommatophora	Pristilomatidae						SC
X	X	X	Round Supercoil	*Paravitrea reesei*	Stylommatophora	Pristilomatidae						
X	X	X	Sculpted Supercoil	*Paravitrea ternaria*	Stylommatophora	Pristilomatidae						T
X	X	X	Open Supercoil	*Paravitrea umbilicaris*	Stylommatophora	Pristilomatidae						SC
X	X	X	Roan Supercoil	*Paravitrea varidens*	Stylommatophora	Pristilomatidae						T
	X		Flat Bladetooth	*Patera appressa*	Stylommatophora	Polygyridae						
	X		Dwarf Proud Globe	*Patera clarkii*	Stylommatophora	Polygyridae						SC
	X		Smooth Bladetooth	*Patera laevior*	Stylommatophora	Polygyridae						
X	X		Noonday Globe	*Patera nantahala*	Stylommatophora	Polygyridae					T	T
	X		Engraved Bladetooth	*Patera perigrapta*	Stylommatophora	Polygyridae						
		X	Carolina Mantleslug	*Philomycus carolinianus*	Stylommatophora	Philomycidae						
			Winding Mantleslug	*Philomycus flexuolaris*	Stylommatophora	Philomycidae						
			Toga Mantleslug	*Philomycus togatus*	Stylommatophora	Philomycidae						
			Brown-spotted Mantleslug	*Philomycus venustus*	Stylommatophora	Philomycidae						
X			Virginia Mantleslug	*Philomycus virginicus*	Stylommatophora	Philomycidae						
X	X		Fragile Glyph	*Pilsbryna clingmani*	Stylommatophora	Oxychilidae						E
X	X		Oar Tooth Bud	*Pilsbryna nodopalma*	Stylommatophora	Oxychilidae						
X	X		Honey Glyph	*Pilsbryna vanattai*	Stylommatophora	Oxychilidae						SC
	X		Southern Flatcoil	*Polygyra cereolus*	Stylommatophora	Polygyridae						
X	X		Appalachian Shrubsnail	*Praticolella lawae*	Stylommatophora	Polygyridae						
	X		Ribbed Striate	*Pseudohyalina exigua*	Stylommatophora	Gastro**don**tidae						
	X	X	Brown Spot	*Punctum blandianum*	Stylommatophora	Punctidae						
	X	X	Small Spot	*Punctum minutissimum*	Stylommatophora	Punctidae						
X	X	X	Lamellate Spot	*Punctum smithi*	Stylommatophora	Punctidae						
X	X	X	Glass Spot	*Punctum vitreum*	Stylommatophora	Punctidae						
	X		Gulf Babybody	*Pupisoma macneilli*	Stylommatophora	Valloniidae		Y				
	X	X	White-lip Dagger	*Pupoides albilabris*	Stylommatophora	Pupillidae						
	X		Decollate Snail	*Rumina decollata*	Stylommatophora	Achatinidae		Y				
	X		Highland Slitmouth	*Stenotrema altispira*	Stylommatophora	Polygyridae						
	X		Bristled Slitmouth	*Stenotrema barbatum*	Stylommatophora	Polygyridae						
	X		Fringed Slitmouth	*Stenotrema barbigerum*	Stylommatophora	Polygyridae						
X	X		Great Smoky Slitmouth	*Stenotrema depilatum*	Stylommatophora	Polygyridae						SC
	X		Hairy Slitmouth	*Stenotrema hirsutum*	Stylommatophora	Polygyridae						
	X		Appalachian Slitmouth	*Stenotrema magnifumosum*	Stylommatophora	Polygyridae						
	X		Pygmy Slitmouth	*Stenotrema pilula*	Stylommatophora	Polygyridae						
	X		Inland Slitmouth	*Stenotrema stenotrema*	Stylommatophora	Polygyridae						
	X		Black Striate	*Striatura ferrea*	Stylommatophora	Gastro**don**tidae						
	X		Median Striate	*Striatura meridionalis*	Stylommatophora	Gastrodontidae						
	X	X	Bronze Pinecone	*Strobilops aeneus*	Stylommatophora	Strobilopsidae						
	X	X	Maze Pinecone	*Strobilops labyrinthicus*	Stylommatophora	Strobilopsidae						
X	X	X	Southern Pinecone	*Strobilops texasianus*	Stylommatophora	Strobilopsidae						
	X		Crinkled Ambersnail	*Succinea campestris*	Stylommatophora	Succineidae						

Table 3-9
LAND SNAILS

2025 WAP Revision
Taxa Team Evaluations

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SGCN Species of Greatest Conservation Need Priority	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
2025	2025	2025										
	X		Spotted Ambersnail	*Succinea concordialis*	Stylommatophora	Succineidae						
	X		Xeric Ambersnail	*Succinea indiana*	Stylommatophora	Succineidae						
	X		Squatty Ambersnail	*Succinea unicolor*	Stylommatophora	Succineidae						
	X		Golden Ambersnail	*Succinea wilsonii*	Stylommatophora	Succineidae						
	X		Pittsylvania Threetooth	*Triodopsis burchi*	Stylommatophora	Polygyridae						
	X		Mimic Threetooth	*Triodopsis fallax*	Stylommatophora	Polygyridae						
X	X		Dwarf Threetooth	*Triodopsis fulciden*	Stylommatophora	Polygyridae						SC
	X		Magnolia Threetooth	*Triodopsis hopetonensis*	Stylommatophora	Polygyridae						
	X		Atlantic Threetooth	*Triodopsis juxtidens*	Stylommatophora	Polygyridae						
	X		Pinhole Threetooth	*Triodopsis messana*	Stylommatophora	Polygyridae						
	X		Nubbin Threetooth	*Triodopsis obsoleta*	Stylommatophora	Polygyridae						
	X		Hanging Rock Threetooth	*Triodopsis pendula*	Stylommatophora	Polygyridae						
X	X		Cape Fear Threetooth	*Triodopsis soelneri*	Stylommatophora	Polygyridae						T
	X		Budded Threetooth	*Triodopsis tennesseensis*	Stylommatophora	Polygyridae						
	X		Northern Threetooth	*Triodopsis tridentata*	Stylommatophora	Polygyridae						
	X		Dished Threetooth	*Triodopsis vulgata*	Stylommatophora	Polygyridae						
	X		Iroquois Vallonia	*Vallonia excentrica*	Stylommatophora	Valloniidae						
	X		Lovely Vallonia	*Vallonia pulchella*	Stylommatophora	Valloniidae		Y?				
	X		Glossy Dome	*Ventridens acerra*	Stylommatophora	Gastro**don**tidae						
	X		Golden Dome	*Ventridens arcellus*	Stylommatophora	Gastro**don**tidae						
	X		Wax Dome	*Ventridens cerinoideus*	Stylommatophora	Gastro**don**tidae						
	X		Bidentate Dome	*Ventridens coelaxis*	Stylommatophora	Gastro**don**tidae						SC
	X		Sculptured Dome	*Ventridens collisella*	Stylommatophora	Gastro**don**tidae						
	X		Crossed Dome	*Ventridens decussatus*	Stylommatophora	Gastro**don**tidae						
	X		Perforate Dome	*Ventridens demissus*	Stylommatophora	Gastro**don**tidae						
	X		Throaty Dome	*Ventridens gularis*	Stylommatophora	Gastro**don**tidae						
	X		Pyramid Dome	*Ventridens intertextus*	Stylommatophora	Gastro**don**tidae						
	X		Hollow Dome	*Ventridens lasmodon*	Stylommatophora	Gastro**don**tidae						
	X		Rounded Dome	*Ventridens lawae*	Stylommatophora	Gastro**don**tidae						
	X		Globose Dome	*Ventridens ligera*	Stylommatophora	Gastro**don**tidae						
	X		Yellow Dome	*Ventridens pilsbryi*	Stylommatophora	Gastro**don**tidae						
	X		Flat Dome	*Ventridens suppressus*	Stylommatophora	Gastro**don**tidae						
	X		Copper Dome	*Ventridens theloides*	Stylommatophora	Gastro**don**tidae						
	X		Alabama Vertigo	*Vertigo alabamensis*	Stylommatophora	Vertiginidae						
X	X		Cupped Vertigo	*Vertigo clappi*	Stylommatophora	Vertiginidae						
	X		Variable Vertigo	*Vertigo gouldii*	Stylommatophora	Vertiginidae						
	X	X	Malleated Vertigo	*Vertigo malleata*	Stylommatophora	Vertiginidae						
	X	X	Blade Vertigo	*Vertigo milium*	Stylommatophora	Vertiginidae						
	X	X	Palmetto Vertigo	*Vertigo oralis*	Stylommatophora	Vertiginidae						
X	X	X	Capital Vertigo	*Vertigo oscariana*	Stylommatophora	Vertiginidae						
	X	X	Ovate Vertigo	*Vertigo ovata*	Stylommatophora	Vertiginidae						
X	X	X	Smallmouth Vertigo	*Vertigo parvula*	Stylommatophora	Vertiginidae						
X	X		Crested Vertigo	*Vertigo pygmaea*	Stylommatophora	Vertiginidae						
	X		Striate Vertigo	*Vertigo rugosula*	Stylommatophora	Vertiginidae						
X	X	X	Swamp Vertigo	*Vertigo teskeyae*	Stylommatophora	Vertiginidae						
	X	X	Glassy Grapeskin	*Vitrinizonites latissimus*	Stylommatophora	Gastrodontidae						
	X	X	Blunt Wedge	*Xolotrema caroliniense*	Stylommatophora	Polygyridae						
	X	X	Velvet Wedge	*Xolotrema denotatum*	Stylommatophora	Polygyridae						
	X	X	Quick Gloss	*Zonitoides arboreus*	Stylommatophora	Gastrodontidae						
	X	X	Green Dome	*Zonitoides elliotti*	Stylommatophora	Gastrodontidae						
	X	X	Black Gloss	*Zonitoides nitidus*	Stylommatophora	Gastrodontidae		Y				
X	X	X	Appalachian Gloss	*Zonitoides patuloides*	Stylommatophora	Gastrodontidae						SC

Table 3-10
INSECTS

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Bumble Bees										
X	an andrenid bee	*Andrena fulvipennis*	Hymenoptera	Andrenidae						
X	an andrenid bee	*Andrena fulvipennis*	Hymenoptera	Andrenidae						
X	an andrenid bee	*Andrena gardineri*	Hymenoptera	Andrenidae						
X	an andrenid bee	*Andrena obscuripennis*	Hymenoptera	Andrenidae						
X	an andrenid bee	*Andrena parnassiae*	Hymenoptera	Andrenidae						
X	a mining bee	*Andrena uvulariae*	Hymenoptera	Andrenidae						
X	Southeastern Ashmeadiella Bee	*Ashmeadiella floridana*	Hymenoptera	Megachilidae						
X	Rusty-patched Bumble Bee	*Bombus affinis*	Hymenoptera	Apidae				VH	E	E
X	Golden Northern Bumble Bee	*Bombus fervidus*	Hymenoptera	Apidae						
X	Southern Plains Bumble Bee	*Bombus fraternus*	Hymenoptera	Apidae				M	At-Risk	
X	American Bumble Bee	*Bombus pensylvanicus*	Hymenoptera	Apidae				M	At-Risk	
X	Yellowbanded Bumble Bee [Mtn/Appalac	*Bombus terricola*	Hymenoptera	Apidae				H		
X	Half Black Bumble Bee	*Bombus vagans*	Hymenoptera	Apidae						
X	Variable Cuckoo Bumble Bee	*Bombus variabilis*	Hymenoptera	Apidae					At-Risk	
X	a plasterer bee	*Caupolicana electa*	Hymenoptera	Colletidae						
X	a leafcutter bee	*Coelioxys galactiae*	Hymenoptera	Megachilidae						
X	a cellophane bee	*Colletes distinctus*	Hymenoptera	Colletidae						
X	Southern Cuckoo Nomad Bee	*Epeolus australis*	Hymenoptera	Apidae						
X	a leafcutter bee	*Megachile brimleyi*	Hymenoptera	Megachilidae						
X	a leafcutter bee	*Megachile deflexa*	Hymenoptera	Megachilidae						
X	a leafcutter bee	*Megachile integra*	Hymenoptera	Megachilidae						
X	a leafcutter bee	*Megachile integrella*	Hymenoptera	Megachilidae						
X	a leafcutter bee	*Megachile oenotherae*	Hymenoptera	Megachilidae						
X	a callirhoe bee	*Melissodes fimbriatus*	Hymenoptera	Apidae						
X	a miner bee	*Perdita consobrina*	Hymenoptera	Andrenidae						
X	a miner bee	*Perdita discreta*	Hymenoptera	Andrenidae						
X	a miner bee	*Perdita georgica*	Hymenoptera	Andrenidae						
X	a miner bee	*Perdita gerardiae*	Hymenoptera	Andrenidae						
X	a miner bee	*Protandrena compositarum*	Hymenoptera	Andrenidae						
Beetles										
X	American Burying Beetle	*Nicrophorus americanus*	Coleoptera	Silphidae					T	T
Butterflies and Moths										
X	Carolina Agrotis	*Agrotis carolina*	Lepidoptera	Noctuidae						
X	Dusky Roadside-Skipper	*Amblyscirtes alternata*	Lepidoptera	Hesperiidae						
X	Regal Fritillary	*Argynnis idalia [= Speyeria idalia]*	Lepidoptera	Nymphalidae					PT	
X	Eastern Arogos Skipper	*Atrytone arogos arogos*	Lepidoptera	Hesperiidae					At-Risk	
X	Crystal Skipper	*Atrytonopsis quinteri [= A. opsis* sp. 1*]*	Lepidoptera	Hesperiidae						
X	Little Metalmark	*Calephelis virginiensis*	Lepidoptera	Riodinidae						
X	Hessel's Hairstreak	*Callophrys hesseli*	Lepidoptera	Lycaenidae						
X	Frosted Elfin Butterfly	*Callophrys irus*	Lepidoptera	Lycaenidae					At-Risk	
X	Grisatra Underwing Moth	*Catocala grisatra*	Lepidoptera	Erebidae						
X	Dusky Azure	*Celastrina nigra*	Lepidoptera	Lycaenidae						
X	Gorgone Checkerspot	*Chlosyne gorgone*	Lepidoptera	Nymphalidae						
X	Monarch	*Danaus plexippus*	Lepidoptera	Nymphalidae					PT	
X	Early Hairstreak	*Erora laeta*	Lepidoptera	Lycaenidae						
X	Mottled Duskywing	*Erynnis martialis*	Lepidoptera	Hesperiidae						

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X	Olympia Marble	*Euchloe olympia*	Lepidoptera	Pieridae						
X	Baltimore Checkerspot	*Euphtdryas phaeton*	Lepidoptera	Nymphalidae						
X	Berry's Skipper	*Euphyes berryi*	Lepidoptera	Hesperiidae						
X	Two-spotted Skipper	*Euphyes bimacula*	Lepidoptera	Hesperiidae						
X	Dukes' Skipper	*Euphyes dukesi*	Lepidoptera	Hesperiidae						
X	Sundew Cutworm Moth	*Hemipachnobia monochromatea*	Lepidoptera	Noctuidae						
X	Venus Flytrap Cutworm Moth	*Hemipachnobia subporphyrea*	Lepidoptera	Noctuidae						
X	Dotted Skipper	*Hesperia attalus*	Lepidoptera	Hesperiidae						
X	Leonard's Skipper	*Hesperia leonardus*	Lepidoptera	Hesperiidae						
X	Cobweb Skipper	*Hesperia metea*	Lepidoptera	Hesperiidae						
X	Fingered Lemmeria Moth	*Lemmeria digitalis*	Lepidoptera	Noctuidae						
X	Cofaqui Giant-Skipper	*Megathymus cofaqui*	Lepidoptera	Hesperiidae						
X	Sullivan's Meropleon	*Meropleon diversicolor sullivani*	Lepidoptera	Noctuidae						
X	Georgia Satyr	*Neonympha areolata*	Lepidoptera	Nymphalidae						
X	St. Francis' Satyr	*Neonympha mitchellii francisci*	Lepidoptera	Nymphalidae					E	E
X	Rattlesnake-master Borer Moth	*Papaipema eryngii*	Lepidoptera	Noctuidae						
X	Appalachian Tawny Crescent	*Phyciodes batesii maconensis*	Lepidoptera	Nymphalidae						
X	Aaron's Skipper	*Poanes aaroni aaroni*	Lepidoptera	Hesperiidae						
X	Long Dash	*Polites mystic*	Lepidoptera	Hesperiidae						
X	Smyth's Green Comma	*Polygonia faunus smythi*	Lepidoptera	Nymphalidae						
X	Gray Comma	*Polygonia progne*	Lepidoptera	Nymphalidae						
X	Checkered White	*Pontia protodice*	Lepidoptera	Pieridae						
X	Rare Skipper	*Problema bulenta*	Lepidoptera	Hesperiidae						
X	Appalachian Grizzled Skipper	*Pyrgus wyandot*	Lepidoptera	Hesperiidae					At-Risk	
X	Hickory Hairstreak	*Satyrium caryaevorum*	Lepidoptera	Lycaenidae						
X	Edwards' Hairstreak	*Satyrium edwardsii*	Lepidoptera	Lycaenidae						
X	A Moth	*Spartiniphaga carterae*	Lepidoptera	Noctuidae						
X	Golden Banded-Skipper	*Telegonus cellus*	Lepidoptera	Hesperiidae						
Caddisflies										
X	saddlecase caddisflies	*Agapetus jocassee*	Trichoptera	Glossosomatidae						
X	a humpless casemaker caddisfly	*Brachycentrus etowahensis*	Trichoptera	Brachycentridae						
X	a longhorned caddisfly	*Ceraclea cama*	Trichoptera	Leptoceridae						
X	A Longhorned Caddisfly	*Ceraclea cancellata*	Trichoptera	Leptoceridae						
X	Lenat's Ceraclea	*Ceraclea joannae*	Trichoptera	Leptoceridae						
X	A Diplectronan Caddisfly	*Diplectrona metaqui*	Trichoptera	Hydropsychidae						
X	a lepidostomatid caddisfly	*Lepidostoma carolina*	Trichoptera	Lepidostomatidae						
X	a lepidostomatid caddisfly	*Lepidostoma excavatum*	Trichoptera	Lepidostomatidae						
X	a lepidostomatid caddisfly	*Lepidostoma flinti*	Trichoptera	Lepidostomatidae						
X	a lepidostomatid caddisfly	*Lepidostoma lobatum*	Trichoptera	Lepidostomatidae						
X	a lepidostomatid caddisfly	*Lepidostoma mitchelli*	Trichoptera	Lepidostomatidae						
X	Gentle Bizarre Caddisfly	*Lepidostoma modestum*	Trichoptera	Lepidostomatidae						
X	a lepidostomatid caddisfly	*Lepidostoma styliferum*	Trichoptera	Lepidostomatidae						
X	a lepidostomatid caddisfly	*Lepidostoma wigginsi*	Trichoptera	Lepidostomatidae						
X	Mount Mitchell Caddisfly	*Manophylax altus*	Trichoptera	Apataniidae						
X	a brachycentrid caddisfly	*Micrasema rickeri*	Trichoptera	Brachycentridae						
X	a uenoid caddisfly	*Neophylax atlanta*	Trichoptera	Uenoidae						
X	a uenoid caddisfly	*Neophylax virginica*	Trichoptera	Uenoidae						

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X	a caddisfly	*Pseudogoera singularis*	Trichoptera	Odontoceridiae						
X	a rhyacophilid caddisfly	*Rhyacophila accola*	Trichoptera	Rhyacophilidae						
X	Friendly free living caddisfly	*Rhyacophila amicis*	Trichoptera	Rhyacophilidae						
X	Appalachian Ryachophilid Caddisfly	*Rhyacophila appalachia*	Trichoptera	Rhyacophilidae						
X	Celodon Caddisfly	*Rhyacophila celadon*	Trichoptera	Rhyacophilidae						
X	a rhyacophilid caddisfly	*Rhyacophila kondratieffi*	Trichoptera	Rhyacophilidae						
X	a free living caddisfly	*Rhyacophila montana*	Trichoptera	Rhyacophilidae						
X	a free living caddisfly	*Rhyacophila mycta*	Trichoptera	Rhyacophilidae						
X	a rhyacophilid caddisfly	*Rhyacophila tricornuta*	Trichoptera	Rhyacophilidae						
X	A Rhyacophilan Caddisfly	*Rhyacophila vibox*	Trichoptera	Rhyacophilidae						
X	a leptocerid caddisfly	*Setodes arenatus*	Trichoptera	Leptoceridae						
X	a caddisfly	*Wormaldia mohri*	Trichoptera	Philopotamidae						
X	a caddisfly	*Wormaldia oconee*	Trichoptera	Philopotamidae						
Dragonflies and Damselflies										
X	Black-tipped Darner	*Aeshna tuberculifera*	Odonata	Aeshnidae						
X	Green-striped Darner	*Aeshna verticalis*	Odonata	Aeshnidae						
X	Ocellated Darner	*Boyeria grafiana*	Odonata	Aeshnidae						
X	Superb Jewelwing	*Calopteryx amata*	Odonata	Calopterygidae						
X	American Emerald	*Cordulia shurtleffii*	Odonata	Corduliidae						
X	Midland Clubtail	*Gomphurus fraternus*	Odonata	Gomphidae						
X	Splendid Clubtail	*Gomphurus lineatifrons*	Odonata	Gomphidae						
X	Septima's Clubtail	*Gomphurus septima*	Odonata	Gomphidae						
X	Skillet Clubtail	*Gomphurus ventricosus*	Odonata	Gomphidae						
X	Cherokee Clubtail	*Gomphus consanguis*	Odonata	Gomphidae					At-Risk	
X	Septima's Clubtain	*Gomphus septima*	Odonata	Gomphidae					At-Risk	
X	Mustached Clubtail	*Hylogomphus adelphus*	Odonata	Gomphidae						
X	Green-faced Clubtail	*Hylogomphus viridifrons*	Odonata	Gomphidae						
X	Spotted Spreadwing	*Lestes congener*	Odonata	Lestidae						
X	Sweetflag Spreadwing	*Lestes forcipatus*	Odonata	Lestidae						
X	Margarita River Skimmer [= Mountain Riv	*Macromia margarita*	Odonata	Gomphidae					At-Risk	
X	Cinnamon Shadowdragon	*Neurocordulia virginiensis*	Odonata	Corduliidae						
X	Stygian Shadowdragon	*Neurocordulia yamaskanensis*	Odonata	Corduliidae						
X	Brook Snaketail	*Ophiogomphus aspersus*	Odonata	Gomphidae						
X	Edmund's Snaketail	*Ophiogomphus edumudo*	Odonata	Gomphidae					At-Risk	
X	Pygmy Snaketail	*Ophiogomphus howei*	Odonata	Gomphidae						
X	Rusty Snaketail	*Ophiogomphus rupinsulensis*	Odonata	Gomphidae						
X	Clearlake Clubtail	*Phanogomphus australis*	Odonata	Gomphidae						
X	Sandhill Clubtail	*Phanogomphus cavillaris*	Odonata	Gomphidae						
X	Harpoon Clubtail	*Phanogomphus descriptus*	Odonata	Gomphidae						
X	Rapids Clubtail	*Phanogomphus quadricolor*	Odonata	Gomphidae						
X	Belle's Sandragon	*Progomphus bellei*	Odonata	Gomphidae						
X	Ski-tipped Emerald	*Somatochlora elongata*	Odonata	Corduliidae						
X	Coppery Emerald	*Somatochlora georgiana*	Odonata	Corduliidae						
X	Cherokee Clubtail	*Stenogomphurus consanguis*	Odonata	Gomphidae						
X	Shining Clubtail	*Stylurus ivae*	Odonata	Gomphidae						
X	Zebra Clubtail	*Stylurus scudderi*	Odonata	Gomphidae						
X	Townes's Clubtail	*Stylurus townesi*	Odonata	Gomphidae						

Table 3-10
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Red Text indicates Updates

SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family	Endemic to NC?	Exotic? Introduced?	NC Responsibility Species for State Listed Species = N	SEAFWA Regional SGCN VH = very high, H = high, M = moderate	Federal ESA Protection Status	NC State Protection Status
X	White-faced Meadowhawk	*Sympetrum obtrusum*	Odonata	Libellulidae						
X	Phantom Darner	*Triacanthagyna trifida*	Odonata	Aeshnidae						
Grasshoppers										
X	Decorated Spur-throat Melanoplus	*Melanoplus decorus*	Orthoptera	Acrididae						
X	Broad-winged Sedge Grasshopper	*Stethophyma celatum*	Orthoptera	Acrididae						
Mayflies										
X	a mayfly	*Acentrella alachua*	Ephemeroptera	Baetidae						
X	A Mayfly	*Baetisca becki*	Ephemeroptera	Baetiscidae						
X	Fork-headed Armored Mayfly	*Baetisca obesa*	Ephemeroptera	Baetiscidae						
X	A Mayfly	*Baetopus trishae*	Ephemeroptera	Baetiscidae						
X	Benfield's Bearded Small Minnow Mayfly	*Barbaetis benfieldi*	Ephemeroptera	Baetiscidae						
X	an ephemerellid mayfly	*Dannella provonshai*	Ephemeroptera	Ephemerelidae						
X	American Sand-burrowing Mayfly	*Dolania americana*	Ephemeroptera	Behningiidae						
X	a mayfly	*Epeorus subpallidus*	Ephemeroptera	Heptageniidae						
X	a spiny crawler mayfly	*Ephemerella floripara*	Ephemeroptera	Ephemerellidae						
X	a spiny crawler mayfly	*Eurylophella oviruptis*	Ephemeroptera	Ephemerellidae						
X	a spiny crawler mayfly	*Eurylophella poconoensis*	Ephemeroptera	Ephemerellidae						
X	a flat headed mayfly	*Heptagenia townesi*	Ephemeroptera	Heptageniidae						
X	Cahaba Sand-filtering Mayfly	*Homoeoneuria cahabensis*	Ephemeroptera	Oligoneuriidae						
X	Hoffman's Isonychia Mayfly	*Isonychia hoffmani*	Ephemeroptera	Isonychiidae						
X	a mayfly	*Iswaeon davidi*	Ephemeroptera	Baetidae						
X	Milk River Small Minnow mayfly	*Iswaeon rubrolaterale*	Ephemeroptera	Baetidae						
X	Wilson Creek Stenonema	*Maccaffertium wudigeum*	Ephemeroptera	Heptageniidae						
X	a large square gilled mayfly	*Neoephemera eatoni*	Ephemeroptera	Neoephemeridae						
X	Anomalous Flat-headed mayfly	*Rhithrogena anomala*	Ephemeroptera	Heptageniidae						
X	a flat headed mayfly	*Rhithrogena rubicunda*	Ephemeroptera	Heptageniidae						
X	a flat headed mayfly	*Rhithrogena uhari*	Ephemeroptera	Heptageniidae						
X	Spiculose Serratellan Mayfly	*Serratella spiculosa*	Ephemeroptera	Ephemerellidae						
X	A Mayfly	*Tortopus puella*	Ephemeroptera	Polymitarcyidae						
Stoneflies										
X	Elegant Stone	*Acroneuria arida*	Plecoptera	Perlidae						
X	Virginia Stone	*Acroneuria kosztarabi*	Plecoptera	Perlidae						
X	Triangular Sallfly	*Alloperla chloris*	Plecoptera	Chloroperlidae						
X	Sandhill Sallfly	*Alloperla lenati*	Plecoptera	Chloroperlidae						
X	Giant Stone	*Attaneuria ruralis*	Plecoptera	Perlidae						
X	Piedmont Stone	*Beloneuria stewarti*	Plecoptera	Perlidae						
X	Jane's Springfly	*Diploperla janeae*	Plecoptera	Perlodidae						
X	Kanawhole Springfly	*Diploperla kanawholensis*	Plecoptera	Perlodidae						
X	Piedmont Sallfly	*Haploperla fleeki*	Plecoptera	Chloroperlidae						
X	Rock Island Springfly	*Isogenoides varians*	Plecoptera	Perlodidae						
X	a stonefly	*Isoperla "mayo river"*	Plecoptera	Perlodidae						
X	a stonefly	*Isoperla "not faucshi"*	Plecoptera	Perlodidae						
X	a stonefly	*Isoperla "sp. 10"*	Plecoptera	Perlodidae						
X	Smokies Stripetail	*Isoperla bellona*	Plecoptera	Perlodidae						
X	Slate Belt Stripetail	*Isoperla borisi*	Plecoptera	Perlodidae						
X	Twisted Stripetail	*Isoperla distincta*	Plecoptera	Perlodidae						
X	Mt. Mitchell Stripetail	*Isoperla pauli*	Plecoptera	Perlodidae						

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X	Stewart Stripetail	*Isoperla stewarti*	Plecoptera	Perlodidae						
X	Alta Needlefly	*Leuctra alta*	Plecoptera	Leuctridae						
X	Cypress Needlefly	*Leuctra hicksi*	Plecoptera	Leuctridae						
X	Blackwater Needlefly	*Leuctra moha*	Plecoptera	Leuctridae						
X	Mountain Needlefly	*Leuctra monticola*	Plecoptera	Leuctridae						
X	Smokies Needlefly [= Williams' Rare Wint	*Megaleuctra williamsae*	Plecoptera	Leuctridae					At-Risk	
X	Hairy Springfly	*Oconoperla innubila*	Plecoptera	Perlodidae						
X	Sandhills Willowfly	*Oemopteryx n.sp.*	Plecoptera	Taeniopterygidae						
X	Virginia Roachfly	*Peltoperla tarteri*	Plecoptera	Peltoperlidae						
X	Raft Swamp Stone	*Perlesta beatyi*	Plecoptera	Perlidae						
X	Anomalous Stone	*Perlesta bjostadi*	Plecoptera	Perlidae						
X	Barbeque Stone	*Perlesta georgiae*	Plecoptera	Perlidae						
X	Sandhills Stone	*Perlesta leathermani*	Plecoptera	Perlidae						
X	Dragon Run Stone	*Perlesta roblei*	Plecoptera	Perlidae						
X	Swamp Forestfly	*Prostoia hallasi*	Plecoptera	Nemouridae						
X	Danielle's Springfly	*Remenus daniellae*	Plecoptera	Perlodidae						
X	Blueridge Springfly	*Remenus kirchneri*	Plecoptera	Perlodidae					At-Risk	
X	Georgia Forest Fly	*Soyedina amicalola*	Plecoptera	Nemouridae						
X	Southeastern Forestfly	*Soyedina kondratieffi*	Plecoptera	Nemouridae						
X	Rediscovered Forestfly	*Soyedina parkeri*	Plecoptera	Nemouridae						
X	Mountain Man Forestfly	*Soyedina sheldoni*	Plecoptera	Nemouridae						
X	Arkansas Willowfly	*Strophopteryx arkansae*	Plecoptera	Taeniopterygidae						
X	Newfound Willowfly	*Strophopteryx limata*	Plecoptera	Taeniopterygidae						
X	Holston Sallfly	*Swelsta holstonensis*	Plecoptera	Chloroperlidae						
X	Savannah Willowfly	*Taeniopteryx robinae*	Plecoptera	Taeniopterygidae						
X	Watauga Springfly	*Yugus kondratieffi*	Plecoptera	Perlodidae						
X	Smokies Forestfly	*Zapada chila*	Plecoptera	Nemouridae						
X	Fumose Forestfly	*Zapada fumosa*	Plecoptera	Nemouridae						
X	Uwharrie Needlefly	*Zealeuctra uwharrie*	Plecoptera	Leuctridae						
Spiders										
X	a Harvestman	*Fumontana deprehendor*	Opiliones	Triaenonychidae						
X	a Lampshade Weaver	*Hypochilus coylei*	Araneae	Hypochilidae						
X	Pocock's Lampshade-web Spider	*Hypochilus pococki*	Araneae	Hypochilidae						
X	a Lampshade Weaver	*Hypochilus sheari*	Araneae	Hypochilidae						
X	a longjawed orbweaver	*Meta menardi*	Araneae	Tetragnathidae						
X	Spruce–fir Moss Spider	*Microhexura montivaga*	Araneae	Dipluridae					E	E
X	a Cave Cobweb Spider	*Nesticus bishopi*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus brimleyi*	Araneae	Nesticidae						
X	Linville Caverns Spider	*Nesticus carolinensis*	Araneae	Nesticidae						
X	Lost Nantahala Cave Spider (endemic)	*Nesticus cooperi*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus crosbyi*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus gertschi*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus mimus*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus nasicus*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus reclusus*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus sheari*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus silvanus*	Araneae	Nesticidae						

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X	a Cave Cobweb Spider	*Nesticus sp. 1*	Araneae	Nesticidae						
X	a Cave Cobweb Spider	*Nesticus sp. 2*	Araneae	Nesticidae						
X	Southern Unstriped Scorpion	*Vaejovis carolinianus*	Scorpiones	Vaejovidae						
True Bugs										
X	Dismal Swamp Green Stink Bug	*Chlorochroa dismalia*	Hemiptera	Pentatomidae						

Table 3-11
Plant SGCN

Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
NONVASCULAR PLANTS (Lichens, Liverworts, Mosses)						
Acrobolbus ciliatus	a liverwort		SC-V	G3?	S1	
Campylium stellatum	Yellow Starry Fen Moss		SC-V	G5	S1	
Cetraria arenaria	Sand-loving Iceland Lichen		SC-V	G4	S2	
Gymnoderma lineare	Rock Gnome Lichen	E	E	G3	S3	
Hypotrachyna virginica	Virginia Loop Lichen		SC-V	G1G2	S1S2	
Lejeunea blomquistii	A liverwort		SC-V	G1G2	S1	
Lochocolea muricata	A liverwort		SC-V	G5	S1	
Lophocolea appalachiana	A liverwort		SC-V	G1G2Q	S1	
Sphagnum contortum	Contorted Peatmoss		T	G5	S1	
Sphagnum warnstorfii	Fen Peatmoss		SC-V	G5	S1	
VASCULAR PLANTS						
Acmispon helleri [Lotus unifoliolatus var. helleri]	Carolina Prairie-trefoil, Carolina Birdfoot-trefoil		T	G3	S3	M
Adiantum capillus-veneris	Southern Maidenhair Fern (Venus Hair Fern)		T	G5	S1	
Adlumia fungosa	Climbing Fumitory		SC-V	G4	S2	
Aeschynomene virginica	Sensitive Joint-vetch	T	T	G2	S1	VH
Agalinis virgata	Branched Gerardia, Pine Barren Gerardia		T	G3G4Q	S2	M
Agrostis mertensii	Arctic Bentgrass		E	G5	S1	
Aletris lutea	Yellow Colicroot		T	G4G5	S1	
Allium allegheniense	Allegheny Onion		SC-V	G3?	S1	H
Allium keeverae	Keever's Onion		SC-V	G2	S2	VH
Alnus crispa	Green Alder, Mountain Alder		SC-V	G5	S1	
Amaranthus pumilus	Seabeach Amaranth	T	T	G2	S1	VH
Amorpha confusa [Amorpha georgiana var. confus	Savanna Indigo-bush		T	G3	S3	M
Amorpha georgiana [Amorpha georgiana var. geor	Georgia Indigobush		E	G3	S2	VH
Amphicarpum muehlenbergianum	Blue Maiden-cane, Florida Goober Grass		E	G4	S1	
Anemone berlandieri	Southern Anemone, Eastern Prairie Anemone		E	G4?	S2	
Anemone caroliniana	Prairie Anemone, Carolina Anemone		E	G5	S1	
Arabis adpressipilis	Hairy Rockcress, Slender Rockcress		E	G4Q	S1	
Arethusa bulbosa	Bog-rose, Dragon's-mouth		E	G5	S1	
Aristida condensata	Big Three-awn Grass		T	G4?	S2	
Aristida simpliciflora	Southern Three-awn Grass		E	G3G4	S1S2	M
Arnoglossum ovatum var. lanceolatum	Savanna Indian-plantain		E	G4G5	S2	
Asclepias cinerea	Carolina Milkweed		SC-H	G4?	SH	
Asclepias pedicellata	Savannah Milkweed		SC-V	G4	S3	
Asplenium heteroresiliens	Carolina Spleenwort, Wagner's Spleenwort		E	G2	S2	
Asplenium monanthes	Single-sorus Spleenwort		E	G4	S1	
Asplenium ruta-muraria var. cryptolepis	American Wall-rue		SC-V	G5	S1	
Astragalus michauxii	Sandhills Milkvetch		SC-V	G3	S3	M
Baccharis glomeruliflora	Silverling		E	G4	S1	
Bacopa caroliniana	Blue Water-hyssop		T	G4G5	S1	
Bacopa innominata	Tropical Water-hyssop		SC-H	G3G5	SH	
Balduina atropurpurea	Purple-disk Honeycomb-head, Purple Balduina		E	G2	S1	VH
Baptisia aberrans	Eastern Prairie Blue Wild Indigo		E	G2	S2	
Baptisia alba	Thick-pod White Wild Indicgo		T	G5	S2	
Baptisia bracteata	Creamy Wild Indigo		SC-H	G4G5	SNR	M
Berberis canadensis	American Barberry		SC-V	G3G4	S2	M
Betula cordifolia	Mountain Paper Birch		SC-V	G5	S1	
Bouteloua curtipendula var. curtipendula	Sideoats Grama		T	G5	SNR	
Bromus ciliatus	Fringed Brome		SC-V	G5	S1	
Buchnera americana	American Bluehearts		E	G5?	S1	
Buckleya distichophylla	Piratebush		T	G3	S2	H
Bulbostylis warei	Ware's Hair Sedge		SC-H	G3G4	SH	M
Calamagrostis cainii	Cain's Reedgrass		E	G1	S1	VH
Calamagrostis canadensis var. canadensis	Canada Reedgrass		SC-V	G5	S1	

Table 3-11
Plant SGCN

Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Calopogon multiflorus	Many-flowered Grass-pink		E	G2G3	S1	
Caltha palustris var. palustris	Marsh Marigold		E	G5	S1	
Camassia scilloides	Wild Hyacinth		T	G4G5	S1	
Campanula rotundifolia	Bluebells		E	G5	S1	
Cardamine dissecta	Dissected Toothwort		SC-V	G4?	S2	
Cardamine longii	Long's Bittercress		SC-V	G3?	S2	H
Cardamine micranthera	Small-anthered Bittercress	E	E	G2	S1	VH
Carex arctata	Black Sedge		T	G5	S1	
Carex argyrantha	Hay Sedge		T	G5	S1	
Carex barrattii	Barratt's Sedge		T	G4	SH	M
Carex basiantha	Widow Sedge		E	G5	S1	
Carex buxbaumii	Brown Bog Sedge		SC-V	G5	S2	
Carex calcifugens	Calcium-fleeing Sedge		SC-V	G3	S2?	M
Carex careyana	Carey's Sedge		T	G4G5	S1	
Carex cherokeensis	Cherokee Sedge		T	G4G5	S1	
Carex conoidea	Cone-shaped Sedge		T	G5	S1	
Carex cristatella	Crested Sedge; Small-crested Sedge		SC-V	G5	S1	
Carex eburnea	Bristle-leaf Sedge		T	G5	S1	
Carex exilis	Coastal Sedge		E	G5	S2	
Carex hormathodes	Marsh Straw Sedge		T	G4G5	S1	
Carex impressinervia	Ravine Sedge, Impressed-nerved Sedge		SC-V	G2	S2	VH
Carex jamesii	James' Sedge		SC-V	G5	S2	
Carex lasiocarpa var. americana	Slender Sedge		SC-V	G5T5	S1	
Carex lutea	Golden Sedge	E	E	G2	S2	VH
Carex meadii	Mead's Sedge		E	G4G5	S1	
Carex oligocarpa	Rich-woods Sedge		T	G4G5	S1	
Carex oligosperma	Few-seeded Sedge		E	G5	S1	
Carex pedunculata var. pedunculata	Longstalk Sedge		SC-V	G5	S2	
Carex radfordii	Radford's Sedge		T	G3	S1	M
Carex reniformis	Kidney Sedge, Reniform Sedge		T	G4?	S1	M
Carex superata	Limestone Forest Sedge		T	G4?	S1?	
Carex tenax	Wire Sedge		E	G5?	S1	
Carex trichocarpa	Hairy-fruited Sedge		SC-V	G4	S1	
Carex trisperma	Three-seeded Sedge		E	G5	S1	
Carex utriculata	Beaked Sedge		E	G5	S1	
Carex vesicaria	Inflated Sedge		E	G5	S1	
Carex vestita	Velvet Sedge		T	G5	S1	
Carya laciniosa	Big Shellbark Hickory		T	G5	S1	
Carya myristiciformis	Nutmeg Hickory		E	G4	S1	
Caulophyllum giganteum	Northern Blue Cohosh		SC-V	G4G5	S1	
Celastrus scandens	American Bittersweet		E	G5	S2?	
Chamerion angustifolium ssp. circumvagum	Fireweed		E	G5T5	S1	
Chasmanthium nitidum	Shiny Spanglegrass, Shiny Spikegrass		T	G3G4	S1	M
Chelone cuthbertii	Cuthbert's Turtlehead		SC-V	G3	S3	M
Chenopodiastrum simplex	Mapleleaf Goosefoot		T	G5	S1	
Chrysoma pauciflosculosa	Woody Goldenrod		E	G4G5	S1	
Cirsium carolinianum	Carolina Thistle		E	G5	S2	
Cirsium lecontei	Le Conte's Thistle		SC-V	G3	S2	M
Clematis occidentalis var. occidentalis	Mountain Clematis		SC-V	G5	S1	
Clinopodium georgianum	Georgia Calamint		E	G5	S1	
Collinsonia verticillata	Whorled Horsebalm		T	G3G4	S2	
Conioselinum chinense	Hemlock-parsley		T	G5	S1	
Coptis trifolia	Goldthread		T	G5	S1	
Coreopsis auristulata	Short-awned Coreopsis		T	G5	S4	VH
Corydalis micrantha	Slender Corydalis		T	G5	S1	

Table 3-11
Plant SGCN

Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Coryphopteris simulata	Bog Fern		E	G4G5	S1	
Crataegus pallens	Pale Hawthorn		T	G1	S1	VH
Crinum americanum var. americanum	Swamp-lily		SC-H	G5	SH	
Crocanthemum bicknellii	Plains Sunrose		SC-V	G5	S1	
Crocanthemum carolinianum	Carolina Sunrose		E	G4	S1	
Crocanthemum corymbosum	Pinebarren Sunrose		T	G4G5	S1	
Crocanthemum georgianum	Georgia Sunrose		E	G4	S1	
Crocanthemum nashii	Florida Scrub Sunrose		E	G3?	S1	
Crocanthemum propinquum	Creeping Sunrose		T	G4	S1	
Crocanthemum rosmarinifolium	Rosemary Sunrose		T	G4	S2	
Croton monanthogynus	Prairie-tea Croton		E	G5	S1	
Cyperus dentatus	Toothed Flatsedge		SC-H	G4	SH	
Cyperus granitophilus	Granite Flatsedge		T	G3G4Q	S2	M
Cyperus lecontei	Le Conte's Flatsedge		T	G4?	S2	
Cyperus subsquarrosus	Small-flowered Halfchaff, Small-flowered Hemicarpha		SC-H	G5	SH	
Cyperus tetragonus	Four-angled Flatsedge		SC-V	G4?	S2	
Cyperus virens	Green Flatsedge		SC-V	G5	S1	
Cystopteris tennesseensis	Tennessee Bladder-fern		E	G5	S1	
Dactylorhiza viridis	Long-bracted Frog Orchid		T	G5	S1	
Dalibarda repens	Robin Runaway		E	G5	S2	
Delphinium exaltatum	Tall Larkspur		T	G3	S2	M
Deschampsia cespitosa ssp. glauca	Tufted Hairgrass		T	G5	S1	
Desmodium ochroleucum	Creamy Tick-trefoil		SC-H	G2G3	SH	H
Desmodium sessilifolium	Sessile Tick-trefoil		SC-H	G5	SH	
Diarrhena americana	Eastern Beakgrain; Eastern Beakgrass		T	G4G5	S1	
Dichanthelium annulum	Ringed Witchgrass		E	G4	S1	
Dichanthelium caerulescens	Blue Witchgrass		T	G2G3	S2	H
Dichanthelium hirstii	Hirst Brothers' Witchgrass		E	G1	S1	VH
Dichanthelium spretum	Eaton's Witchgrass		E	G5	S1S2	
Dichanthelium strigosum var. glabrescens	Hairless Witchgrass		T	G5T4T5	S1	
Diervilla rivularis [Diervilla sessilifolia var. rivularis]	Riverbank Bush-honeysuckle		T	G3	S1	M
Dionaea muscipula	Venus Flytrap		T	G2	S2	VH
Diplachne maritima	Salt-meadow Grass, Long-awned Sprangletop		E	G4Q	S1	M
Drosera filiformis var. filiffornis	Threadleaf Sundew		SC-V	G4	S2	
Echinacea laevigata	Smooth Coneflower	T	E	G2G3	S1S2	H
Eleocharis cellulosa	Gulfcoast Spikerush		T	G4G5	S2	
Eleocharis elongata	Florida Spikerush		E	G5?	S1	
Eleocharis parvula	Dwarf Spikerush		T	G5	S1	
Eleocharis robbinsii	Robbins' Spikerush		SC-V	G4G5	S2S3	
Eleocharis vivipara	Viviparous Spikerush		T	G5	S1	
Elymus trachycaulus ssp. trachycaulus	Slender Wheatgrass		T	G5	S1	
Enemion biternatum	Eastern Isopyrum; False Rue-anemone		SC-V	G5	S2	
Epidendrum conopseum	Green-fly Orchid		T	G4	S1S2	
Erigenia bulbosa	Harbinger-of-spring		T	G5	S1	
Eriocaulon aquaticum	Seven-angled Pipewort		SC-V	G5	S2	
Eriocaulon parkeri	Estuary Pipewort, Parker's Pipewort		T	G3	S1	H
Eriocaulon texense	Texas Hatpins		E	G4	S1	
Eriogonum tomentosum	Southern Wild-buckwheat		SC-H	G4G5	SH	
Erythrina herbacea	Coralbean		E	G5	S2	
Eupatorium leptophyllum	Limesink Dog-fennel		E	G4G5	S2	
Eupatorium paludicola	Bay Boneset		E	G2	S1S2	VH
Euphorbia commutata	Cliff Spurge		T	G5	S1	
Euphorbia cordifolia	Heartleaf Sandmat		T	G5	S1	
Euphorbia mercurialina	Cumberland Spurge		SC-V	G4	S2	
Filipendula rubra	Queen-of-the-Prairie		E	G4G5	S1	

Table 3-11
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Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Fimbristylis perpusilla	Harper's Fimbry		T	G2	S1	VH
Gaillardia aestivalis var. aestivalis	Sandhills Blanket-flower		E	G5	S2	
Galactia mollis	Soft Milk-pea		T	G4G5	S2	
Gaylussacia brachycera	Box Huckleberry		E	G3	S1	M
Gaylussacia nana	Confederate Huckleberry; Dwarf Dangleberry		E	G4	S1	
Gaylussacia orocola	Appalachian Dwarf Huckleberry		E	G1	S1	VH
Gelsemium rankinii	Swamp Jessamine		SC-V	G5	S1S2	
Gentiana alba	Pale Gentian; Yellow Gentian		SC-H	G4	SH	M
Gentiana latidens	Balsalm Mountain Gentian		T	G1G2	S1S2	
Gentianopsis crinita	Fringed Gentian		E	G5	S1	
Geum aleppicum	Yellow Avens		E	G5	S1	
Geum geniculatum	Bent Avens		SC-V	G2	S1S2	VH
Geum laciniatum	Rough Avens		E	G5	S1	
Geum radiatum	Spreading Avens	E	E	G2	S2	VH
Gillenia stipulata	Indian Physic		T	G5	S2	
Glyceria laxa	Lax Mannagrass		SC-V	G5	S2	
Gratiola lutea	Golden Hedge-hyssop		SC-V	G5	S1	
Gymnocarpium appalachianum	Appalachian Oak Fern		T	G3	S1	M
Harperella nodosa (Ptilimnium nodosum)	Harperella	E	E	G2	S1	VH
Helanthium tenellum	Dwarf Burhead		E	G5?	S1	
Helenium brevifolium	Littleleaf Sneezeweed, Shortleaf Sneezeweed		E	G4	S1	M
Helenium vernale	Spring Sneezeweed		E	G4?	S1	
Helianthus floridanus	Florida Sunflower		T	G3G4	S1	M
Helianthus laevigatus	Smooth Sunflower		SC-V	G4	S3	
Helianthus occidentalis ssp. occidentalis	Naked-stem Sunflower		SC-H	G5T5	SX	
Helianthus schweinitzii	Schweinitz's Sunflower	E	E	G3	S3	M
Helonias bullata	Swamp-pink	T	T	G3	S2	H
Hexastylis contracta	Southern Heartleaf		E	G3	S1	M
Hexastylis naniflora	Dwarf-flower Heartleaf	T	T	G3	S3	M
Hibiscus aculeatus	Comfortroot		T	G4G5	S1	
Hottonia inflata	Featherfoil		SC-V	G4	S1?	M
Houstonia montana [Hedyotis purpurea var. mont	Roan Mountain Bluet	E	E	G1	S1	VH
Hudsonia montana	Mountain Golden-heather	T	T	G1	S1	VH
Hudsonia tomentosa	Sand-heather		T	G5	S2	
Hydrastis canadensis	Goldenseal		SC-V	G3G4	S3	M
Hymenocallis occidentalis var. occidentalis	Hillside Spiderlily, Woodland Spiderlily		SC-H	G?TNR	SH	
Hymenocallis pygmaea	Waccamaw River Spiderlily		SC-V	G2Q	S1	VH
Hypericum adpressum	Bog St. John's-wort		SC-H	G3	SH	
Hypericum brachyphyllum	Coastal Plain St. John's-wort		SC-V	G5	S1S2	
Hypericum fasciculatum	Peelbark St. John's-wort		E	G5	S1	
Hypericum radfordiorum	Radford"s St. John's-word		SC-V	G2	S2	VH
Hypericum suffruticosum	Pineland St. John's-wort		SC-H	G4G5	SH	
Ilex collina	Long-stalked Holly		SC-V	G3	S1	H
Ipomoea imperati	Beach Morning-glory		SC-V	G5	S1	
Ipomoea macrorhiza	Manroot, Large-stem Morning-glory		SC-H	G3G5	SH	M
Isoetes microvela	Thin-wall Quillwort		T	G1	S1	VH
Isoetes piedmontana	Piedmont Quillwort		T	G4	S2	
Isotria medeoloides	Small Whorled Pogonia	T	T	G2G3	S1	H
Iva microcephala	Small-headed Marsh Elder		T	G5	S2	
Jeffersonia diphylla	Twinleaf		T	G5	S1	
Juncus articulatus	Jointleafed Rush		SC-H	G5	SH	
Juncus caesariensis	New Jersey Rush		E	G2G3	S1	H
Juniperus communis var. depressa	Dwarf Juniper		T	G5T5	S1	
Kalmia angustifolia	Sheep-laurel		T	G5	S1	
Koeleria spicata (Koeleria spicata ssp. spicata)	Soft Trisetum, Spike Trisetum		SC-H	G3G4	S2	

Table 3-11
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Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Lachnocaulon minus	Brown Bogbutton		T	G5T3Q	S1	M
Lechea maritima var. virginica	Maritime Pinweed		T	G5T3Q	S1	M
Lechea torreyi var. congesta	Torrey's Pinweed		E	G4TMR	S1	
Liatris aspera	Rough Blazing-star		SC-V	G4G5	S1	
Liatris helleri	Heller's Blazing-star	T	T	G2Q	S2	VH
Liatris microcephala	Small-head Blazing-star		SC-V	G3G4	S1	M
Lilium canadense	Canada Lily		E	G5	S1	
Lilium grayi	Gray's Lily		T	G1G2	S1S2	VH
Lilium philadelphicum var. philadelphicum	Wood Lily		E	G5	S1	
Lilium pyrophilum	Sandhills Lily		E	G2	S2	VH
Limosella australis	Awl-leaf Mudwort		T	G5	S1	
Lindera melissifolia	Pondberry	E	E	G3	S1	H
Lindera subcoriacea	Bog Spicebush		SC-V	G3	S2	M
Linum floridanum var. chrysocarpum	Yellow-fruited Flax		T	G5?T3?	S1S2	M
Linum sulcatum	Glade Flax		SC-H	G5	SH	
Liparis loeselii	Fen Orchid		E	G5	S1	
Lithospermum canescens	Hoary Puccoon		T	G5	S2	
Litsea aestivalis	Pondspice		SC-V	G3?	S2S3	M
Lobelia boykinii	Boykin's Lobelia		E	G2G3	S1S2	H
Lophiola aurea	Golden-crest		E	G4	S2	
Ludwigia lanceolata	Lanceleaf Seedbox		E	G3	S1	M
Ludwigia linifolia	Flaxleaf Seedbox		T	G4	S2	
Ludwigia ravenii	Raven's Seedbox		E	G1G2	S1 (S2?)	VH
Ludwigia sphaerocarpa	Globe-fruit Seedbox		E	G5	S1	
Ludwigia suffruticosa	Shrubby Seedbox		T	G5	S2	
Lupinus villosus	Lady Lupine, Pink Sandhill Lupine		E	G5	S1	
Lycopodiella inundata	Bog Clubmoss		E	G5	S1	
Lysimachia asperulifolia	Rough-leaf Loosestrife	E	E	G3	S3	M
Trientalis borealis	Northern Starflower		T	G5	S1	
Lysimachia fraseri	Fraser's Loosestrife		E	G3	S3	M
Macbridea caroliniana	Carolina Birds-in-a-nest, Carolina Bogmint		E	G2G3	S2	H
Magnolia macrophylla	Bigleaf Magnolia		SC-V	G5	S2	
Malaxis spicata	Florida Adder's-mouth		SC-V	G4?	S1	
Marshallia grandiflora	Large-flowered Barbara's-buttons		SC-H	GX	SX	VH
Marshallia legrandii	Oak Barrens Barbara's-buttons		E	G1	S1	VH
Marshallia trinervia	Broadleaf Barbara's-buttons		SC-H	G3	SH	M
Melanthium woodii	Ozark Bunchflower		T	G5	S1	
Melica nitens	Three-flowered Melic		E	G5	S1	
Menyanthes trifoliata	Buckbean		T	G5	S1	
Micranthes pensylvanica	Swamp Saxifrage		E	G5	S1	
Mnesithea cylindrica	Carolina Jointgrass		SC-H	G4G5	SH	
Mononeuria groenlandica	Greenland Sandwort		T	G5	S2	
Mononeuria paludicola [Minuartia godfreyi]	Godfrey's Sandwort		E	G1	S1	VH
Mononeuria uniflora	Single-flowered Sandwort		E	G4	S1	
Moranopteris nimbata	West Indian Dwarf Polypody		T	G4?	S1	
Muhlenbergia glomerata	Spiked Muhly		SC-V	G5	S1	
Muhlenbergia sobolifera	Rock Muhly		T	G5	S2	
Muhlenbergia torreyana	Pinebarren Smokegrass, Torrey's Dropseed		SC-V	G3	S2	H
Myrica gale	Sweet Gale		E	G5	S1	
Myriophyllum laxum	Loose Water-milfoil		E	G3	S2	M
Myriophyllum tenellum	Leafless Water-milfoil		E	G5	S1	
Nabalus albus	Northern Rattlesnake-root, White Rattlesnakeroot		SC-V	G5	S2?	
Narthecium montanum	Appalachian Yellow Asphodel		SC-H	GX	SX	VH
Oenothera perennis	Perennial Sundrops		SC-V	G5	S2	
Oldenlandia boscii	Bosc's Bluet		T	G5	S2	

Table 3-11
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Oligoneuron album	Prairie Goldenrod, White Prairie-goldenrod		E	G5	S1	
Oligoneuron jacksonii	Southeastern Bold Goldenrod		SC-V	G4	S2	
Oligoneuron rigidum	Midwestern Bold Goldenrod, Prairie Bold Goldenrod		T	G5T5 [G5]	S1 [SNR]	
Orbexilum macrophyllum	Bigleaf Scurfpea		SC-H	GX	SX	VH
Orbexilum onobrychis	Lanceleaf Scurfpea		SC-H	G5	SH	
Orbexilum pedunculatum	Western Sampson's Snakeroot		E	G5	SNR	
Oreojuncus trifidus	Highland Rush		T	G5	S1	
Orthochilus ecristatus	Spiked Medusa		E	G2G3	S1	
Pachysandra procumbens	Allegheny Spurge		E	G4G5	S1	
Packera crawfordii	Bog Ragwort, Crawford's Ragwort		E	G2	S1	VH
Packera millefolium	Blue Ridge Ragwort		SC-V	G3	S2	H
Packera paupercula var. appalachiana	Appalachian Ragwort		T	G5	S1?	
Packera paupercula var. paupercula	Balsam Ragwort		SC-V	G5T5	S1?	
Packera schweinitziana	New England Ragwort		T	G5?	S2	
Packera serpenticola	Buck Creek Ragwort		T	G1	S1	VH
Palustricodon aparinoides var. aparinoides	Marsh Bellflower		T	G5TNR	S2	
Panicum flexile	Wiry Panic Grass		T	G5	S1	
Parnassia caroliniana	Carolina Grass-of-Parnassus		T	G3	S2	H
Parnassia grandifolia	Bigleaf Grass-of-Parnassus		T	G3	S2	M
Paronychia herniarioides	Michaux's Whitlow-wort, Coastal Plain Nailwort		E	G2G4	S1	M
Paspalum dissectum	Mudbank Crown Grass		E	G4?	S2	M
Pedicularis lanceolata	Swamp Lousewort		T	G5	S1	
Pellaea wrightiana	Wright's Cliffbrake		E	G5	S1	
Persicaria hirsuta	Hairy Smartweed		E	G3G4	S1	
Phacelia maculata	Flatrock Phacelia, Spotted Scorpionweed		E	G3G4	S1	M
Phegopteris connectilis	Northern Beech Fern		E	G5	S2	
Phemeranthus piedmontanus	Piedmont Rock-pink		E	G1	S1	VH
Pinguicula lutea	Yellow Butterwort		SC-V	G4G5	S1	
Pinguicula pumila	Small Butterwort		T	G4	S2	M
Pityopsis graminifolia	A Silkgrass		E	G5	S1?	
Plantago cordata	Heart-leaf Plantain		E	G4	S1	M
Plantago sparsiflora	Pineland Plantain		T	G3	S1S2	M
Platanthera herbiola	Northern Rein Orchid, Tubercled Rein Orchid		SC-V	G4Q	S1S2	M
Platanthera integra	Yellow Fringeless Orchid		T	G3G4	S2	M
Platanthera integrilabia	White Fringeless Orchid	T	T	G2G3	SH	H
Platanthera nivea	Snowy Orchid		E	G5	SH	M
Platanthera peramoena	Purple Fringeless Orchid		T	G5	S2	
Platanthera shriveri	Shriver's Purple Fringed Orchid		E	G1	S1	VH
Poa saltuensis	Old-pasture Bluegrass		T	G5	S1	
Polemonium reptans var. reptans	Spreading Jacob's Ladder		T	G5T5	S1	
Polygala hookeri	Hooker's Milkwort		SC-V	G3	S2S3	M
Polygala senega	Seneca Snakeroot		SC-V	G4G5	S2	
Polygonella articulata	Coast Jointweed, Northern Wireweed		SC-H	G5	SH	
Polygonum glaucum	Seabeach Knotweed		E	G3	S1	M
Ponthieva racemosa	Shadow-witch		T	G4G5	S2	
Portulaca smallii	Small's Portulaca		T	G3	S2	M
Potamogeton illinoensis	Illinois Pondweed		E	G5	S1	
Primula meadia	Eastern Shooting-star		SC-V	G4G5	S2S3	
Pseudognaphalium helleri	Heller's Rabbit-tobacco		E	G3G4	S2S3	M
Ptilimnium costatum	Big Bishopweed		T	G4	SNR	M
Pyrola elliptica	Elliptic Shinleaf		T	G5	S1	
Pyxidanthera brevifolia	Sandhills Pyxie-moss		T	G3	S2	H
Quercus elliottii	Running Oak		E	G3G5	S2	
Quercus ilicifolia	Bear Oak		E	G5	S2	
Quercus minima	Dwarf Live Oak		E	G5	S1	

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Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Quercus prinoides	Dwarf Chinquapin Oak		E	G5	S1	
Ranunculus ambigens	Water-plantain Spearwort		SC-H	G4	SH	
Ranunculus hederaceus	Ivy Buttercup, Ivy-leaved Water Crowfoot		T	G5	S1	
Rhexia aristosa	Awned Meadow-beauty		SC-V	G3G4	S3	
Rhodiola rosea	Roseroot		E	G5	SH	
Rhododendron prinophyllum	Election Pink		T	G5	S1	
Rhus michauxii	Michaux's Sumac	E	E	G2G3	S2	H
Rhynchospora crinipes	Alabama Beaksedge		T	G3	S1	M
Rhynchospora decurrens	Swamp Forest Beaksedge		T	G3G4	S1S2	M
Rhynchospora harperi	Harper's Beaksedge		SC-V	G4?	S2	M
Rhynchospora macra	Southern White Beaksedge		T	G3G4	S2	M
Rhynchospora microcarpa	Southern Beakssedge		T	G5	S2	
Rhynchospora odorata	Fragrant Beaksedge		SC-V	G4	S1	
Rhynchospora pleiantha	Coastal Beaksedge		T	G2G3	S2	H
Rhynchospora thornei	Thorne's Beaksedge		SC-V	G3	S2	H
Rhynchospora tracyi	Tracy's Beaksedge		T	G4	S2	
Rubus strigosus	American Red Raspberry		T	G5	S2?	
Rudbeckia heliopsidis	Sun-facing Coneflower		E	G2	S1	VH
Ruellia ciliosa	Sandhills Wild-petunia		T	G3G5	S2	
Ruellia humilis	Low Wild-petunia		T	G5	S1	
Ruellia purshiana	Pursh's Wild-petunia		SC-V	G3	S2	M
Ruellia strepens	Limestone Wild Petunia		E	G4G5	S1	
Sabal palmetto	Cabbage Palmetto		T	G5	S1	
Sabatia kennedyana	Plymouth Gentian		T	G3G4	S2	M
Sageretia minutiflora	Small-flowered Buckthorn		T	G4	S1	M
Sagittaria chapmanii	Chapman's Arrowhead		T	G3?	S1	M
Sagittaria fasciculata	Bunched Arrowhead	E	E	G2	S1	VH
Sagittaria isoetiformis	Quillwort Arrowhead		T	G4?	S2	M
Sagittaria macrocarpa	Streamhead Arrowhead, Streamhead Sagittaria		T	G2	S2	VH
Sagittaria weatherbiana	Grassleaf Arrowhead		E	G3G4	S2	M
Sarracenia jonesii	Mountain Sweet Pitcherplant	E	E	G2	S1	VH
Sarracenia minor var. minor	Hooded Pitcherplant		E	G4T4	S2	
Sarracenia oreophila	Green Pitcherplant	E	E	G2	S1	VH
Sarracenia purpurea var. montana	Southern Appalachian Purple Pitcher Plant		E	G5T1T2	S1S2	VH
Sceptridium jenmanii	Alabama Grape-fern		SC-V	G3G4	S2	
Schisandra glabra	Magnolia Vine		T	G3	S1	M
Schwalbea americana	Chaffseed	E	E	G2	S2	VH
Scirpus flaccidifolius	Reclining Bulrush		E	G2	S1	VH
Scirpus lineatus	Drooping Bulrush		T	G4	S2	
Scleria baldwinii	Baldwin's Nutrush		T	G4	S2	
Scleria bellii	Smooth-seeded Hairy Nutrush		E	G4	S2	H
Scleria reticularis	Netted Nutrush		SC-V	G4	S2	
Sclerolepis uniflora	One-flower Hardscale, Sclerolepis		T	G4	S2	
Scutellaria australis	Southern Skullcap		E	G5	SH	
Scutellaria galericulata	Hooded Skullcap		SC-H	G5	SH	
Scutellaria leonardii	Shale-barren Skullcap		E	G4	S2	
Scutellaria nervosa	Veined Skullcap		E	G5	S1	
Sedum pusillum	Puck's Orpine		E	G3	S1	M
Senecio suaveolens	Sweet Indian-plantain		E	G4	S1	
Sesuvium maritimum	Slender Sea-purslane		E	G5	S1	
Sesuvium portulacastrum	Shoreline Sea-purslane		E	G5	S1	
Seymeria pectinata ssp. pectinata	Comb Seymeria		SC-H	G4G5	SNR	
Shortia brevistyla	Northern Oconee Bells		T	G2	S2	VH
Shortia galacifolia	Southern Oconee Bells		SC-V	G3	S2	H
Sideroxylon tenax	Tough Bumelia		T	G3?	S1	M

Table 3-11
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Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Silene ovata	Mountain Catchfly		SC-V	G3	S3	M
Silphium connatum [Silphium perfoliatum var. con	Virginia Cup-plant		SC-V	G3G4	S2	M
Silphium perfoliatum	Common Cup-plant		SC-V	G5	S1	
Sisyrinchium dichotomum	White Irisette	E	E	G2	S2	VH
Solidago leavenworthii	Leavenworth's Goldenrod		E	G3G4	S1	M
Solidago plumosa	Yadkin River Goldenrod		T	G1	S1	
Solidago radula [S. radula var. laeta, S.radula var.	Western Rough Goldenrod		E	G5?	S1	M, H
Solidago spithamaea	Blue Ridge Goldenrod	T	T	G2	S2	VH
Solidago tortifolia	Twisted-leaf Goldenrod		E	G4G5	S1	
Solidago verna	Spring-flowering Goldenrod		T	G3	S3	M
Solidago villosicarpa	Carolina Maritime Goldenrod, Coastal Goldenrod		T	G1	S1	VH
Sparganium acaule	Greenfruit Bur-reed		E	GNR	S1	
Spartina pectinata	Freshwater Cordgrass		T	G5	S1	
Spigelia marilandica	Pink-root		T	G4	S1	
Spiraea corymbosa	Rock Spirea, Shinyleaf Meadowsweet		E	G4?	S1	
Spiraea virginiana	Virginia Spiraea	T	T	G2	S2	VH
Spiranthes lacera var. lacera	Northern Slender Ladies'-tresses		E	G5T5	S1	
Spiranthes laciniata	Lace-lip Ladies'-tresses		SC-V	G4G5	S2	
Spiranthes longilabris	Giant-spiral Orchid		E	G3	S1	M
Spiranthes lucida	Shining Ladies'-tresses		E	G4	S1	M
Spiranthes ochroleuca	Yellow Nodding Ladies'-tresses		T	G4	S1	
Sporobolus heterolepis	Prairie Dropseed		T	G5	S1	
Sporobolus teretifolius	Wireleaf Dropseed		E	G2	S1	VH
Sporobolus virginicus	Saltmarsh Dropseed, Seashore Dropseed		T	G5	S1	
Stachys appalachiana	Appalachian Hedge-nettle		E	G1G2	S1	VH
Stachys eplingii	Epling's Hedge-nettle		E	G1G2	S1	VH
Stachys matthewsii	Yadkin Hedge-nettle		E	G1G2	S1	VH
Stenanthium gramineum var. robustum	Bog Featherbells		E	G4G5	S3?	H
Stenanthium leimanthoides	Pinebarrens Death-camas		T	G4Q	S1	VH
Stylisma aquatica	Water Dawnflower		E	G4	S2	M
Stylisma pickeringii var. pickeringii	Pickering's Dawnflower		SC-V	G4T3	S3	M
Swida asperifolia	Eastern Roughleaf Dogwood		E	G4	S1	
Swida racemosa	Gray Dogwood		SC-V	G5	S1	
Symphyotrichum concinnum	Narrow-leaved Smooth Aster		E	G4	S2	
Symphyotrichum depauperatum	Serpentine Aster		E	G2	S1	VH
Symphyotrichum georgianum	Georgia Aster	C	T	G3	S3	M
Symphyotrichum oblongifolium	Eastern Aromatic Aster		T	G5	S1	
Symphyotrichum rhiannon	Buck Creek Aster		T	G1	S1	VH
Synandra hispidula	Synandra		T	G4	S1	M
Taxus canadensis	Canada Yew		T	G5	S1	
Thalictrum cooleyi	Cooley's Meadowrue	E	E	G1	S1	VH
Thalictrum macrostylum	Small-leaved Meadowrue		SC-V	G3G4	S2	M
Thaspium pinnatifidum	Mountain Thaspium		E	G2G3	S1	H
Thermopsis fraxinifolia	Ash-leaved Golden-banner		SC-V	G3?	S2?	M
Tiedemannia canbyi (Oxypolis canbyi)	Canby's Dropwort	E	E	G2	S1	VH
Triantha glutinosa	Sticky Bog Asphodel		SC-V	G5	S1	
Trichostema brachiatum	Glade Bluecurls		E	G5	S1	
Trichostema nesophilum	Dune Bluecurls		SC-V	G2	S2	VH
Tridens ambiguus	Pineland Triodia		E	G4	S1	
Tridens chapmanii	Chapman's Redtop, Chapman's Triodia		SC-V	G5T3	S1S2	M
Tridens strictus	Spike Triodia		SC-H	G5	SH	
Trifolium carolinianum	Carolina Clover		SC-H	G5	SH	
Trifolium reflexum	Buffalo Clover		T	G3G4	S1S2	M
Trillium discolor	Mottled Trillium, Pale Yellow Trillium		T	G3	S1	
Trillium flexipes	Bent White Trillium		T	G5	S1	

Table 3-11
Plant SGCN

Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]
Trillium pusillum var. ozarkanum	Ozark Least Trillium		E	G4T3	SH (S1)	M
Trillium pusillum var. pusillum	Carolina Least Trillium		E	T3	S2	H
Trillium pusillum var. virginianum	Virginia Least Trillium		E	G4T3	S1	H
Trillium recurvatum	Prairie Trillium, Recurved Trillium		T	G5	S1	
Trillium sessile	Sessile-flowered Trillium		T	G5	S1	
Trillium simile	Sweet White Trillium		SC-V	G3	S2	M
Turritis glabra	Tower Mustard		E	G5	S1	
Urtica chamaedryoides	Dwarf Stinging Nettle		T	G4G5	S2	
Utricularia cornuta	Horned Bladderwort		T	G5	S1S2	
Utricularia geminiscapa	Two-flowered Bladderwort		SC-V	G4G5	S1	
Utricularia minor	Small Bladderwort		SC-H	G5	SH	
Utricularia olivacea	Dwarf Bladderwort		T	G4	S2	M
Utricularia resupinata	Northeastern Bladderwort		E	G4	S1	M
Vaccinium macrocarpon	Cranberry		T	G5	S2	
Vandenboschia boschiana	Appalachian Filmy-fern, Appalachian Bristle Fern		E	G4	S1	
Veronica americana	American Speedwell		T	G5	S2	
Waldsteinia lobata	Lobed Barren-strawberry		E	G3	SH	M
Warea cuneifolia	Carolina Pineland-cress, Nuttall's Warea		E	G4	S1	M
Woodsia ilvensis	Rusty Cliff Fern		E	G5	S1	
Xyris floridana	Florida Yellow-eyed-grass		SC-V	G4G5	S1	
Xyris scabrifolia	Harper's Yellow-eyed-grass, Roughleaf Yellow-eyed-grass		SC-V	G3	S2	M
Xyris serotina	Acid-swamp Yellow-eyed-grass		SC-H	G3G4	SH	M
Xyris stricta	Pineland Yellow-eyed-grass		E	G4	SNR	
Zephyranthes simpsonii	Rain Lily, Florida Atamasco-lily		E	G2G3	S1	H

[1] **Federal and State Status Abbreviations**

Federal Listings

E = Endangered T = Threatened T (S/A) = Threatened due to Similar Appearance C = Candidate
PE = Proposed Endangered PT = Proposed Threatened

In North Carolina, Endangered, Threatened, and Special Concern species have legally protected status through the North Carolina Plant Conservation Program (NCPCP).

State Listings

E = Endangered T = Threatened SC = Special Concern
SC-H = Special Concern, Historic
SC-V = Special Concern, Vulnerable

A copy of this table can be downloaded in MicroSoft Excel format from the NC Wildlife Action Plan web site: **www.ncwildlife.org/plan**

[2] **Natureserve Global and State Ranks**

Conservation ranks are either state (S) or global (G) and are based on a one-to-five scale, ranging from critically imperiled (S1 or G1) to demonstrably secure (S5 or G5). Global (G) ranks apply to the species throughout its range while state (S) ranks apply to the species within North Carolina. A rank involving two numbers indicates uncertainty based on existing data.

S1/G1 Critically imperiled: Typically 5 or fewer occurrences or very few remaining individuals (<1,000).
S2/G2 Imperiled: Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000).
S3/G3 Vulnerable: Typically 21 to 100 occurrences or between 3,000 to 10,000 individuals.
S4/G4 Apparently Secure: Usually with more than 100 occurrences and more than 10,000 individuals.
S5/G5 Secure: Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Table 3-11
Plant SGCN

Scientific Name	Common Name	Federal Status [1]	State Status [1]	Global Rank [2]	State Rank [2]	SEAFWA RSGCN [3]

Additional designations are used to further indicate status globally (G) or within the state (S).

H - Historical: Possibly extirpated; known from historical records but may not have been verified in the past 20 to 40 years.
NR - Not Ranked: Rank not yet assessed in the state.
NA - Not Applicable: Applies to hybrid, exotic origin, accidental/irregular occurrence; synonym or taxon not recognized, or never found in state.
Q - Questionable Taxonomy: Distinctiveness of this species as a taxon at the current level is questionable.
X - Presumed Extirpated: Believed to be extirpated; has not been located after intensive searches of historical sites or other appropriate habitats.
U - Unrankable: More information is needed; unrankable due to lack of information or substantially conflicting information about status or trends.
? - Uncertain: Inexact or uncertain numeric rank.

[3] SEAFWA Regional SGCN

VH = Very High H = High M = Moderate

Table 3-12
EBCI SGCN and Culturally Important Priority Species

2025 WAP Revision

NC SWAP SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family
AMPHIBIANS				
	Alleghany Mountain Dusky Salamander	*Desmognathus ochrophaeus*	Caudata (Urodela)	Plethodontidae
	Appalachian Mountain Chorus Frog	*Pseudacris brachyphona*	Anura	Hylidae
	Camp's Dusky Salamander	*Desmognathus campi*	Caudata (Urodela)	Plethodintidae
	Carolina Mountain Dusky Salamander	*Desmognathus carolinensis*	Caudata (Urodela)	Plethodontidae
	Cave Salamander	*Eurycea lucifuga*	Caudata (Urodela)	Plethodontidae
X	Chamerlain's Dwarf salamander	*Eurycea chamberlaini*	Caudata (Urodela)	Plethodontidae
X	Chattahoochee slimy salamander	*Plethodon chattahoochee*	Caudata (Urodela)	Plethodontidae
	Cherokee Black-bellied Salamander	*Desmognathus gvnigeusgwotli*	Caudata (Urodela)	Plethodontidae
X	Dwarf Black-bellied Salamander	*Desmognathus folkertsi*	Caudata (Urodela)	Plethodontidae
X	Eastern tiger salamander	*Ambystoma tigrinum*	Caudata (Urodela)	Ambystomatidae
X	Four-toed Salamander	*Hemidactylium scutatum*	Caudata (Urodela)	Plethodontidae
	Great Balsams Mountain Dusky Salamander	*Desmognathis balsameus*	Caudata (Urodela)	Plethodontidae
	Great Smokies Mountain Dusky Salamander	*Desmognathus adatsihi*	Caudata (Urodela)	Plethodontidae
X	Imitator Salamander	*Desmognathus imitator*	Caudata (Urodela)	Plethodontidae
X	Jordan's Salamander (complex)	*Plethodon jordani*	Caudata (Urodela)	Plethodontidae
X	Junaluska Salamander	*Eurycea junaluska*	Caudata (Urodela)	Plethodontidae
X	Long-tailed Salamander	*Eurycea lingicauda*	Caudata (Urodela)	Plethodontidae
	Marbled Salamander	*Ambystoma opacum*	Caudata (Urodela)	Ambystomatidae
X	Mole Salamander	*Ambystoma talpoideum*	Caudata (Urodela)	Ambystomatidae
	Mud Salamander	*Pseudotriton montanus*	Caudata (Urodela)	Plethodontidae
X	Mudpuppy	*Necturus maculosus*	Caudata (Urodela)	Proteidae
	Nantahala black-bellied salamander	*Desmognathus amphileucas*	Caudata (Urodela)	Plethodontidae
	Nantahala Black-bellied Salamander	*Desmognathus aureatus*	Caudata (Urodela)	Plethodontidae
X	Northern Pygmy Salamander	*Desmognathus organi*	Caudata (Urodela)	Plethodontidae
	Red-backed Salamander	*Plethodon cinereus*	Caudata (Urodela)	Plethodontidae
X	Santeetlah Dusky Salamander	*Desmognathus santeetlah*	Caudata (Urodela)	Plethodontidae
X	Seepage Salamander	*Desmognathus aenus*	Caudata (Urodela)	Plethodontidae

Table 3-12
EBCI SGCN and Culturally Important Priority Species

2025 WAP Revision

NC SWAP SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family
	Shovel-nosed Salamander	*Desmognathus marmoratus*	Caudata (Urodela)	Plethodontidae
X	Southern Pygmy Salamander	*Desmognathus wrighti*	Caudata (Urodela)	Plethodontidae
X	Southern Ravine Salamander	*Plethodon richmondi*	Caudata (Urodela)	Plethodontidae
X	Southern Zigzag Salamander	*Plethodon ventralis*	Caudata (Urodela)	Plethodontidae
X	Spotted Dusky Salamander	*Desmognathus conanti*	Caudata (Urodela)	Plethodontidae
	Spotted Salamander	*Ambystoma maculatum*	Caudata (Urodela)	Ambystomatidae
	Tallulah Salamander	*Desmognathus perlapsus*	Caudata (Urodela)	Plethodontidae
X	Tellico Salamander	*Plethodon aureolus*	Caudata (Urodela)	Plethodontidae
	Virginia Dusky Salamander, Flat-headed Sala	*Desmognathus planiceps*	Caudata (Urodela)	Plethodontidae
X	Wehrle's (Roanoke) Salamander	*Plethodon wehrlei*	Caudata (Urodela)	Plethodontidae
X	Yonahlossee Salamander	*Plethodon yonahlossee*	Caudata (Urodela)	Plethodontidae
BIRDS				
X,N	American Bittern	*Botaurus lentiginosus*	Pelicaniformes	Areidae
X	American Black Duck	*Anas rubripes*	Anseriformes	Anatidae
X	Bald Eagle	*Haliaeetus leucocephalus*	Accipitriformes	Accipitridae
X	Bank Swallow	*Riparia riparia*	Passeriformes	Hirundinidae
X	Barn Owl	*Tyto alba*	Strigiformes	Tytonidae
	Blue-headed Vireo	*Vireo solitarius alticola*	Passeriformes	Vireonidae
X	Bobolink	*Dolichonyx oryzivorus*	Passeriformes	Icteridae
X	Brown Creeper	*Certhia americana nigrescens*	Passeriformes	Certhiidae
X,N	Brown-headed nuthatch	*Sitta pusillo*	Passeriformes	Sittidae
X	Canvasback	*Aythya valisineria*	Anseriformes	Anatidae
	Carin's Black-throated Blue Warbler	*Setophaga caerulescens cairnsi*	Passeriformes	Parulidae
	Carolina Slate-colored Junco	*Junco hyemalis carolinensis*	Passeriformes	Passerellidae
X	Cerulean Warbler	*Setophaga cerulea*	Passeriformes	Parulidae
X	Common Gallinule	*Gallinula galeata*	Gruiformes	Rallidae
X	Common Tern	*Sterna hirundo*	Charadriiformes	Laridae
X	Dickcissel	*Spiza americana*	Passeriformes	Cardinalidae

Table 3-12
EBCI SGCN and Culturally Important Priority Species

2025 WAP Revision

NC SWAP SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family
X	Eastern Whip-poor-will	*Antrostomus vociferus*	Caprimulgiformes	Caprimulgidae
X	Gadwall	*Anas strepera*	Anseriformes	Anatidae
X	Golden Eagle	*Aquilla chrysaetos*	Accipitriformes	Accipitridae
X	Golden-winged Warbler	*Vermivora chrysoptera*	Passeriformes	Parulidae
X	Grasshopper Sparrow	*Ammodramus savannarum*	Passeriformes	Passerellidae
X	Kentucky Warbler	*Geothlypis formosa*	Passeriformes	Parulidae
X	Little Blue Heron	*Egretta caerulea*	Pelicaniformes	Ardeidae
X	Loggerhead Shrike	*Lanius ludovicianus*	Passeriformes	Laniidae
X	Northern Bobwhite	*Colinus virginianus*	Galliformes	Odontophoridae
X	Northern Saw-whet Owl	*Aegolius acadicus*	Strigiformes	Strigidae
X	Osprey	*Pandion haliaetus*	Accipitriformes	Pandionidae
X	Peregrine Falcon	*Falco peregrinus*	Falconiformes	Falconidae
X	Red Crossbill	*Loxia curvirostra*	Passeriformes	Fringillidae
X	Ruffed Grouse	*Bonasa umbellus*	Galliformes	Phasianidae
X	Savannah Sparrow	*Passerculus sandwichensis*	Passeriformes	Passerellidae
X	Sharp-shinned Hawk	*Accipiter striatus*	Accipitriformes	Accipitridae
	Southern Appalachian Black-capped Chi	*Poecile atricapilla practica*	Passeriformes	Paridae
	Veery	*Catharus fuscescens pulichorum*	Passeriformes	Turdidae
X	Vesper Sparrow	*Pooecetes gramineus*	Passeriformes	Passerellidae
X	Virginia Rail	*Rallus limicola*	Gruiformes	Rallidae
	Winter Wren	*Troglodytes hiemalis pullus*	Passeriformes	Troglodytidae
X	Wood Thrush	*Hylocichla mustelina*	Passeriformes	Turdidae
X	Yellow Warbler	*Setophaga petechia*	Passeriformes	Parulidae
	Yellow-bellied Sapsucker	*Sphyrapicus varius "appalachiensis"*	Piciformes	Picidae
X	Yellow-crowned Night Heron	*Nyctanassa violacea*	Pelicaniformes	Ardeidae
FRESHWATER FISH				
X	Black Buffalo	*Ictiobus niger*	Cypriniformes	Catostomidae
	Black Redhorse	*Moxostoma duquesnei*	Cypriniformes	Catostomidae

Table 3-12
EBCI SGCN and Culturally Important Priority Species

2025 WAP Revision

NC SWAP SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family
X	Blotchside Logperch	*Percina burtoni*	Perciformes	Percidae
X	Brook Trout (Native)	*Salvelinus fontinalis*	Salmoniformes	Salmonidae
X	Freshwater Drum	*Aplodinotus grunniens*	Perciformes	Sciaenidae
	Gizzard Shad	*Dorosoma cepedianum*	Clupeiformes	Dorosomatidae
	Golden Redhorse	*Moxostoma erythrurum*	Cypriniformes	Catostomidae
	Lake Sturgeon	*Acipenser fulvescens*	Acipenseriformes	Acipenseridae
	Longnose Gar	*Lepisosteus osseus*	Lepisosteiformes	Lepisosteidae
X	Mooneye	*Hiodon tergisus*	Osteoglossiformes	Hiodontidae
	Mountain Brook Lamprey	*Ichthyomyzon greeleyi*	Petromyzontiformes	Petromyzontidae
	Muskellunge (Naturalized)	*Esox masquinongy*	Esociformes	Esocidae
	Olive Darter	*Percina squamata*	Perciformes	Percidae
	Paddlefish	*Polyodon spathula*	Acipenseriformes	Polyodontidae
X	Quillback	*Carpiodes cyprinus*	Cypriniformes	Catostomidae
X	Redside Daces (Hiwassee, Smoky Dace)	*Clinostomus sp.*	Cypriniformes	Leuciscidae
X	River Redhorse	*Moxostoma carinatum*	Cypriniformes	Catostomidae
	Sauger	*Sander canadensis*	Perciformes	Percidae
X	Sicklefin Redhorse	*Moxostoma sp.*	Cypriniformes	Catostomidae
	Silver Redhorse	*Moxostoma anisurum*	Cypriniformes	Catostomidae
X	Smallmouth Buffalo	*Ictiobus bubalus*	Cypriniformes	Catostomidae
	Smallmouth Redhorse	*Moxostoma breviceps*	Cypriniformes	Catostomidae
X	Spotfin Chub	*Erimonax monachus*	Cypriniformes	Leuciscidae
X	Stonecat Madtom	*Noturus flavus*	Siluriformes	Ictaluridae
	Tuckasegee Darter	*Etheostoma gutselli*	Perciformes	Percidae
	Walleye	*Sander vitreus*	Perciformes	Percidae
	White Sucker	*Catostomus commersonii*	Cypriniformes	Catostomidae
X	Wounded Darter	*Nothonotus vulneratus*	Perciformes	Percidae
MAMMALS				
X	Allegheny Woodrat	*Neotoma magister*	Rodentia	Cricetidae

Table 3-12
EBCI SGCN and Culturally Important Priority Species

2025 WAP Revision

NC SWAP SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family
X	American Pygmy Shrew	*Sorex hoyi*	Eulipotyphala	Soricidae
	American Water Shrew	*Sorex paulstris*	Eulipotyphla	Soricidae
X	Appalachian Cottontail Rabbit	*Sylvilagus obscurus*	Lagomorpha	Leporidae
X	Carolina Northern Flying Squirrel	*Glaucomys sabrinus*	Rodentia	Sciuridae
	Eastern Fox Squirrel	*Sciurus niger*	Rodentia	Sciuridae
	Eastern Red Bat	*Lasiurus borealis*	Chiroptera	Vespertilionidae
X	Eastern Small-footed Bat	*Myotis leibii*	Chiroptera	Vespertilionidae
X	Eastern Spotted Skunk	*Spilogale putorius*	Carnivora	Mephitidae
	Elk	*Cervus elaphus*	Artiodactyla	Cervidae
	Fisher	*Pekania pennanti*	Carnivora	Mustelidae
X	Gray Myotis	*Myotis grisescens*	Chiroptera	Vespertilionidae
	Hairy-tailed mole	*Parascalops breweri*	Eulipotyphla	Talpidae
X	Hoary Bat	*Lasiurus cinereu*	Chiroptera	Vespertilionidae
X	Indiana Bat	*Myotis septentrionalis*	Chiroptera	Vespertilionidae
X	Little Brown Bat	*Myotis lucifugus*	Chiroptera	Vespertilionidae
X	Long-tailed Shrew	*Sorex dispar*	Eulipotyphla	Soricidae
	Nine-banded Armadillo	*Dasypus novemcinctus*	Cingulata	Dasypodidae
	North American Porcupine	*Erethizon dorsatum*	Rodentia	Erethizontidae
X	Northern Long-eared Bat	*Myotis septentrionalis*	Chiroptera	Vespertilionidae
X	Northern Yellow Bat	*Lasiurus intermedius*	Chiroptera	Vespertilionidae
X	Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii rafinesquii*	Chiroptera	Vespertilionidae
X	Rock Vole	*Microtus chrotorrhinus*	Rodentia	Cricetidae
	Seminole Bat	*Lasiurus seminolus*	Chiroptera	Vespertilionidae
	Silver-haired Bat	*Lasionycteris noctivagan*	Chiroptera	Verpertilionidae
	Southern red-backed Vole	*Clethrionomys gapperi*	Rodentia	Cricetidae
X	Tricolored Bat	*Perimyotis subflavus*	Chiroptera	Vespertilionidae
	White-tailed Deer	*Odocoileus virginianus*	Artiodactyla	Cervidae
REPTILES				

Table 3-12
EBCI SGCN and Culturally Important Priority Species

2025 WAP Revision

NC SWAP SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family
X	Bog Turtle	*Glyptemys muhlenbergii*	Testudines	Emydidae
X	Coal Skink	*Plestiodon anthracinus*	Squamata	Scincidae
X, N	Cumberland Slider	*Trachemys scripta troostii*	Testudines	Emydidae
X	Eastern Box Turtle	*Terrapene carolina carolina*	Testudines	Emydidae
X	Eastern Hognose Snake	*Heterodon platirhinos*	Squamata	Colubridae
X	Eastern Milksnake	*Lampropeltis triangulum triangulum*	Squamata	Colubridae
	Eastern Musk Turtle	*Sternotherus odoratus*	Testudines	Kinosternidae
X, N	Eastern Spiny Softshell	*Apalone spinifera*	Testudines	Trionychudae
X	Mole Kingsnake	*Lampropeltis rhombomaculata*	Squamata	Colubridae
X, N	Northern Map Turtle	*Graptemys geographica*	Testudines	Emydidae
X, N	Pine Snake	*Pituophis melanoleucos*	Squamata	Colubridae
X	Queen Snake	*Regina septemvittata*	Squamata	Colubridae
X, N	Slender Glass Lizard	*Ophisaurus attenuatus*	Squamata	Anguidae
X	Smooth Earth Snake	*Virginia valeriae*	Squamata	Colubridae
X, N	Stripe-necked Musk Turtle	*Sternotherus peltifer*	Testudines	Kinosternidae
X, N	Timber Rattlesnake	*Crotalus horridus*	Squamata	Viperidae

Table 3-13 Federal and state listing status abbreviations and definitions.

Federal Listing Status	
E	**Endangered**; a taxon which is in danger of extinction throughout all or a significant portion of its range.
T	**Threatened**; a taxon which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
C	**Candidate**; taxa for which the [Fish and Wildlife] Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.
At-Risk	**At-Risk Species**; Those that appear to be in decline or otherwise in need of conservation and are under consideration for listing or for which there is insufficient information to support listing at this time. At-risk species may also include species petitioned by outside parties and other selected focal species identified in USFWS strategic plans, State Wildlife Action Plans, or Natural Heritage Program Lists.
State Listing Status	
E	**Endangered**; any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined to be in jeopardy or listed as a federal endangered species.
T	**Threatened**; any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range or listed as a federal threatened species.
SC	**Special Concern**; any species of wild animal native or once-native to North Carolina which is determined to require monitoring but which may be taken under regulations adopted under State laws.

Table 3-14 Invasive or nonnative species common and scientific names.

Scientific Name	Common Name
A Terrestrial Snail	*Bulimulus tennuissimus*
A Terrestrial Snail	*Bulimulus tennuissimus puellaris*
Alligatorweed	*Alternanthera philoxeroides*
Asian Clam	*Corbicula fluminea*
Asian Dayflower	*Murdannia keisak*
Balsam Woolly Adelgid	*Adelges piceae*
Beach Vitex	*Vitex rotundifolia*
Bighead Carp	*Hypophthalmichthys nobilis*
Black Mat Algae	*Lyngbya spp*
Blue Catfish	*Ictalarus furcatus*
Blue-Green Mat Algae	*Lyngbya spp*
Bodie Bass	*Morone saxatilis x chrysops*
Brown Anole	*Anolis sagrei*
Brown Rat	*Rattus norvegicus*
Brown-Banded Arion	*Arion circumscriptus*
Brown-Headed Cowbird	*Molothrus ater*
Cattle Egret	*Bubulcus ibis*
Channel Catfish	*Ictalurus punctatus*
Chinese Mystery Snail	*Cipangopaludina chinensis*
Chinese Privet	*Ligustrum chinensis*
Chinese Tallow Tree	*Triadica sebifera*
Cogongrass	*Imperata cylindrica*
Common Carp	*Cyprinus carpio*
Coosa River Spiny Crayfish	*Orconectes spinosus*
Coyote	*Canis latrans*
Coypu	*Myocastor coypus*
Creeping Ancylid	*Ferrissia rivularis*
Dusky Arion	*Arion subfuscus*
Emerald Ash Borer	*Agrilus planipennis*
Eurasian Watermilfoil	*Myriophyllum spicatum*
European Starling	*Sturnus vulgaris*
Fathead Minnow	*Pimephales promelas*
Feral Hog	*Sus scrofa*
Feral Horse	*Equus caballus*
Feral Swine	*Sus scrofa*
Fire Ant	Genus *Solenopsis*
Flathead Catfish	*Pylodictus olivaris*
Garlic Glass-Snail	*Oxychilus alliarius*
Giant Gardenslug	*Limax maximus*
Giant Rams-Horn	*Marisa cornuarietis*

Table 3-14 Invasive or nonnative species common and scientific names.

Scientific Name	Common Name
Giant Salvinia	*Salvinia molesta*
Goldfish	*Carassius auratus*
Grass Carp	*Ctenopharyngodon idella*
Green Sunfish	*Lepomis cyanellus*
Gypsy Moth	*Lymantria dispar*
Hemlock Wooly Adelgid	*Adelges tsugae*
House Mouse	*Mus musculus*
Hydrilla	*Hydrilla verticillata*
Japanese Honeysuckle	*Lonicera japonica*
Japanese Mystery Snail	*Cipangopaludina japonica*
Japanese Stiltgrass	*Microstegium vimineum*
Kentucky River Crayfish	*Orconectes juvenilis*
Kokanee/Sockeye Salmon	*Oncorhynchus nerka*
Kudzu	*Pueraria montana*
Lilliput	*Taxolasma parvum (parvus)*
Mediterranean Gecko	*Hemidactylus turcicus*
Mississippi Map Turtle	*Graptemys kohnii*
Nine-Banded Armadillo	*Dasypus novemcinctus*
Nutria (Coypu)	*Myocastor coypus*
Orange-Banded Arion	*Arion fasciatus*
Phragmites	*Phragmites*
Rainbow Trout	*Oncorhynchus mykiss*
Red Fox	*Vulpes vulpes*
Red Shiner	*Cyprinella lutrensis*
Red Swamp Crawfish	*Procambarus clarkii*
Redear Sunfish	*Lepomis microlophus*
Red-Eared Slider	*Trachemys scripta elegans*
Red-Rim Melania	*Melanoides tuberculata*
Rock Bass	*Ambloplites rupestris*
Rock Pigeon	*Columba livia*
Roof Rat	*Rattus rattus*
Rusty Crayfish	*Orconectes rusticus*
Silver Carp	*Hypophthalmichthys molitrix*
Smallmouth Buffalo	*Ictiobus bubalus*
Spike Awlsnail	*Allopeas clavulinum*
Swamp Rabbit	*Sylvilagus aquaticus*
Texas Horned Lizard	*Phrynosoma cornutum*
Threadfin Shad	*Dorosoma petenense*
Threeband Gardenslug	*Lehmannia valentiana*
Virile Crayfish	*Orconectes virilis*

Table 3-14 Invasive or nonnative species common and scientific names.

Scientific Name	Common Name
White Bass	*Morone chrysops*
Zebra Mussel	*Dreissena polymorpha*

Table 3-14 Native plant species common and scientific names.

Common Name	Scientific Name
American Elm	*Ulmus americana*
Atlantic White Cedar	*Chamaecyparis thyoides*
Bald Cypress	*Taxodium distichum*
Black Needlerush	*Juncus roemerianus*
Cherrybark Oak	*Quercus pagoda*
Dwarf Palmetto	*Sabal minor*
Glasswort (Saltwort)	*Salicornia spp.*
Laurel Oak	*Quercus laurifolia*
Laurel-Leaf Greenbrier	*Smilax laurifolia*
Loblolly Pine	*Pinus taeda*
Longleaf Pine	*Pinus palustris*
Pond Pine	*Pinus serotine*
Red Bay	*Persea borbonia*
Red Maple	*Acer rubrum*
Red Spruce	*Picea rubens*
Salt Grass	*Distichlis spicata*
Saltmarsh Cordgrass	*Spartina alterniflora*
Swamp Black Gum	*Nyssa biflora*
Swamp Chestnut Oak	*Quercus michauxii*
Sweet Bay	*Magnolia virginiana*
Sweetgum	*Liquidambar styraciflua*
Tulip Poplar	*Liriodendron tulipifera*

Table 3-15 Selected Federal and North Carolina laws that protect wildlife.

Federal Resource Laws[1]	NC General Statutes[2]
• Bald and Golden Eagle Protection Act • Endangered Species Act • Federal Aid in Fish Restoration Act • Federal Aid in Sport Fish Restoration Act (Dingell–Johnson Act, Wallop–Breaux Act) • Federal Aid in Wildlife Conservation Act (Pittman–Robertson Act) • Fish & Wildlife Act • Fish & Wildlife Conservation Act (Nongame Act) • Fisheries Conservation & Management Act • Lacey Act • Land & Water Conservation Act • Magnuson–Stevens Fishery Conservation and Management Act • Marine Mammal Protection Act • Migratory Bird Conservation Act • Migratory Bird Treaty Act • Neotropical Migratory Bird Conservation Act • Protection of Migratory Game & Insectivorous Birds Migratory Bird Treaty • Whaling Convention Act • Wild Bird Conservation Act	• **Chapter 19A**: Protection of Animals (includes protection of black bears) • **Chapter 77**: Rivers, Creeks, and Coastal Waters (defines river basins, covers obstructions in streams, various lake management commissions, and clean water regulation) • **Chapter 104:** US Lands (covers inland waterways, forest reserves, migratory bird sanctuaries, wildlife refuges, National Park system lands) • **Chapter 106**: Agriculture (covers pest control, forestry services and development, prescribed burning) • **Chapter 113**: Conservation and Development (covers state forests and park topics, fire control, game laws, trapping, conservation agencies, coastal fisheries, regulation of wildlife and fisheries, endangered and threatened species, species of special concern) • **Chapter 146**: State Lands (covers land acquisition topics including wetland mitigation, public parks and forests, public waters access)
[1]See http://www.fws.gov/laws/lawsdigest/Resourcelaws.html for enacted and revision dates	[2]See http://www.ncga.state.nc.us/gascripts/Statutes/StatutesTOC.pl for enacted and revision dates

Table 3-16 Selected Federal and North Carolina laws that protect plants.

Federal Resource Laws[1]	NC General Statutes[2]
• Endangered Species Act of 1973 establishes protections for fish, wildlife, and plants that are listed as threatened or endangered; provides for adding species to and removing them from the list of threatened and endangered species, and for preparing and implementing plans for their recovery; provides for interagency cooperation to avoid take of listed species and for issuing permits for otherwise prohibited activities; provides for cooperation with States, including authorization of financial assistance; and implements the provisions of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). • Land and Water Conservation Fund Act (LWCF) was established by Congress in 1964 to fulfill a bipartisan commitment to safeguard natural areas, water resources and cultural heritage, and to provide recreation opportunities to all Americans. The fund helps strengthen communities, preserve history and protect the national endowment of lands and waters. • Farm Bill (e.g., Agriculture Improvement Act of 2018) provides conservation incentive programs for America's farmers and ranchers through reauthorization and expanded flexibility of NRCS conservation programs. Programs include the Conservation Stewardship Program; Agricultural Conservation Easement Program; Environmental Quality Incentives Program; and Regional Conservation Partnership Program. • Plant Protection Act (7 USC Chapter 104) establishes regulation of movement (import, export, trade) of plant pests; create a regulatory list of plant pests; and requires	• **Article 15 Aquatic Weed Control Act of 1991.** Governs the control, removal, or destruction of any noxious aquatic weed located in the waters of the State or in areas adjacent to such waters wherever such weeds threaten to invade such waters. • **Article 19B Plant Protection and Conservation Act**: The recreational needs of the people, the interests of science, and the economy of the State require that threatened and endangered species of plants and species of plants of special concern be protected and conserved, that their numbers should be enhanced and that propagative techniques be developed for them. • **Article 31 NC Seed Law**: Regulates the labeling, possessing for sale, sale and offering or exposing for sale or otherwise providing for planting purposes of agricultural seeds and vegetable seeds; to prevent misrepresentation thereof; and for other purposes. • **Article 36 Plant Pests**: Any insect, mite, nematode, other invertebrate animal, disease, noxious weed, plant or animal parasite in any stage of development which is injurious to plants and plant products. Any plant, plant product, object or article which has been, or which the Commissioner of Agriculture or his agents have reasonable grounds to believe has been exposed to a plant pest, may be treated as a plant pest per this Article. • **Chapter 113**: Conservation and Development (covers state forests and park topics, fire control, game laws, trapping, conservation agencies, coastal fisheries, regulation of wildlife and fisheries,

Table 3-16 Selected Federal and North Carolina laws that protect plants.

Federal Resource Laws[1]	NC General Statutes[2]
permits to authorize and control movement of pest plants or products related to plant pests.	endangered and threatened species, species of special concern) • **Chapter 146**: State Lands (covers land acquisition topics including wetland mitigation, public parks and forests, public waters access)
[1]See http://www.fws.gov/laws/lawsdigest/Resourcelaws.html for enacted and revision dates	[2]See http://www.ncga.state.nc.us/gascripts/Statutes/StatutesTOC.pl for enacted and revision dates

Table 3-17
AMPHIBIANS

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Habitat Associations by Ecoregion														
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family	Population Designation ?	SGCN Species of Greatest Conservation Need Priority (Responsibility Species: G=Global, N=State Listed)	Knowledge Gap (Research) Priority	Management Concern/Need Priority	SEAFWA Regional SGCN M = moderate, H = High, VH = Very High	FEDERAL STATUS	STATE STATUS
21	15	1	1	*Lithobates catesbeianus*	American Bullfrog	Anura	Ranidae				X			
20	13	0	0	*Desmognathus monticola*	Appalachian Seal salamander	Caudata	Plethodontidae							
0	0	0	4	*Lithobates [= Rana] kauffeldi*	Atlantic Coast Leopard Frog	Anura	Ranidae		X					
0	0	12	13	*Plethodon chlorobryonis*	Atlantic Coast Slimy Salamander	Caudata	Plethodontidae			X				
0	4	8	11	*Hyla gratiosa*	Barking Treefrog	Anura	Hylidae		X		X	M		
13	7	0	0	*Desmognathus quadramaculatus*	Black-Bellied Salamander	Caudata	Plethodontidae							
18	0	0	0	*Desmognathus orestes*	Blue Ridge Dusky Salamander	Caudata	Plethodontidae					M		
6	0	0	0	*Plethodon amplus*	Blue Ridge Gray-Cheeked Salamander	Caudata	Plethodontidae		X	X	X	H		
21	0	0	0	*Eurycea wilderae*	Blue Ridge Two-Lined Salamander	Caudata	Plethodontidae					M		
0	0	0	10	*Pseudacris brimleyi*	Brimley's Chorus Frog	Anura	Hylidae			X	X			
18	0	0	0	*Desmognathus carolinensis*	Carolina Mountain Dusky Salamander	Caudata	Plethodontidae							
0	0	5	8	*Lithobates virgatipes*	Carpenter Frog	Anura	Ranidae			X				
0	7	9	12	*Eurycea chamberlaini*	Chamberlain's Dwarf Salamander	Caudata	Plethodontidae		X	X		M	At-Risk	
5	0	0	0	*Plethodon chattahoochee*	Chattahoochee Slimy Salamander	Caudata	Plethodontidae		X	X	X	M		
4	0	0	0	*Plethodon cheoah*	Cheoah Bald Salamander	Caudata	Plethodontidae		X	X		M		
11	0	0	0	*Pseudacris collinsorum*	Collinses' Mountain Chorus Frog	Anura	Hylidae		X,N					SC
12	0	0	0	*Necturus maculosus maculosus*	Common Mudpuppy	Caudata	Proteidae		X,N	X	X			SC
17	14	9	12	*Hyla chrysoscelis*	Cope's Gray Treefrog	Anura	Hylidae			X	X			
6	0	0	0	*Plethodon longicrus [= P. yonahlo*	Crevice Salamander	Caudata	Plethodontidae		X,N	X	X			SC
9	0	0	0	*Desmognathus folkertsi*	Dwarf Black-Bellied Salamander	Caudata	Plethodontidae		X,N	X		M		SC
0	0	5	6	*Eurycea quadridigitata*	Dwarf Salamander	Caudata	Plethodontidae		X,N	X	X			SC
0	4	5	8	*Necturus punctatus*	Dwarf Waterdog	Caudata	Proteidae			X		M		
26	21	1	2	*Anaxyrus americanus americanus*	Eastern American Toad	Anura	Bufonidae				X			
8	0	0	0	*Cryptobranchus alleganiensis allaga*	Eastern Hellbender	Caudata	Cryptobranchidae		X		X	VH	At-Risk	SC
0	5	11	12	*Siren intermedia intermedia*	Eastern Lesser Siren	Caudata	Sirenidae		X	X				
18	0	0	0	*Eurycea longicauda longicauda*	Eastern Long-Tailed Salamander	Caudata	Plethodontidae		X,N					T
11	8	1	1	*Pseudotriton montanus montanu*	Eastern Mud Salamander	Caudata	Plethodontidae			X		M		
0	0	0	0	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	Anura	Microhylidae							
27	21	1	2	*Notophthalmus viridescens*	Eastern Newt	Caudata	Salamandridae				X			
8	6	0	1	*Plethodon cinereus*	Eastern Red-Backed Salamander	Caudata	Plethodontidae			X				
18	3	2	9	*Scaphiopus holbrookii*	Eastern Spadefoot	Anura	Scaphiopodidae			X				
0	3	3	5	*Ambystoma tigrinum tigrinum*	Eastern Tiger Salamander	Caudata	Ambystomatidae		X,N		X			T
8	6	3	5	*Hemidactylium scutatum*	Four-Toed Salamander	Caudata	Plethodontidae		X,N	X	X			SC
26	21	1	2	*Anaxyrus fowleri*	Fowler's Toad	Anura	Bufonidae				X			
0	0	3	4	*Lithobates [= Rana] capito*	Gopher Frog	Anura	Ranidae		X		X	VH	At-Risk	E
0	4	1	2	*Siren lacertina*	Greater Siren	Caudata	Sirenidae		X	X		M		
21	15	1	1	*Lithobates clamitans*	Green Frog	Anura	Ranidae				X			
9	0	0	0	*Aneides aeneus*	Green Salamander	Caudata	Plethodontidae		X,N		X	H		T
1	9	14	19	*Hyla cinerea*	Green Treefrog	Anura	Hylidae				X			
7	0	0	0	*Aneides caryaensis*	Hickory Nut Gorge Green Salamander	Caudata	Plethodontidae		X	X (New)	X (New)		At-Risk	E
7	0	0	0	*Desmognathus imitator*	Imitator Salamander	Caudata	Plethodontidae		X		X	H		
3	0	0	0	*Desmognathus imitator pop.1*	Imitator Salamander - Waterrock Knob pop	Caudata	Plethodontidae	Waterrock Knob	X	X				
5	0	0	0	*Plethodon jordani*	Jordan's Salamander	Caudata	Plethodontidae		X	X		M		
10	0	0	0	*Eurycea junaluska*	Junaluska Salamander	Caudata	Plethodontidae		X,N	X		H		T
0	0	7	8	*Pseudacris ocularis*	Little Grass Frog	Anura	Hylidae					M		
0	0	5	9	*Ambystoma mabeei*	Mabee's Salamander	Caudata	Ambystomatidae		X,N	X	X	H		T
0	0	0	4	*Stereochilus marginatus*	Many-Lined Salamander	Caudata	Plethodontidae		X			M		
7	6	0	1	*Ambystoma opacum*	Marbled Salamander	Caudata	Ambystomatidae			X	X			
7	6	0	0	*Ambystoma talpoideum*	Mole Salamander	Caudata	Ambystomatidae		X,N	X	X			SC
22	0	0	0	*Pseudacris brachyphona*	Mountain Chorus Frog	Anura	Hylidae			X	X			
0	7	0	5	*Necturus lewisi*	Neuse River Waterdog	Caudata	Proteidae		X		X	VH	T	T
0	0	0	0	*Acris crepitans*	Northern Cricket Frog	Anura	Hylidae							
20	14	0	0	*Desmognathus fuscus*	Northern Dusky Salamander	Caudata	Plethodontidae							

Table 3-17
AMPHIBIANS

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Count of Habitat Associations by Ecoregion														
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family	Population Designation ?	SGCN Species of Greatest Conservation Need Priority (Responsibility Species: G=Global, N=State Listed)	Knowledge Gap (Research) Priority	Management Concern/Need Priority	SEAFWA Regional SGCN M = moderate, H = High, VH = Very High	FEDERAL STATUS	STATE STATUS
0	**14**	0	0	*Hyla versicolor*	Northern Gray Treefrog	Anura	Hylidae		**X,N**	**X**				**SC**
10	0	0	0	*Plethodon montanus*	Northern Gray-Cheeked Salamander	Caudata	Plethodontidae							
5	0	0	0	*Desmognathus organi*	Northern Pigmy Salamander	Caudata	Plethodontidae		**X**	**X**	**X**	**H**		
7	**0**	**0**	**0**	*Plethodon glutinosus*	Northern Slimy Salamander	Caudata	Plethodontidae		**X**	**X**				
25	**17**	0	1	*Pseudacris crucifer*	Northern Spring Peeper	Anura	Hylidae				**X**			
0	**14**	0	0	*Eurycea bislineata*	Northern Two-Lined Salamander	Caudata	Plethodontidae			**X**				
0	0	**4**	**7**	*Anaxyrus [= Bufo] quercicus*	Oak Toad	Anura	Bufonidae		**X**		**X**	**M**		
17	0	0	0	*Desmognathus ocoee*	Ocoee Salamander	Caudata	Plethodontidae							
0	0	**3**	**5**	*Pseudacris ornata*	Ornate Chorus Frog	Anura	Hylidae		**X,N**	**X**		**H**		
28	**19**	0	0	*Lithobates palustris*	Pickerel Frog	Anura	Ranidae							
0	0	**7**	**7**	*Hyla andersonii*	Pine Barrens Treefrog	Anura	Hylidae		**X,N**	**X**	**X**	**VH**		
0	0	0	0	*Hyla femoralis*	Pine Woods Treefrog	Anura	Hylidae							
11	**8**	0	0	*Pseudotriton ruber*	Red Salamander	Caudata	Plethodontidae			**X**				
6	0	0	0	*Plethodon shermani*	Red-Legged Salamander	Caudata	Plethodontidae		**X**			**H**		
0	0	0	**7**	*Lithobates [= Rana] heckscheri*	River Frog	Anura	Ranidae		**X,N**	**X**		**H**		**E**
0	0	8	**0**	*Eurycea sp. 9*	Sandhills Salamander	Caudata	Plethodontidae		**X**					
13	0	0	0	*Desmognathus santeetlah*	Santeetlah Dusky salamander	Caudata	Plethodontidae		**X**	**X**		**H**		
13	0	0	0	*Desmognathus aeneus*	Seepage Salamander	Caudata	Plethodontidae		**X**	**X**		**M**		
13	0	0	0	*Desmognathus marmoratus*	Shovel-Nosed Salamander	Caudata	Plethodontidae			**X**		**H**		
6	0	0	0	*Plethodon meridianus*	South Mountain Gray-Cheeked Salaman	Caudata	Plethodontidae		**X**	**X**		**M**		
7	0	0	0	*Plethodon teyahalee*	Southern Appalachian Salamander	Caudata	Plethodontidae		**X,N**	**X**		**M**		
0	0	**7**	**7**	*Pseudacris nigrita*	Southern Chorus Frog	Anura	Hylidae		**X,N**	**X**	**X**			
0	0	0	0	*Acris gryllus*	Southern Cricket Frog	Anura	Hylidae							
0	0	0	**5**	*Desmognathus auriculatus*	Southern Dusky Salamander	Caudata	Plethodontidae		**X**	**X**		**H**		
10	**6**	0	0	*Plethodon metcalfi*	Southern Gray-Cheeked Salamander	Caudata	Plethodontidae							
0	**15**	**16**	**21**	*Lithobates sphenocephalus utricular*	Southern Leopard Frog	Anura	Ranidae				**X**			
5	0	0	0	*Desmognathus wrighti*	Southern Pigmy Salamander	Caudata	Plethodontidae		**X**	**X**	**X**	**H**		
6	0	0	0	*Plethodon richmondi*	Southern Ravine Salamander	Caudata	Plethodontidae		**X**	**X**		**M**		
6	0	0	0	*Plethodon serratus*	Southern Red-Backed Salamander	Caudata	Plethodontidae		**X**	**X**		**H**		
0	1	**18**	**23**	*Anaxyrus terrestris*	Southern Toad	Anura	Bufonidae				**X**			
22	**15**	0	0	*Eurycea cirrigera*	Southern Two-Lined Salamander	Caudata	Plethodontidae							
6	0	0	0	*Plethodon ventralis*	Southern Zigzag Salamander	Caudata	Plethodontidae		**X,N**	**X**	**X**	**M**		**SC**
13	0	0	0	*Desmognathus conanti*	Spotted Dusky Salamander	Caudata	Plethodontidae		**X**	**X**				
8	**6**	4	5	*Ambystoma maculatum*	Spotted Salamander	Caudata	Ambystomatidae			**X**	**X**			
21	**14**	0	0	*Gyrinophilus porphyriticus*	Spring Salamander	Caudata	Plethodontidae							
0	**9**	**14**	**19**	*Hyla squirella*	Squirrel Treefrog	Anura	Hylidae				**X**			
5	0	0	0	*Plethodon aureolus*	Tellico Salamander	Caudata	Plethodontidae		**X**	**X**		**H**		
15	**10**	0	0	*Eurycea guttolineata*	Three-Lined Salamander	Caudata	Plethodontidae							
0	**7**	**12**	**15**	*Amphiuma means*	Two-Toed Amphiuma	Caudata	Amphiumidae			**X**				
23	**17**	0	0	*Pseudacris feriarum*	Upland Chorus Frog	Anura	Hylidae							
7	0	0	0	*Plethodon wehrlei*	Wehrle's Salamander	Caudata	Plethodontidae		**X,N**	**X**	**X**	**H**		**T**
5	0	0	0	*Plethodon welleri*	Weller's Salamander	Caudata	Plethodontidae		**X,N**	**X**	**X**	**H**		**SC**
8	**7**	0	0	*Plethodon cylindraceus*	White-Spotted Slimy Salamander	Caudata	Plethodontidae			**X**				
26	**18**	0	0	*Lithobates sylvaticus*	Wood Frog	Anura	Ranidae				**X**			
0	0	0	**5**	*Lithobates [= Rana] sylvatica pop.3*	Wood Frog - Coastal Plain Pop.	Anura	Ranidae	**CP pop.**	**X**	**X**	**X**			
8	0	0	0	*Plethodon yonahlossee*	Yonahlossee Salamander	Caudata	Plethodontidae		**X**	**X**		**M**		

Appendix 3-17
BIRDS

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Habitat Associations by Ecoregion								Species of Greatest Conservation Need (SGCN) Priority (Responsibility Species: G = Global, N = NC)	Knowledge Gap Priority	Management Need/Concern Priority	SEAFWA Regional SGCN	Population Designation ?	FEDERAL STATUS	STATE STATUS	Statewide Occurrences (>75 Counties)	Buildings, Structures
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*		Common Name	Order	Family								
0	0	0	3	*Recurvirostra americana*	American Avocet	Charadriiformes	Recurvirostridae	X				non-breeding				
0	0	0	3	*Botaurus lentiginosus*	American Bittern	Ciconiiformes	Ardeidae	X	X			both				
3	4	0	10	*Anas rubripes*	American Black Duck	Anseriformes	Anatidae	X		X		both				
0	0	0	3	*Haematopus palliatus*	American Oystercatcher	Charadriiformes	Haematopodidae	X		X	H	both		SC		
0	2	4	4	*Peucaea aestivalis*	Bachman's Sparrow	Passeriformes	Emberizidae	X		X	VH	both		SC		
0	3	1	9	*Haliaeetus leucocephalus*	Bald Eagle	Falconiformes	Accipitridae	X		X		both		T		
3	4	1	5	*Riparia riparia*	Bank Swallow	Passeriformes	Hirundinidae	X	X			breeding				
3	3	0	3	*Tyto alba*	Barn Owl	Strigiformes	Tytonidae	X	X			both		SC		X
2	1	1	3	*Laterallus jamaicensis*	Black Rail	Gruiformes	Rallidae	X	X		VH	both	T	T		
0	0	0	4	*Rynchops niger*	Black Skimmer	Charadriiformes	Laridae	X		X	H	both		T		X
0	0	0	3	*Pluvialis squatarola*	Black-bellied Plover	Charadriiformes	Charadriidae	X	X	X		non-breeding				
0	0	0	4	*Nycticorax nycticorax*	Black-crowned Night-Heron	Ciconiiformes	Ardeidae	X	X			both				
0	0	0	2	*Himantopus mexicanus*	Black-necked Stilt	Charadriiformes	Recurvirostridae	X	X	X		breeding				
1	1	1	1	*Dolichonyx oryzivorus*	Bobolink	Passeriformes	Icteridae	X	X			breeding				
0	0	0	2	*Branta bernicla*	Brant	Anseriformes	Anatidae	X		X		non-breeding				
4	0	0	0	*Certhia americana*	Brown Creeper	Passeriformes	Certhiidae	X				both		SC		
0	2	0	4	*Aythya valisineria*	Canvasback	Anseriformes	Anatidae	X		X		non-breeding				
0	0	0	4	*Hydroprogne caspia*	Caspian Tern	Charadriiformes	Laridae	X		X		both		T		
3	0	0	2	*Setophaga cerulea*	Cerulean Warbler	Passeriformes	Parulidae	X			H	breeding		SC		
0	0	0	1	*Rallus longirostris*	Clapper Rail	Gruiformes	Rallidae	X	X		M	both				
4	3	2	3	*Gallinula galeata*	Common Gallinule	Gruiformes	Rallidae	X	X			both				
0	0	0	4	*Sterna hirundo*	Common Tern	Charadriiformes	Laridae	X		X		breeding		E		X
0	1	0	0	*Spiza americana*	Dickcissel	Passeriformes	Cardinalidae	X	X			breeding				
0	0	0	5	*Passerina ciris*	Eastern Painted Bunting	Passeriformes	Cardinalidae	X			H	breeding		SC		
2	5	1	3	*Antrostomus vociferus*	Eastern Whip-poor-will	Caprimulgiformes	Caprimulgidae	X			H	breeding				
0	0	0	4	*Sterna forsteri*	Forster's Tern	Charadriiformes	Laridae	X	X	X		both				
3	4	0	8	*Anas strepera*	Gadwall	Anseriformes	Anatidae	X		X		both				
0	0	0	6	*Plegadis falcinellus*	Glossy Ibis	Ciconiiformes	Threskiornithidae	X		X		both		SC		
5	0	0	0	*Aquila chrysaetos*	Golden Eagle	Accipitriformes	Accipitridae	X	X			non-breeding	At-Risk			
7	0	0	0	*Vermivora chrysoptera*	Golden-winged Warbler	Passeriformes	Parulidae	X		X	H	breeding	At-Risk	SC		
1	1	0	1	*Ammodramus savannarum*	Grasshopper Sparrow	Passeriformes	Emberizidae	X			H	both			X	
0	2	0	6	*Larus marinus*	Great Black-backed Gull	Charadriiformes	Laridae	X		X		both				
0	0	0	3	*Gelochelidon nilotica*	Gull-billed Tern	Charadriiformes	Laridae	X		X	H	breeding		T		
0	2	0	4	*Ammodramus henslowii*	Henslow's Sparrow	Passeriformes	Emberizidae	X			H	breeding		E		
3	2	3	4	*Geothlypis formosa*	Kentucky Warbler	Passeriformes	Parulidae	X			M	breeding			X	
2	1	1	3	*Rallus elegans*	King Rail	Gruiformes	Rallidae	X	X	X	H	both			X	
0	0	0	8	*Ixobrychus exilis*	Least Bittern	Ciconiiformes	Ardeidae	X	X		M	breeding		SC		
0	0	0	6	*Sterna [Sternula] antillarum*	Least Tern	Charadriiformes	Laridae	X		X	H	breeding		SC		X
0	0	0	6	*Egretta caerulea*	Little Blue Heron	Ciconiiformes	Ardeidae	X		X	M	both		SC		
1	2	3	2	*Lanius ludovicianus*	Loggerhead Shrike	Passeriformes	Laniidae	X			H	both		SC		
0	0	0	2	*Clangula hyemalis*	Long-tailed Duck	Anseriformes	Anatidae	X		X		non-breeding				
0	0	0	3	*Limosa fedoa*	Marbled Godwit	Charadriiformes	Scolopacidae	X	X	X		non-breeding				
0	0	0	3	*Ammodramus nelsoni*	Nelson's Sparrow	Passeriformes	Emberizidae	X	X		H	non-breeding				
3	2	5	7	*Colinus virginianus*	Northern Bobwhite	Galliformes	Odontophoridae	X		X	H	both				
2	0	0	0	*Aegolius acadicus*	Northern Saw-whet Owl	Strigiformes	Strigidae	X				both		T		
0	2	1	3	*Pandion haliaetus*	Osprey	Falconiformes	Accipitridae	X				Breeding				
2	0	0	3	*Falco peregrinus*	Peregrine Falcon	Falconiformes	Falconidae	X		X		both		E		X
0	0	0	3	*Charadrius melodus*	Piping Plover	Charadriiformes	Charadriidae	X		X	H	both	E/T	E		
0	0	0	1	*Calidris maritima*	Purple Sandpiper	Charadriiformes	Scolopacidae	X				non-breeding				
2	0	0	0	*Loxia curvirostra*	Red Crossbill	Passeriformes	Fringillidae	X	X			both		SC		
0	0	0	3	*Calidris canutus*	Red Knot	Charadriiformes	Scolopacidae	X		X	H	non-breeding	T	T		
0	0	2	3	*Picoides borealis*	Red-cockaded Woodpecker	Piciformes	Picidae	X		X	VH	both	T	T		
0	0	0	4	*Thalasseus maximus*	Royal Tern	Charadriiformes	Laridae	X		X	M	both				

Appendix 3-17
BIRDS

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Habitat Associations by Ecoregion								Species of Greatest Conservation Need (SGCN) Priority (Responsibility Species: G = Global, N = NC)	Knowledge Gap Priority	Management Need/Concern Priority	SEAFWA Regional SGCN	Population Designation ?	FEDERAL STATUS	STATE STATUS	Statewide Occurrences (>75 Counties)	Buildings, Structures
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update												
				Scientific Name	Common Name	Order	Family									
8	0	0	0	*Bonasa umbellus*	Ruffed Grouse	Galliformes	Phasianidae	X		X		both				
0	0	0	3	*Ammodramus caudacutus*	Saltmarsh Sparrow	Passeriformes	Emberizidae	X	X		VH	non-breeding	At-Risk			
0	0	0	3	*Calidris alba*	Sanderling	Charadriiformes	Scolopacidae	X				non-breeding				
0	0	0	4	*Thalasseus sandvicensis*	Sandwich Tern	Charadriiformes	Laridae	X		X	H	breeding				
1	0	0	3	*Passerculus sandwichensis*	Savannah Sparrow	Passeriformes	Emberizidae	X				both				
0	0	0	1	*Ammodramus maritimus*	Seaside Sparrow	Passeriformes	Emberizidae	X	X		H	both				
5	2	0	0	*Accipiter striatus*	Sharp-shinned Hawk	Falconiformes	Accipitridae	X	X			both				
0	0	0	11	*Egretta thula*	Snowy Egret	Ciconiiformes	Ardeidae	X		X	M	both		SC		
0	0	0	2	*Melanitta perspicillata*	Surf Scoter	Anseriformes	Anatidae	X		X		non-breeding				
0	0	0	4	*Elanoides forficatus*	Swallow-tailed Kite	Accipitriformes	Accipitridae	X	X		VH	breeding		SC		
0	0	0	3	*Egretta tricolor*	Tricolored Heron	Ciconiiformes	Ardeidae	X		X		both		SC		
3	0	0	0	*Pooecetes gramineus*	Vesper Sparrow	Passeriformes	Emberizidae	X	X			both		SC		
0	0	0	5	*Rallus limicola*	Virginia Rail	Gruiformes	Rallidae	X	X			both				
0	0	0	5	*Setophaga virens waynei*	Wayne's Black-throated Green Wa	Passeriformes	Parulidae	X	X		H	breeding	At-Risk	E		
0	0	0	3	*Numenius phaeopus*	Whimbrel	Charadriiformes	Scolopacidae	X		X	H	non-breeding				
0	0	0	9	*Eudocimus albus*	White Ibis	Ciconiiformes	Threskiornithidae	X		X		both				
0	0	0	4	*Melanitta fusca*	White-winged Scoter	Anseriformes	Anatidae	X		X		non-breeding				
0	0	0	3	*Tringa semipalmata*	Willet	Charadriiformes	Scolopacidae	X		X	H	both				
0	0	0	3	*Charadrius wilsonia*	Wilson's Plover	Charadriiformes	Charadriidae	X		X	H	breeding		SC		
0	0	0	11	*Mycteria americana*	Wood Stork	Ciconiiformes	Ciconiidae	X			H	breeding	T	T		
0	0	0	5	*Coturnicops noveboracensis*	Yellow Rail	Gruiformes	Rallidae	X	X		H	non-breeding				
0	4	4	10	*Nyctanassa violacea*	Yellow-crowned Night-Heron	Ciconiiformes	Ardeidae	X	X		M	breeding				
1	1	5	6	*Empidonax virescens*	Acadian Flycatcher	Passeriformes	Tyrannidae	X,N				breeding			X	
2	3	2	3	*Sitta pusilla*	Brown-headed Nuthatch	Passeriformes	Sittidae	X,N			M	both			X	
0	0	0	2	*Chaetura pelagica*	Chimney Swift	Apodiformes	Apodidae	X,N			M	breeding				
0	3	1	3	*Antrostomus carolinensis*	Chuck-will's-widow	Caprimulgiformes	Caprimulgidae	X,N			M	breeding				
5	2	2	7	*Setophaga discolor*	Prairie Warbler	Passeriformes	Parulidae	X,N	X		M	breeding			X	
1	1	1	5	*Protonotaria citrea*	Prothonotary Warbler	Passeriformes	Parulidae	X,N			M	breeding			X	
0	0	0	6	*Helmitheros vermivorum*	Worm-eating Warbler	Passeriformes	Parulidae	X,N	X	X	M	breeding				
1	4	3	10	*Setophaga dominica*	Yellow-throated Warbler	Passeriformes	Parulidae	X,N	X		H	breeding			X	
2	0	0	0	*Empidonax alnorum*	Alder Flycatcher	Passeriformes	Tyrannidae					breeding				
1	2	1	4	*Falco sparverius*	American Kestrel	Falconiformes	Falconidae					both			X	
2	2	0	3	*Scolopax minor*	American Woodcock	Charadriiformes	Scolopacidae			X	M	both				
0	0	0	8	*Anhinga anhinga*	Anhinga	Pelecaniformes	Anhingidae					breeding				
5	0	0	0	*Coragyps atratus*	Black Vulture	Falconiformes	Cathartidae					both				
4	0	0	0	*Mniotilta varia*	Black-and-white Warbler	Passeriformes	Parulidae					breeding				
3	0	0	0	*Coccyzus erythropthalmus*	Black-billed Cuckoo	Cuculiformes	Cuculidae		X			breeding				
3	1	1	0	*Setophaga fusca*	Blackburnian Warbler	Passeriformes	Parulidae		X			breeding				
3	0	0	0	*Poecile atricapilla*	Black-capped Chickadee	Passeriformes	Paridae		X			both		SC		
4	0	0	0	*Setophaga caerulescens*	Black-throated Blue Warbler	Passeriformes	Parulidae					breeding				
5	0	0	0	*Setophaga virens*	Black-throated Green Warbler	Passeriformes	Parulidae					breeding				
4	0	0	0	*Passerina caerulea*	Blue Grosbeak	Passeriformes	Cardinalidae					breeding				
4	0	0	0	*Cyanocitta cristata*	Blue Jay	Passeriformes	Corvidae					both				
2	0	0	0	*Polioptila caerulea*	Blue-gray Gnatcatcher	Passeriformes	Sylviidae					both				
5	0	0	0	*Vireo solitarius*	Blue-headed Vireo	Passeriformes	Vireonidae					both				
2	2	1	8	*Anas discors*	Blue-winged Teal	Anseriformes	Anatidae			X		non-breeding				
3	0	0	0	*Vermivora cyanoptera*	Blue-winged Warbler	Passeriformes	Parulidae		X			breeding				
0	0	0	1	*Chroicocephalus philadelphia*	Bonaparte's Gull	Charadriiformes	Laridae					non-breeding				
0	0	0	1	*Euphagus cyanocephalus*	Brewer's Blackbird	Passeriformes	Icteridae					non-breeding				
3	0	0	0	*Buteo platypterus*	Broad-winged Hawk	Falconiformes	Accipitridae					breeding				
0	0	0	4	*Pelecanus occidentalis*	Brown Pelican	Pelecaniformes	Pelecanidae			X		both				
2	0	0	0	*Toxostoma rufum*	Brown Thrasher	Passeriformes	Mimidae					both				
2	0	0	0	*Molothrus ater*	Brown-headed Cowbird	Passeriformes	Icteridae					both				

Count of Habitat Associations by Ecoregion				Appendix 3-17 BIRDS SGCN - Habitat Associations 2025 NC WAP Revision				Species of Greatest Conservation Need (SGCN) Priority (Responsibility Species: G = Global, N = NC)	Knowledge Gap Priority	Management Need/Concern Priority	SEAFWA Regional SGCN	Population Designation ?	FEDERAL STATUS	STATE STATUS	Statewide Occurrences (>75 Counties)	Buildings, Structures
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family									
2	2	1	6	*Bucephala albeola*	Bufflehead	Anseriformes	Anatidae					non-breeding				
6	5	3	9	*Branta canadensis*	Canada Goose	Anseriformes	Anatidae					both				
3	0	0	0	*Cardellina canadensis*	Canada Warbler	Passeriformes	Parulidae		X			breeding				
2	1	1	1	*Setophaga tigrina*	Cape May Warbler	Passeriformes	Parulidae		X			non-breeding				
6	0	0	0	*Poecile carolinensis*	Carolina Chickadee	Passeriformes	Paridae					both				
2	6	6	7	*Thryothorus ludovicianus*	Carolina Wren	Passeriformes	Troglodytidae					both				
0	12	9	13	*Bubulcus ibis*	Cattle Egret	Ciconiiformes	Ardeidae					breeding				
4	0	0	0	*Setophaga pensylvanica*	Chestnut-sided Warbler	Passeriformes	Parulidae		X	X		breeding				
3	0	0	0	*Spizella passerina*	Chipping Sparrow	Passeriformes	Emberizidae					both				
2	3	3	3	*Spizella pallida*	Clay-Colored Sparrow	Passeriformes	Emberizidae					non-breeding				
2	2	1	6	*Gavia immer*	Common Loon	Gaviiformes	Gaviidae		X	X		non-breeding				
2	2	1	4	*Mergus merganser*	Common Merganser	Anseriformes	Anatidae		X			non-breeding				
1	2	1	3	*Chordeiles minor*	Common Nighthawk	Caprimulgiformes	Caprimulgidae		X			breeding				
2	1	0	0	*Corvus corax*	Common Raven	Passeriformes	Corvidae		X			both				
6	0	0	0	*Geothlypis trichas*	Common Yellowthroat	Passeriformes	Parulidae					both				
4	3	0	2	*Accipiter cooperii*	Cooper's Hawk	Falconiformes	Accipitridae					both				
2	0	0	0	*Junco hyemalis*	Dark-eyed Junco	Passeriformes	Emberizidae					both				
3	4	0	5	*Phalacrocorax auritus*	Double-crested Cormorant	Pelecaniformes	Phalacrocoracidae			X		both			X	
0	0	0	1	*Calidris alpina*	Dunlin	Charadriiformes	Scolopacidae					non-breeding				
2	0	0	0	*Sialia sialis*	Eastern Bluebird	Passeriformes	Turdidae					both				
11	1	0	1	*Tyrannus tyrannus*	Eastern Kingbird	Passeriformes	Tyrannidae					breeding				
1	1	0	1	*Sturnella magna*	Eastern Meadowlark	Passeriformes	Icteridae				H	both				
2	0	0	0	*Sayornis phoebe*	Eastern Phoebe	Passeriformes	Tyrannidae					both				
5	0	0	0	*Megascops asio*	Eastern Screech Owl	Strigiformes	Strigidae					both				
4	4	4	5	*Pipilo erythrophthalmus*	Eastern Towhee	Passeriformes	Emberizidae					both			X	
2	4	0	5	*Contopus virens*	Eastern Wood Pewee	Passeriformes	Tyrannidae					breeding				
0	4	4	5	*Sturnus vulgaris*	European Starling	Passeriformes	Sturnidae					both				
3	3	1	0	*Coccothraustes vespertinus*	Evening Grosbeak	Passeriformes	Fringillidae					non-breeding				
2	1	0	1	*Spizella pusilla*	Field Sparrow	Passeriformes	Emberizidae					both			X	
0	4	2	6	*Corvus ossifragus*	Fish Crow	Passeriformes	Corvidae					both				
2	4	4	6	*Regulus satrapa*	Golden-crowned Kinglet	Passeriformes	Regulidae		X			both			X	
5	0	0	0	*Dumetella carolinensis*	Gray Catbird	Passeriformes	Mimidae					both				
1	1	1	1	*Catharus minimus*	Gray-cheeked Thrush	Passeriformes	Turdidae		X			non-breeding			X	
0	13	10	14	*Ardea herodias*	Great Blue Heron	Ciconiiformes	Ardeidae					both				
4	0	0	0	*Myiarchus crinitus*	Great Crested Flycatcher	Passeriformes	Tyrannidae					breeding				
0	13	8	20	*Ardea alba*	Great Egret	Ciconiiformes	Ardeidae					both				
6	0	0	0	*Bubo virginianus*	Great Horned Owl	Strigiformes	Strigidae					both				
0	0	0	6	*Aythya marila*	Greater Scaup	Anseriformes	Anatidae			X		non-breeding				
0	3	3	8	*Tringa melanoleuca*	Greater Yellowlegs	Charadriiformes	Scolopacidae					non-breeding				
15	12	9	16	*Butorides virescens*	Green Heron	Ciconiiformes	Ardeidae					breeding				
4	4	2	10	*Anas crecca*	Green-winged Teal	Anseriformes	Anatidae			X		non-breeding			X	
4	4	0	4	*Picoides villosus*	Hairy woodpecker	Piciformes	Picidae		X			both				
2	1	1	6	*Catharus guttatus*	Hermit Thrush	Passeriformes	Turdidae		X			both			X	
0	2	0	5	*Larus argentatus*	Herring Gull	Charadriiformes	Laridae			X		both				
4	6	3	7	*Lophodytes cucullatus*	Hooded Merganser	Anseriformes	Anatidae			X		both			X	
3	3	0	6	*Setophaga citrina*	Hooded Warbler	Passeriformes	Parulidae					breeding				
0	0	0	1	*Podiceps auritus*	Horned Grebe	Podicipediformes	Podicipedidae		X			non-breeding				
1	0	0	0	*Eremophila alpestris*	Horned Lark	Passeriformes	Alaudidae					both				
3	0	0	0	*Passerina cyanea*	Indigo Bunting	Passeriformes	Cardinalidae					breeding				
0	1	0	1	*Charadrius vociferus*	Killdeer	Charadriiformes	Charadriidae					both				
0	0	3	6	*Ammodramus leconteii*	Le Conte's Sparrow	Passeriformes	Emberizidae		X		H	non-breeding				
2	0	0	0	*Empidonax minimus*	Least Flycatcher	Passeriformes	Tyrannidae		X			breeding				
0	0	0	1	*Calidris minutilla*	Least Sandpiper	Charadriiformes	Scolopacidae					non-breeding				

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Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family									
2	2	1	6	*Aythya affinis*	Lesser Scaup	Anseriformes	Anatidae			X		non-breeding				
0	3	3	8	*Tringa flavipes*	Lesser Yellowlegs	Charadriiformes	Scolopacidae					non-breeding				
2	2	2	2	*Melospiza lincolnii*	Lincoln's Sparrow	Passeriformes	Emberizidae					non-breeding				
0	2	1	5	*Limnodromus scolopaceus*	Long-billed Dowitcher	Charadriiformes	Scolopacidae		X	X		non-breeding				
1	1	2	2	*Parkesia motacilla*	Louisiana Waterthrush	Passeriformes	Parulidae				M	breeding			X	
1	0	0	0	*Setophaga magnolia*	Magnolia Warbler	Passeriformes	Parulidae		X			breeding				
0	0	0	7	*Cistothorus palustris*	Marsh Wren	Passeriformes	Troglodytidae		X			both				
4	0	2	4	*Falco columbarius*	Merlin	Falconiformes	Falconidae					non-breeding				
0	0	0	2	*Ictinia mississippiensis*	Mississippi Kite	Falconiformes	Accipitridae		X			breeding				
10	14	14	20	*Zenaida macroura*	Mourning Dove	Columbiformes	Columbidae			X		both				
4	3	0	0	*Oreothlypis ruficapilla*	Nashville Warbler	Passeriformes	Parulidae					non-breeding				
2	4	0	4	*Colaptes auratus*	Northern Flicker	Piciformes	Picidae					both				
0	0	0	1	*Morus bassanus*	Northern Gannet	Suliformes	Sulidae		X			non-breeding				
0	0	0	5	*Circus cyaneus*	Northern Harrier	Falconiformes	Accipitridae		X			both				
2	0	0	0	*Setophaga americana*	Northern Parula	Passeriformes	Parulidae		X			breeding				
1	2	1	6	*Anas acuta*	Northern Pintail	Anseriformes	Anatidae			X		non-breeding				
1	2	1	5	*Anas clypeata*	Northern Shoveler	Anseriformes	Anatidae			X		non-breeding				
1	0	0	0	*Contopus cooperi*	Olive-sided Flycatcher	Passeriformes	Tyrannidae		X			non-breeding				
0	0	0	4	*Oreothlypis celata*	Orange-crowned Warbler	Passeriformes	Parulidae					non-breeding				
1	1	0	1	*Icterus spurius*	Orchard Oriole	Passeriformes	Icteridae					breeding				
3	0	0	0	*Seiurus aurocapilla*	Ovenbird	Passeriformes	Parulidae					breeding				
3	1	1	2	*Vireo philadelphicus*	Philadelphia Vireo	Passeriformes	Vireonidae		X			non-breeding				
0	5	4	5	*Podilymbus podiceps*	Pied-billed Grebe	Podicipediformes	Podicipedidae		X			both				
3	0	0	0	*Dryocopus pileatus*	Pileated Woodpecker	Piciformes	Picidae					both				
1	0	0	0	*Spinus pinus*	Pine Siskin	Passeriformes	Fringillidae		X			both				
2	0	0	0	*Setophaga pinus*	Pine Warbler	Passeriformes	Parulidae					both				
0	10	14	19	*Progne subis*	Purple Martin	Passeriformes	Hirundinidae					breeding				
5	0	0	0	*Melanerpes carolinus*	Red-bellied Woodpecker	Piciformes	Picidae					both				
1	2	1	4	*Mergus serrator*	Red-breasted Merganser	Anseriformes	Anatidae					non-breeding				
1	4	7	7	*Sitta canadensis*	Red-breasted Nuthatch	Passeriformes	Sittidae		X			both				
0	0	0	2	*Egretta rufescens*	Reddish Egret	Ciconiiformes	Ardeidae					non-breeding				
4	0	0	0	*Vireo olivaceus*	Red-eyed Vireo	Passeriformes	Vireonidae					breeding				
0	0	0	3	*Aythya americana*	Redhead	Anseriformes	Anatidae			X		non-breeding				
3	7	2	8	*Melanerpes erythrocephalus*	Red-headed Woodpecker	Piciformes	Picidae		X			both			X	
0	0	0	1	*Phalaropus lobatus*	Red-necked Phalarope	Charadriiformes	Scolopacidae					non-breeding				
2	0	0	0	*Buteo lineatus*	Red-shouldered Hawk	Falconiformes	Accipitridae					both				
5	0	0	0	*Buteo jamaicensis*	Red-tailed Hawk	Falconiformes	Accipitridae					both				
0	0	0	3	*Gavia stellata*	Red-throated Loon	Gaviiformes	Gaviidae		X	X		Non-Breeding				
4	4	2	6	*Aythya collaris*	Ring-necked Duck	Anseriformes	Anatidae			X		non-breeding				
0	2	2	2	*Columba livia*	Rock Pigeon	Columbiformes	Columbidae					both				
2	0	0	0	*Pheucticus ludovicianus*	Rose-breasted Grosbeak	Passeriformes	Cardinalidae		X			breeding				
0	11	10	11	*Archilochus colubris*	Ruby-throated Hummingbird	Apodiformes	Trochilidae			X		both				
1	2	1	4	*Oxyura jamaicensis*	Ruddy Duck	Anseriformes	Anatidae			X		non-breeding				
0	2	0	4	*Arenaria interpres*	Ruddy Turnstone	Charadriiformes	Scolopacidae			X		non-breeding				
0	1	3	6	*Euphagus carolinus*	Rusty Blackbird	Passeriformes	Icteridae		X		H	non-breeding		T		
3	0	0	0	*Piranga olivacea*	Scarlet Tanager	Passeriformes	Cardinalidae					breeding				
0	0	0	3	*Cistothorus platensis*	Sedge Wren	Passeriformes	Troglodytidae		X			non-breeding				
0	2	1	4	*Charadrius semipalmatus*	Semipalmated Plover	Charadriiformes	Charadriidae		X			non-breeding				
0	0	0	3	*Calidris pusilla*	Semipalmated Sandpiper	Charadriiformes	Scolopacidae					non-breeding				
0	0	0	2	*Limnodromus griseus*	Short-billed Dowitcher	Charadriiformes	Scolopacidae		X	X		non-breeding				
0	0	0	3	*Asio flammeus*	Short-eared Owl	Strigiformes	Strigidae		X			non-breeding				
0	0	0	4	*Chen caerulescens*	Snow Goose	Anseriformes	Anatidae			X		non-breeding				
1	0	0	0	*Melospiza melodia*	Song Sparrow	Passeriformes	Emberizidae					both			X	

Count of Habitat Associations by Ecoregion				Appendix 3-17 BIRDS SGCN - Habitat Associations 2025 NC WAP Revision				Species of Greatest Conservation Need (SGCN) Priority (Responsibility Species: G = Global, N = NC)	Knowledge Gap Priority	Management Need/Concern Priority	SEAFWA Regional SGCN	Population Designation ?	FEDERAL STATUS	STATE STATUS	Statewide Occurrences (>75 Counties)	Buildings, Structures
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family									
0	0	0	3	*Porzana carolina*	Sora	Gruiformes	Rallidae		X			non-breeding				
0	4	3	7	*Actitis macularius*	Spotted Sandpiper	Charadriiformes	Scolopacidae		X			non-breeding				
0	0	0	1	*Calidris himantopus*	Stilt Sandpiper	Charadriiformes	Scolopacidae					non-breeding				
2	0	0	0	*Piranga rubra*	Summer Tanager	Passeriformes	Cardinalidae					breeding				
1	0	0	0	*Catharus ustulatus*	Swainson's Thrush	Passeriformes	Turdidae					breeding				
2	1	2	5	*Limnothlypis swainsonii*	Swainson's Warbler	Passeriformes	Parulidae		X		H	breeding				
1	0	0	0	*Melospiza georgiana*	Swamp Sparrow	Passeriformes	Emberizidae					non-breeding				
5	0	0	2	*Oreothlypis peregrina*	Tennessee Warbler	Passeriformes	Parulidae		X			non-breeding				
1	8	9	14	*Tachycineta bicolor*	Tree Swallow	Passeriformes	Hirundinidae		X			both				
0	0	0	6	*Cygnus columbianus*	Tundra Swan	Anseriformes	Anatidae			X		non-breeding				
5	0	0	0	*Cathartes aura*	Turkey Vulture	Falconiformes	Cathartidae					both				
4	0	0	0	*Catharus fuscescens*	Veery	Passeriformes	Turdidae					breeding				
3	0	0	0	*Vireo gilvus*	Warbling Vireo	Passeriformes	Vireonidae			X		breeding				
0	0	0	1	*Calidris mauri*	Western Sandpiper	Charadriiformes	Scolopacidae					non-breeding				
4	0	0	0	*Sitta carolinensis*	White-breasted Nuthatch	Passeriformes	Sittidae					both				
4	0	0	0	*Vireo griseus*	White-eyed Vireo	Passeriformes	Vireonidae					both				
1	9	11	12	*Meleagris gallopavo*	Wild Turkey	Galliformes	Phasianidae			X		both				
4	1	0	0	*Empidonax traillii*	Willow Flycatcher	Passeriformes	Tyrannidae		X			breeding				
5	11	9	13	*Gallinago delicata*	Wilson's Snipe	Charadriiformes	Scolopacidae					non-breeding				
4	6	8	9	*Troglodytes troglodytes*	Winter Wren	Passeriformes	Troglodytidae					both				
6	6	3	9	*Aix sponsa*	Wood Duck	Anseriformes	Anatidae			X		both				
2	3	0	4	*Hylocichla mustelina*	Wood Thrush	Passeriformes	Turdidae				M	breeding				
1	0	0	0	*Setophaga petechia*	Yellow Warbler	Passeriformes	Parulidae					breeding				
4	0	0	0	*Sphyrapicus varius*	Yellow-bellied Sapsucker	Piciformes	Picidae					both				
3	3	0	4	*Coccyzus americanus*	Yellow-billed Cuckoo	Cuculiformes	Cuculidae				H	breeding				
4	0	0	0	*Icteria virens*	Yellow-breasted Chat	Passeriformes	Parulidae					breeding				
1	7	9	13	*Setophaga coronata*	Yellow-rumped Warbler	Passeriformes	Parulidae					both				
3	0	0	0	*Vireo flavifrons*	Yellow-throated Vireo	Passeriformes	Vireonidae					breeding				

Table 3-17
MAMMALS

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Natural Communities by Ecoregion				Red Text = Update				Population Designation ?	SGCN - Species of Greatest Conservation Need	Knowledge Gap Priority	Management Concern Priority	SEAFWA Regional SGCN M = Moderate, H = High, VH = Very High	FEDERAL STATUS	STATE STATUS
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Order	Family							
2	0	0	0	*Neotoma magister*	Allegheny Woodrat	Rodentia	Cricetidae		X	X		H		SC
0	0	0	1	*Sorex sp. 1*	An undescribed Shrew	Rodentia	Soricidae		X	X				
4	0	0	0	*Sylvilagus obscurus*	Appalachian Cottontail	Rodentia	Leporidae		X	X	X	M		
5	0	0	0	*Eptesicus fuscus*	Big Brown Bat	Chiroptera	Vespertilionidae				X			
10	7	4	7	*Tadarida brasiliensis*	Brazilian Free-tailed Bat	Chiroptera	Molossidae				X			
0	0	0	2	*Peromyscus leucopus buxtoni*	Buxton Woods White-footed Deermouse	Rodentia	Cricetidae		X	X		VH		SC
2	0	0	0	*Glaucomys sabrinus coloratus*	Carolina Northern Flying Squirrel	Rodentia	Sciuridae		X				E	E
0	0	0	3	*Peromyscus gossypinus*	Cotton Deermouse	Rodentia	Cricetidae			X		H		
0	0	0	0	*Microtus pennsylvanicus nigrans*	Dismal Swamp Meadow Vole	Rodentia	Cricetidae			X				
0	0	0	4	*Synaptomys cooperi helaletes*	Dismal Swamp Southern Bog Lemming	Rodentia	Cricetidae		X	X				
7	5	4	4	*Lasiurus borealis*	Eastern Red Bat	Chiroptera	Vespertilionidae			X	X			
2	0	0	1	*Myotis leibii*	Eastern Small-footed Bat	Chiroptera	Vespertilionidae		X		X	H		SC
2	0	0	0	*Spilogale putorius*	Eastern Spotted Skunk	Carnivora	Mephitidae		X			H		
1	0	0	2	*Neotoma floridana*	Eastern Woodrat	Rodentia	Cricetidae		X	X				T
0	0	0	1	*Neotoma floridana floridana*	Eastern Woodrat - CP	Rodentia	Cricetidae	CP Pop.	X					T
11	11	7	6	*Nycticeius humeralis*	Evening Bat	Chiroptera	Vespertilionidae				X			
1	0	0	0	*Myotis grisescens*	Gray Bat	Chiroptera	Vespertilionidae		X		X	M	E	E
2	0	0	0	*Parascalops breweri*	Hairy-tailed Mole	Rodentia	Talpidae			X				
13	9	6	9	*Lasiurus cinereus*	Hoary Bat	Chiroptera	Vespertilionidae		X		X	H	At-Risk	
2	0	0	0	*Myotis sodalis*	Indiana Bat	Chiroptera	Vespertilionidae		X		X	VH	E	E
3	0	0	0	*Mustela nivalis*	Least Weasel	Carnivora	Mustelidae			X				
15	19	3	10	*Myotis lucifugus*	Little Brown Bat	Chiroptera	Vespertilionidae		X		X	VH	At-Risk	E
4	3	0	6	*Neogale frenata*	Long-tailed Weasel	Carnivora	Mustelidae			X				
0	1	3	1	*Oryzomys palustris*	Marsh Rice Rat	Rodentia	Cricetidae			X				
2	1	0	0	*Zapus hudsonius*	Meadow Jumping Mouse	Rodentia	Dipodidae			X				
2	1	0	2	*Microtus pennsylvanicus pennsylvanicus*	Meadow Vole	Rodentia	Cricetidae			X				
2	0	0	16	*Myotis septentrionalis*	Northern Long-eared Bat	Chiroptera	Vespertilionidae		X		X	VH	E	E
0	0	0	4	*Lasiurus intermedius*	Northern Yellow Bat	Chiroptera	Vespertilionidae		X	X	X	H		SC
6	0	0	7	*Corynorhinus rafinesquii rafinesquii*	Rafinesque's Big-eared Bat - Mtn	Chiroptera	Vespertilionidae	Mtn Pop.	X		X	H		T
0	0	0	10	*Corynorhinus rafinesquii macrotis*	Rafinesque's Eastern Big-eared Bat - CP	Chiroptera	Vespertilionidae	CP Pop.	X		X	H		SC
0	1	0	8	*Canis rufus*	Red Wolf	Carnivora	Canidae		X		X	VH	E, Exp	T
3	0	0	0	*Sorex dispar*	Rock Shrew	Rodentia	Soricidae		X	X		H		
0	3	7	4	*Lasiurus seminolus*	Seminole Bat	Chiroptera	Vespertilionidae				X			
6	5	4	2	*Lasionycteris noctivagans*	Silver-haired Bat	Chiroptera	Vespertilionidae			X	X			
0	1	0	3	*Myotis austroriparius*	Southeastern Bat	Chiroptera	Vespertilionidae		X		X	M		SC
3	0	0	0	*Neotoma floridana haematoreia*	Southern Appalachian Woodrat	Rodentia	Cricetidae		X	X		M		
3	0	0	0	*Synaptomys cooperi stonei*	Southern Bog Lemming	Rodentia	Cricetidae		X					
2	0	0	5	*Sorex hoyi winnemana*	Southern Pygmy Shrew	Rodentia	Soricidae		X	X				
2	0	0	0	*Myodes gapperi*	Southern Red-backed Vole	Rodentia	Cricetidae			X				
7	0	0	0	*Microtus chrotorrhinus carolinensis*	Southern Rock Vole	Rodentia	Cricetidae		X			H		SC
5	4	7	7	*Condylura cristata*	Star-Nosed Mole	Rodentia	Talpidae		X	X				SC
0	0	0	6	*Condylura cristata pop. 1*	Star-Nosed Mole	Rodentia	Talpidae	CP Pop.	X	X				SC
14	20	9	25	*Perimyotis subflavus*	Tri-colored Bat	Chiroptera	Vespertilionidae		X		X	H	At-Risk	E
1	0	0	0	*Corynorhinus townsendii virginianus*	Virginia Big-eared Bat	Chiroptera	Vespertilionidae		X		X	VH	E	E

Count of Natural Communities by Ecoregion				Table 3-17 MAMMALS SGCN - Habitat Associations 2025 NC WAP Revision										
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family	Population Designation ?	SGCN - Species of Greatest Conservation Need	Knowledge Gap Priority	Management Concern Priority	SEAFWA Regional SGCN M = Moderate, H = High, VH = Very High	FEDERAL STATUS	STATE STATUS
0	0	0	3	*Trichechus manatus*	West Indian Manatee	Sirenia	Trichechidae		X				T	T
6	5	4	5	*Peromyscus leucopus*	White-footed Deermouse	Rodentia	Cricetidae			X				
2	0	0	0	*Napaeozapus insignis*	Woodland Jumping Mouse	Rodentia	Dipodidae			X				
3	3	3	4	*Microtus pinetorum*	Woodland Vole	Rodentia	Cricetidae			X				

Table 3-17
REPTILES

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Habitat Associations by Ecoregion				Red Text = Status Change				Population Designation ?	Species of Greatest Conservation Need (SGCN) Priority (Responsibility Species: G = Global, N = NC)	Knowledge Gap Priority	Management Concern Priority	SEAFWA Regional SGCN M = Moderate, H = High, VH = Very High	FEDERAL STATUS	STATE STATUS
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Order	Family							
0	4	2	5	*Alligator mississippiensis*	American Alligator	Alligatoria	Alligatoridae		X		X		T(S/A)	T
0	9	6	9	*Apalone spinifera aspera*	Gulf Coast Spiny Softshell	Testudines	Trionychidae		X	X				
13	0	0	0	*Apalone spinifera spinifera*	Eastern Spiny Softshell	Testudines	Trionychidae		X	X				SC
0	0	0	4	*Caretta caretta*	Loggerhead Sea Turtle	Testudines	Cheloniidae		X		X	H	T	T
2	5	2	6	*Cemophora coccinea copei*	Northern Scarlet Snake	Squamata	Colubridae		X	X				
0	0	0	3	*Chelonia mydas*	Green Sea Turtle	Testudines	Cheloniidae		X		X	H	T	T
0	5	2	8	*Clemmys guttata*	Spotted Turtle	Testudines	Emydidae		X	X	X	H		
0	0	0	7	*Crotalus adamanteus*	Eastern Diamondback Rattlesnake	Squamata	Viperidae		X	X	X	H	At-Risk	E
13	8	3	10	*Crotalus horridus*	Timber (Canebrake) Rattlesnake	Squamata	Viperidae		X	X	X	M		SC
0	0	3	6	*Deirochelys reticularia*	Eastern Chicken Turtle	Testudines	Emydidae		X	X	X	H		SC
0	0	0	3	*Dermochelys coriacea*	Leatherback Sea Turtle	Testudines	Dermochelyidae		X		X	VH	E	E
0	0	0	3	*Eretmochelys imbricata ~~imbricata~~*	Atlantic Hawksbill Sea Turtle	Testudines	Cheloniidae		X	X		VH	E	E
9	3	0	0	*Eumeces [= Plestiodon] anthracinus*	Coal Skink	Squamata	Scincidae		X	X		H		
0	0	3	8	*Farancia abacura abacura*	Eastern Mudsnake	Squamata	Colubridae			X		M		
0	0	0	3	*Farancia erytrogramma erytrogramma*	Common Rainbow Snake	Squamata	Colubridae		X	X		H		
3	2	0	0	*Glyptemys muhlenbergii*	Bog Turtle	Testudines	Emydidae		X		X		T(S/A)	T
13	0	0	0	*Graptemys geographica*	Northern Map Turtle	Testudines	Emydidae		X	X				SC
0	0	3	4	*Heterodon simus*	Southern Hognose Snake	Squamata	Colubridae		X	X	X	H	At-Risk	T
0	0	0	6	*Kinosternon baurii*	Striped Mud Turtle	Testudines	Kinosternidae		X	X		M		
4	7	6	7	*Lampropeltis calligaster rhombomaculata*	Mole Kingsnake	Squamata	Colubridae		X	X				
1	5	3	4	*Lampropeltis getula getula*	Eastern Kingsnake	Squamata	Colubridae			X	X			
0	0	0	3	*Lampropeltis getula sticticeps*	Outer Banks Kingsnake	Squamata	Colubridae		X	X				SC
0	5	2	4	*Lampropeltis triangulum elapsoides*	Scarlet Kingsnake	Squamata	Colubridae		X	X				
0	0	0	6	*Lampropeltis triangulum temporalis*	Coastal Plain Milk Snake	Squamata	Colubridae		X	X				
18	13	0	0	*Lampropeltis triangulum triangulum*	Eastern Milk Snake	Squamata	Colubridae		X	X				
0	0	0	4	*Lepidochelys kempii*	Kemp's Ridley Sea Turtle	Testudines	Cheloniidae		X		X	VH	E	E
0	0	0	4	*Malaclemys terrapin*	Diamondback Terrapin	Testudines	Emydidae		X		X	H		SC
0	0	2	7	*Masticophis [= Coluber] flagellum*	Eastern Coachwhip	Squamata	Colubridae		X	X	X			SC
0	0	2	4	*Micrurus fulvius*	Eastern Coral Snake	Squamata	Elapidae		X	X	X	H		E
0	9	6	9	*Nerodia erythrogaster*	Plain-Bellied Water Snake	Squamata	Colubridae			X				
0	0	0	4	*Nerodia sipedon williamengelsi*	Carolina Water Snake	Squamata	Colubridae		X	X		M		SC
2	7	5	6	*Ophisaurus attenuatus longicaudus*	Eastern Slender Glass Lizard	Squamata	Anguidae		X	X		H		SC
0	0	0	3	*Ophisaurus mimicus*	Mimic Glass Lizard	Squamata	Anguidae		X	X		H		E
3	1	1	5	*Pituophis melanoleucus melanoleucus*	Northern Pine Snake	Squamata	Colubridae		X	X	X	H		T
0	0	0	17	*Pseudemys rubriventris*	Northern Red-bellied Cooter	Testudines	Emydidae		X			M		
0	0	0	5	*Regina rigida*	Glossy Crayfish Snake	Squamata	Colubridae		X	X				
7	5	1	0	*Regina septemvittata*	Queen Snake	Squamata	Colubridae		X					
0	0	2	5	*Rhadinaea flavilata*	Pine Woods Litter Snake	Squamata	Colubridae		X	X		H		
0	0	1	5	*Seminatrix pygaea paludis*	Carolina Swamp Snake	Squamata	Colubridae		X	X				SC
0	2	3	5	*Sistrurus miliarius miliarius*	Carolina Pigmy Rattlesnake	Squamata	Viperidae		X	X	X	M		SC
7	0	0	0	*Sternotherus minor peltifer*	Stripe-necked Musk Turtle	Testudines	Kinosternidae		X	X		H		SC
11	7	4	8	*Sternotherus odoratus*	Eastern Musk Turtle	Testudines	Kinosternidae			X				
1	4	2	3	*Tantilla coronata*	Southeastern Crowned Snake	Squamata	Colubridae			X				
15	10	8	8	*Terrapene carolina carolina*	Eastern Box Turtle	Testudines	Emydidae		X		X	M		

Table 3-17
REPTILES

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Habitat Associations by Ecoregion				Red Text = Status Change										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Order	Family	Population Designation ?	Species of Greatest Conservation Need (SGCN) Priority (Responsibility Species: G = Global, N = NC)	Knowledge Gap Priority	Management Concern Priority	SEAFWA Regional SGCN M = Moderate, H = High, VH = Very High	FEDERAL STATUS	STATE STATUS
1	9	7	10	*Thamnophis sauritus sauritus*	Eastern Ribbon Snake	Squamata	Colubridae		X	X				
11	0	0	0	*Trachemys scripta troostii*	Cumberland Slider	Testudines	Emydidae		X	X		M		SC
0	3	3	4	*Virginia striatula*	Rough Earth Snake	Squamata	Colubridae			X				
11	12	11	12	*Virginia valeriae valeriae*	Eastern Smooth Earth Snake	Squamata	Colubridae		X	X				

Table 3-17
LAND SNAILS

SGCN - Habitat Associations
2025 NC WAP Revision

Count of Habitat Associations by Ecoregion														
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family	Species of Greatest Conservation Need SGCN Priority	Knowledge Gap Priorities	Management Concern Priorities	Population Designation ?	Exotic? Invasive?	FEDERAL STATUS	STATE STATUS
3	0	0	0	*Allogona profunda*	Broad-banded Forestsnail	Stylommatophora	Polygyridae		X					
6	0	0	0	*Anguispira alternata*	Flamed Tigersnail	Stylommatophora	Discidae		X	X				
1	5	2	10	*Anguispira fergusoni*	Coastal-plain Tigersnail	Stylommatophora	Discidae		X	X				
0	0	0	0	*Anguispira jessica*	Mountain Disc	Stylommatophora	Discidae		X	X				
0	0	0	0	*Anguispira mordax*	Appalachian Tigersnail	Stylommatophora	Discidae		X	X				
0	0	0	0	*Anguispira strongylodes*	Southeastern Tigersnail	Stylommatophora	Discidae		X	X				
7	0	0	0	*Appalachina chilhoweensis*	Queen Crater	Stylommatophora	Polygyridae	X	X					
5	0	0	0	*Appalachina sayanus*	Spike-lip Crater	Stylommatophora	Polygyridae		X					
0	0	0	0	*Arion circumscriptus*	Brown-banded Arion	Stylommatophora	Arionidae		X	X		Y		
2	0	0	0	*Arion fasciatus*	Orange-banded Arion	Stylommatophora	Arionidae		X			Y		
2	0	0	0	*Arion subfuscus*	Dusky Arion	Stylommatophora	Arionidae		X	X		Y		
2	0	0	0	*Carychium arboreum*	Tree Thorn	Basommatophora	Ellobiidae	X	X					
8	3	0	0	*Carychium clappi*	Appalachian Thorn	Basommatophora	Ellobiidae							
5	3	2	2	*Carychium exiguum*	Obese Thorn	Basommatophora	Ellobiidae	X						
0	0	0	0	*Carychium exile*	Ice Thorn	Basommatophora	Ellobiidae							
6	0	0	0	*Carychium nannodes*	File Thorn	Basommatophora	Ellobiidae							
5	5	0	0	*Cochlicopa lubrica*	Glossy Pillar	Stylommatophora	Cochlicopidae		X	X		Y		
6	4	0	0	*Cochlicopa morseana*	Appalachian Pillar	Stylommatophora	Cochlicopidae			X				
6	5	0	0	*Columella simplex*	Toothless pupa, High-spire Column S	Stylommatophora	Truncatellinidae		X					
0	0	0	4	*Daedalochila postelliana*	Coastal Liptooth	Stylommatophora	Polygyridae		X					
10	6	5	8	*Deroceras laeve*	Meadow Slug	Stylommatophora	Agriolimacidae			X				
0	0	0	0	*Deroceras reticulatum*	Gray Fieldslug	Stylommatophora	Agriolimacidae					Y		
6	0	0	0	*Discus bryanti*	Sawtooth Disc	Stylommatophora	Discidae			X				
6	0	0	0	*Discus nigrimontanus*	Black Mountain Disc	Stylommatophora	Discidae		X	X				
7	4	0	0	*Discus patulus*	Domed Disc	Stylommatophora	Discidae		X	X				
3	0	0	0	*Discus whitneyi*	Forest Disc	Stylommatophora	Discidae		X	X				
1	6	0	0	*Dryachloa dauca*	Carrot Glass	Stylommatophora	Euconulidae		X					
6	0	0	0	*Euchemotrema fasciatum*	Mountain Pillsnail	Stylommatophora	Polygyridae		X					
4	3	0	0	*Euchemotrema fraternum*	Upland Pillsnail	Stylommatophora	Polygyridae		X					
0	0	0	0	*Euconulus chersinus*	Wild Hive	Stylommatophora	Euconulidae		X					
0	0	0	0	*Euconulus dentatus*	Toothed Hive	Stylommatophora	Euconulidae		X					
6	3	0	3	*Euconulus fulvus*	Brown Hive	Stylommatophora	Euconulidae		X					
0	0	0	0	*Euconulus trochulus*	Silk Hive	Stylommatophora	Euconulidae		X					
0	0	0	7	*Euglandina rosea*	Rosy Wolfsnail	Stylommatophora	Spiraxidae		X	X		Y		
3	0	0	0	*Fumonelix cherohalaensis*	Rock-loving Covert	Stylommatophora	Polygyridae	X	X					
7	3	0	0	*Fumonelix christyi*	Glossy Covert	Stylommatophora	Polygyridae		X					
3	0	0	0	*Fumonelix clingmanica*	Clingman Covert	Stylommatophora	Polygyridae	X	X					
2	0	0	0	*Fumonelix jonesiana*	Big-tooth Covert	Stylommatophora	Polygyridae	X	X					
3	0	0	0	*Fumonelix langdoni*	Talus covert	Stylommatophora	Polygyridae	X	X					
3	0	0	0	*Fumonelix orestes*	Engraved Covert	Stylommatophora	Polygyridae	X	X					
6	0	0	0	*Fumonelix wheatleyi*	Cinnamon Covert	Stylommatophora	Polygyridae		X					
13	9	0	8	*Gastrocopta contracta*	Bottleneck Snaggletooth	Stylommatophora	Gastrocoptidae							
4	4	0	0	*Gastrocopta corticaria*	Bark Snaggletooth	Stylommatophora	Gastrocoptidae			X				
12	10	0	8	*Gastrocopta pentodon*	Comb Snaggletooth	Stylommatophora	Gastrocoptidae		X					
0	2	0	4	*Gastrocopta procera*	Wing Snaggletooth	Stylommatophora	Gastrocoptidae		X					
0	0	3	7	*Gastrocopta riparia*	Gulf Coast Snaggletooth	Stylommatophora	Gastrocoptidae		X					
2	2	0	6	*Gastrocopta rupicola*	Tapered Snaggletooth	Stylommatophora	Gastrocoptidae		X					
1	2	4	0	*Gastrocopta tappaniana*	White Snaggletooth	Stylommatophora	Gastrocoptidae		X					
8	3	0	0	*Gastrodonta interna*	Brown Bellytooth	Stylommatophora	Gastrodontidae		X					
7	0	0	0	*Glyphyalinia carolinensis*	Spiral Mountain Glyph	Stylommatophora	Gastrodontidae		X					

Table 3-17
LAND SNAILS

SGCN - Habitat Associations
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Count of Habitat Associations by Ecoregion				Red Text = Update				Species of Greatest Conservation Need SGCN Priority	Knowledge Gap Priorities	Management Concern Priorities	Population Designation ?	Exotic? Invasive?	FEDERAL STATUS	STATE STATUS
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Order	Family							
7	0	0	0	*Glyphyalinia cumberlandiana*	Hill Glyph	Stylommatophora	Gastrodontidae		X					
11	8	7	8	*Glyphyalinia indentata*	Carved Glyph	Stylommatophora	Gastrodontidae			X				
5	0	0	0	*Glyphyalinia junaluskana*	Dark Glyph	Stylommatophora	Gastrodontidae	X	X					
0	3	4	3	*Glyphyalinia luticola*	Furrowed Glyph	Stylommatophora	Gastrodontidae		X					
4	0	0	0	*Glyphyalinia pentadelphia*	Pink Glyph	Stylommatophora	Gastrodontidae	X	X					
6	6	0	0	*Glyphyalinia praecox*	Brilliant Glyph	Stylommatophora	Gastrodontidae		X					
7	6	5	2	*Glyphyalinia rhoadsi*	Sculpted Glyph	Stylommatophora	Gastrodontidae		X					
4	3	0	0	*Glyphyalinia sculptilis*	Suborb Glyph	Stylommatophora	Gastrodontidae		X					
8	7	3	9	*Glyphyalinia solida*	Solid Glyph	Stylommatophora	Gastrodontidae		X					
0	0	0	0	*Glyphyalinia umbilicata*	Texas Glyph	Stylommatophora	Gastrodontidae		X					
6	2	0	0	*Glyphyalinia wheatleyi*	Bright Glyph	Stylommatophora	Gastrodontidae		X					
8	7	0	4	*Guppya sterkii*	Sterki's Granule	Stylommatophora	Euconulidae		X					
0	0	0	0	*Haplotrema concavum*	Gray-foot Lancetooth	Stylommatophora	Haplotrematidae							
5	0	0	0	*Haplotrema kendeighi*	Blue-footed Lancetooth	Stylommatophora	Haplotrematidae	X	X					
0	0	0	4	*Hawaiia alachuana*	Southeastern Gem	Stylommatophora	Prtistilomatidae		X	X				
0	0	0	0	*Hawaiia minuscula*	Minute Gem	Stylommatophora	Prtistilomatidae		X					
6	0	0	0	*Helicodiscus bonamicus*	Spiral Coil	Stylommatophora	Helicodiscidae	X	X					
3	0	0	0	*Helicodiscus multidens*	Twilight Coil	Stylommatophora	Helicodiscidae	X	X					
9	6	0	0	*Helicodiscus notius*	Tight Coil	Stylommatophora	Helicodiscidae		X					
8	8	8	10	*Helicodiscus parallelus*	Compound Coil	Stylommatophora	Helicodiscidae		X					
5	0	0	0	*Helicodiscus saludensis*	Corncob Snail	Stylommatophora	Helicodiscidae	X	X					
5	0	0	0	*Hendersonia occulta*	Cherrystone Drop	Neritopsina	Helicinidae		X					
3	0	0	0	*Inflectarius downieanus*	Dwarf Globelet	Stylommatophora	Polygyridae	X	X					
3	0	0	0	*Inflectarius ferrissi*	Smoky Mountain Covert	Stylommatophora	Polygyridae	X	X					
0	0	0	0	*Inflectarius inflectus*	Shagreen	Stylommatophora	Polygyridae		X					
0	0	0	0	*Inflectarius kalmianus*	Brown Globelet	Stylommatophora	Polygyridae	X	X	X				
8	3	0	0	*Inflectarius rugeli*	Deep-tooth Shagreen	Stylommatophora	Polygyridae		X					
4	0	0	0	*Inflectarius subpalliatus*	Velvet Covert	Stylommatophora	Polygyridae	X	X					
0	0	0	0	*Lehmannia valentiana*	Threeband Gardenslug	Stylommatophora	Limacidae					Y		
0	0	0	0	*Limax maximus*	Giant Gardenslug	Stylommatophora	Limacidae							
0	2	0	0	*Lobosculum pustuloides*	Tiny Liptooth	Stylommatophora	Polygyridae		X					
8	5	0	3	*Lucilla inermis*	Oldfield Coil	Stylommatophora	Helicodiscidae	X	X	X				
4	5	0	0	*Lucilla scintilla*	Oldfield Coil	Stylommatophora	Helicodiscidae							
4	0	0	4	*Lucilla singleyana*	Smooth Coil	Stylommatophora	Helicodiscidae		X					
0	0	0	1	*Mediappendix hubrichti [Catinella hubri*	Snowhill Ambersnail	Stylommatophora	Succineidae	X	X					
3	0	0	5	*Mediappendix oklahomarum*	Detritus Ambersnail	Stylommatophora	Succineidae		X					
5	0	0	0	*Mediappendix oklahomarum [Catinella*	Detritus Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	4	*Mediappendix pugilator*	Weedpatch Ambersnail	Stylommatophora	Succineidae	X	X					
0	0	0	0	*Mediappendix pugilator {Catinella pugil*	Weedpatch Ambersnail	Stylommatophora	Succineidae	X	X					
3	0	0	0	*Mediappendix vermeta*	Suboval Ambersnail	Stylommatophora	Succineidae		X					
3	0	0	0	*Mediappendix vermeta [Catinella verme*	Suboval Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	1	*Mediappendix waccamawensis*	Waccamaw Ambersnail	Stylommatophora	Succineidae	X	X					
0	0	0	0	*Mediappendix waccamawensis [Catinell*	Waccamaw Ambersnail	Stylommatophora	Succineidae	X	X					
9	7	9	6	*Megapallifera mutabilis*	Changeable Mantleslug	Stylommatophora	Phylomycidae							
3	0	0	0	*Mesodon altivagus*	Wandering Globe	Stylommatophora	Polygyridae	X	X					
5	0	0	0	*Mesodon andrewsae*	Balsam Globe	Stylommatophora	Polygyridae		X					
4	1	0	1	*Mesodon clausus*	Yellow Globelet	Stylommatophora	Polygyridae		X					
4	0	0	0	*Mesodon elevatus*	Proud Globe	Stylommatophora	Polygyridae		X					
9	0	0	0	*Mesodon mitchellianus*	Sealed Globelet	Stylommatophora	Polygyridae		X					
14	0	0	0	*Mesodon normalis*	Grand Globe	Stylommatophora	Polygyridae		X					

Table 3-17
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SGCN - Habitat Associations
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Count of Habitat Associations by Ecoregion				Red Text = Update				Species of Greatest Conservation Need SGCN Priority	Knowledge Gap Priorities	Management Concern Priorities	Population Designation ?	Exotic? Invasive?	FEDERAL STATUS	STATE STATUS
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Order	Family							
13	10	6	10	*Mesodon thyroidus*	White-lip Globe	Stylommatophora	Polygyridae		X					
4	0	0	0	*Mesodon zaletus*	Toothed Globe	Stylommatophora	Polygyridae		X					
6	0	0	0	*Mesomphix andrewsae*	Mountain Button	Stylommatophora	Gastrodontidae		X					
1	6	0	3	*Mesomphix cupreus*	Copper Button	Stylommatophora	Gastrodontidae		X					
4	2	0	0	*Mesomphix latior*	Broad Button	Stylommatophora	Gastrodontidae	X	X					
0	5	4	0	*Mesomphix pilsbryi*	Striate Button	Stylommatophora	Gastrodontidae	X	X					
9	0	0	0	*Mesomphix rugeli*	Wrinkled Button	Stylommatophora	Gastrodontidae		X					
9	0	0	0	*Mesomphix subplanus*	Flat Button	Stylommatophora	Gastrodontidae		X					
10	6	4	0	*Neohelix albolabris*	Whitelip	Stylommatophora	Polygyridae		X					
5	0	0	0	*Neohelix dentifera*	Big-tooth Whitelip	Stylommatophora	Polygyridae		X					
5	3	4	3	*Neohelix major*	Southeastern Whitelip	Stylommatophora	Polygyridae		X					
0	4	5	8	*Neohelix solemi*	Coastal Whitelip	Stylommatophora	Polygyridae		X					
7	0	0	0	*Novisuccinea ovalis*	Oval Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	1	*Opeas hannensis*	Dwarf Awlsnail	Stylommatophora	Achatinidae		X			Y		
0	2	0	0	*Opeas pyrgula*	Sharp Awlsnail	Stylommatophora	Achatinidae		X			Y		
0	0	0	0	*Oxychilus alliarius*	Garlic Glass-snail	Stylommatophora	Oxychilidae		X	X		Y		
0	0	0	6	*Oxyloma effusum*	Coastal-plain Ambersnail	Stylommatophora	Succineidae		X					
5	5	4	0	*Pallifera dorsalis*	Pale Mantleslug	Stylommatophora	Philomycidae			X				
8	6	4	3	*Pallifera fosteri*	Foster Mantleslug	Stylommatophora	Philomycidae							
5	0	0	0	*Pallifera hemphilli*	Black Mantleslug	Stylommatophora	Philomycidae	X	X					
6	0	0	0	*Pallifera secreta*	Severed Mantleslug	Stylommatophora	Philomycidae							
5	0	0	0	*Paravitrea andrewsae*	High Mountain Supercoil	Stylommatophora	Oxychilidae	X	X	X				
5	0	0	0	*Paravitrea capsella*	Dimple Supercoil	Stylommatophora	Oxychilidae		X	X				
4	0	0	0	*Paravitrea clappi*	Mirey Ridge Supercoil	Stylommatophora	Oxychilidae	X	X	X				
5	0	0	0	*Paravitrea lacteodens*	Ramp Cove Supercoil	Stylommatophora	Oxychilidae	X	X	X				
7	0	0	0	*Paravitrea lamellidens*	Lamellate Supercoil	Stylommatophora	Oxychilidae		X	X				
6	0	0	0	*Paravitrea multidentata*	Dentate Supercoil	Stylommatophora	Oxychilidae		X	X				
0	4	0	0	*Paravitrea nunnehi*	Broad River Supercoil	Stylommatophora	Oxychilidae	X						
5	0	0	0	*Paravitrea placentula*	Glossy Supercoil	Stylommatophora	Oxychilidae	X	X	X				
6	0	0	0	*Paravitrea reesei*	Round Supercoil	Stylommatophora	Oxychilidae	X	X	X				
3	0	0	0	*Paravitrea ternaria*	Sculpted Supercoil	Stylommatophora	Oxychilidae	X	X	X				
5	0	0	0	*Paravitrea umbilicaris*	Open Supercoil	Stylommatophora	Oxychilidae	X	X	X				
6	0	0	0	*Paravitrea varidens*	Roan Supercoil	Stylommatophora	Oxychilidae	X	X	X				
7	5	0	0	*Patera appressa*	Flat Bladetooth	Stylommatophora	Polygyridae		X					
10	0	0	0	*Patera clarkii*	Dwarf Proud Globe	Stylommatophora	Polygyridae		X					
2	1	0	2	*Patera laevior*	Smooth Bladetooth	Stylommatophora	Polygyridae		X					
4	0	0	0	*Patera nantahala*	Noonday Globe	Stylommatophora	Polygyridae	X	X				T	
10	6	0	0	*Patera perigrapta*	Engraved Bladetooth	Stylommatophora	Polygyridae		X					
9	7	7	7	*Philomycus carolinianus*	Carolina Mantleslug	Stylommatophora	Philomycidae			X				
9	5	0	0	*Philomycus flexuolaris*	Winding Mantleslug	Stylommatophora	Philomycidae							
9	5	0	1	*Philomycus togatus*	Toga Mantleslug	Stylommatophora	Philomycidae							
9	2	0	0	*Philomycus venustus*	Brown-spotted Mantleslug	Stylommatophora	Philomycidae							
3	0	0	0	*Philomycus virginicus*	Virginia Mantleslug	Stylommatophora	Philomycidae	X						
8	0	0	0	*Pilsbryna clingmani*	Fragile Glyph	Stylommatophora	Oxychilidae	X	X					
4	0	0	0	*Pilsbryna nodopalma*	Oar Tooth Bud	Stylommatophora	Oxychilidae	X	X					
7	0	0	0	*Pilsbryna vanattai*	Honey Glyph	Stylommatophora	Oxychilidae	X	X					
0	0	0	9	*Polygyra cereolus*	Southern Flatcoil	Stylommatophora	Polygyridae		X					
2	0	0	0	*Praticolella lawae*	Appalachian Shrubsnail	Stylommatophora	Polygyridae	X	X					
0	0	0	0	*Pseudohyalina exigua*	Ribbed Striate	Stylommatophora	Gastro**don**tidae		*X*					
10	6	3	1	*Punctum blandianum*	Brown Spot	Stylommatophora	Punctidae		X	X				

Table 3-17
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SGCN - Habitat Associations
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Count of Habitat Associations by Ecoregion				Red Text = Update				Species of Greatest Conservation Need SGCN Priority	Knowledge Gap Priorities	Management Concern Priorities	Population Designation ?	Exotic? Invasive?	FEDERAL STATUS	STATE STATUS
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Order	Family							
8	8	7	8	*Punctum minutissimum*	Small Spot	Stylommatophora	Punctidae		X	X				
0	4	0	3	*Punctum smithi*	Lamellate Spot	Stylommatophora	Punctidae	X	X	X				
5	0	0	0	*Punctum vitreum*	Glass Spot	Stylommatophora	Punctidae	X	X	X				
0	0	0	3	*Pupisoma macneilli*	Gulf Babybody	Stylommatophora	Valloniidae		X					
0	0	0	0	*Pupoides albilabris*	White-lip Dagger	Stylommatophora	Pupillidae		X	X				
0	0	0	1	*Rumina decollata*	Decollate Snail	Stylommatophora	Achatinidae		X			Y		
9	4	0	0	*Stenotrema altispira*	Highland Slitmouth	Stylommatophora	Polygyridae		X					
0	4	0	2	*Stenotrema barbatum*	Bristled Slitmouth	Stylommatophora	Polygyridae		X					
3	3	0	0	*Stenotrema barbigerum*	Fringed Slitmouth	Stylommatophora	Polygyridae		X					
6	0	0	0	*Stenotrema depilatum*	Great Smoky Slitmouth	Stylommatophora	Polygyridae	X	X					
3	5	0	0	*Stenotrema hirsutum*	Hairy Slitmouth	Stylommatophora	Polygyridae		X					
5	3	0	0	*Stenotrema magnifumosum*	Appalachian Slitmouth	Stylommatophora	Polygyridae		X					
5	0	0	0	*Stenotrema pilula*	Pygmy Slitmouth	Stylommatophora	Polygyridae		X					
7	5	0	0	*Stenotrema stenotrema*	Inland Slitmouth	Stylommatophora	Polygyridae		X					
4	0	0	0	*Striatura ferrea*	Black Striate	Stylommatophora	Gastrodontidae		X					
11	8	6	10	*Striatura meridionalis*	Median Striate	Stylommatophora	Gastrodontidae		X					
9	8	7	8	*Strobilops aeneus*	Bronze Pinecone	Stylommatophora	Strobilopsidae		X	X				
6	7	0	6	*Strobilops labyrinthicus*	Maze Pinecone	Stylommatophora	Strobilopsidae		X	X				
0	3	6	7	*Strobilops texasianus*	Southern Pinecone	Stylommatophora	Strobilopsidae	X	X	X				
0	0	0	8	*Succinea campestris*	Crinkled Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	0	*Succinea concordialis*	Spotted Ambersnail	Stylommatophora	Succineidae		*X*					
0	0	0	2	*Succinea indiana*	Xeric Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	6	*Succinea unicolor*	Squatty Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	6	*Succinea wilsonii*	Golden Ambersnail	Stylommatophora	Succineidae		X					
0	0	0	0	*Triodopsis burchi*	Pittsylvania Threetooth	Stylommatophora	Polygyridae		X					
0	9	6	8	*Triodopsis fallax*	Mimic Threetooth	Stylommatophora	Polygyridae		X					
0	9	0	0	*Triodopsis fulciden*	Dwarf Threetooth	Stylommatophora	Polygyridae	X	X					
3	8	8	13	*Triodopsis hopetonensis*	Magnolia Threetooth	Stylommatophora	Polygyridae		X					
0	5	5	4	*Triodopsis juxtidens*	Atlantic Threetooth	Stylommatophora	Polygyridae		X					
0	0	6	7	*Triodopsis messana*	Pinhole Threetooth	Stylommatophora	Polygyridae		X					
0	0	0	8	*Triodopsis obsoleta*	Nubbin Threetooth	Stylommatophora	Polygyridae		X					
3	7	0	0	*Triodopsis pendula*	Hanging Rock Threetooth	Stylommatophora	Polygyridae		X					
0	0	0	4	*Triodopsis soelneri*	Cape Fear Threetooth	Stylommatophora	Polygyridae	X	X					
4	0	0	0	*Triodopsis tennesseensis*	Tennessee Threetooth (Budded Thre	Stylommatophora	Polygyridae							
8	10	0	0	*Triodopsis tridentata*	Northern Threetooth	Stylommatophora	Polygyridae							
7	0	0	0	*Triodopsis vulgata*	Dished Threetooth	Stylommatophora	Polygyridae							
5	2	0	0	*Vallonia excentrica*	Iroquois Vallonia	Stylommatophora	Valloniidae		X					
0	3	0	0	*Vallonia pulchella*	Lovely Vallonia	Stylommatophora	Valloniidae		X					
5	0	0	0	*Ventridens acerra*	Glossy Dome	Stylommatophora	Gastrodontidae		X					
6	0	0	0	*Ventridens arcellus*	Golden Dome	Stylommatophora	Gastrodontidae		X					
0	4	4	6	*Ventridens cerinoideus*	Wax Dome	Stylommatophora	Gastrodontidae		X					
6	0	0	0	*Ventridens coelaxis*	Bidentate Dome	Stylommatophora	Gastrodontidae		X					
3	0	0	0	*Ventridens collisella*	Sculptured Dome	Stylommatophora	Gastrodontidae		X					
6	0	0	0	*Ventridens decussatus*	Crossed Dome	Stylommatophora	Gastrodontidae		X					
5	8	5	5	*Ventridens demissus*	Perforate Dome	Stylommatophora	Gastrodontidae		X					
7	8	0	0	*Ventridens gularis*	Throaty Dome	Stylommatophora	Gastrodontidae		X					
9	8	7	9	*Ventridens intertextus*	Pyramid Dome	Stylommatophora	Gastrodontidae		X					
7	0	0	0	*Ventridens lasmodon*	Hollow Dome	Stylommatophora	Gastrodontidae		X					
8	7	0	0	*Ventridens lawae*	Rounded Dome	Stylommatophora	Gastrodontidae		X					
6	7	0	0	*Ventridens ligera*	Globose Dome	Stylommatophora	Gastrodontidae		X					

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SGCN - Habitat Associations
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Count of Habitat Associations by Ecoregion								Species of Greatest Conservation Need SGCN Priority	Knowledge Gap Priorities	Management Concern Priorities	Population Designation ?	Exotic? Invasive?	FEDERAL STATUS	STATE STATUS
Mountain	Piedmont	Sandhills	Coastal Plain	Red Text = Update *Scientific Name*	Common Name	Order	Family							
10	6	0	0	*Ventridens pilsbryi*	Yellow Dome	Stylommatophora	Gastrodontidae		X					
0	4	0	0	*Ventridens suppressus*	Flat Dome	Stylommatophora	Gastrodontidae		X					
7	5	0	0	*Ventridens theloides*	Copper Dome	Stylommatophora	Gastrodontidae		X					
0	0	2	3	*Vertigo alabamensis*	Alabama Vertigo	Stylommatophora	Vertiginidae		X					
3	0	0	0	*Vertigo clappi*	Cupped Vertigo	Stylommatophora	Vertiginidae	X	X					
8	4	0	0	*Vertigo gouldii*	Variable Vertigo	Stylommatophora	Vertiginidae		X					
0	0	0	6	*Vertigo malleata*	Malleated Vertigo	Stylommatophora	Vertiginidae		X	X				
3	2	0	5	*Vertigo milium*	Blade Vertigo	Stylommatophora	Vertiginidae		X	X				
0	0	0	8	*Vertigo oralis*	Palmetto Vertigo	Stylommatophora	Vertiginidae		X	X				
5	0	0	7	*Vertigo oscariana*	Capital Vertigo	Stylommatophora	Vertiginidae	X	X	X				
2	2	0	3	*Vertigo ovata*	Ovate Vertigo	Stylommatophora	Vertiginidae		X	X				
0	4	0	0	*Vertigo parvula*	Smallmouth Vertigo	Stylommatophora	Vertiginidae	X	X	X				
2	0	0	2	*Vertigo pygmaea*	Crested Vertigo	Stylommatophora	Vertiginidae	X	X					
0	2	0	5	*Vertigo rugosula*	Striate Vertigo	Stylommatophora	Vertiginidae		X					
0	0	0	6	*Vertigo teskeyae*	Swamp Vertigo	Stylommatophora	Vertiginidae	X	X	X				
9	0	0	0	*Vitrinizonites latissimus*	Glassy Grapeskin	Stylommatophora	Gastrodontidae		X	X				
0	5	1	2	*Xolotrema caroliniense*	Blunt Wedge	Stylommatophora	Polygyridae		X	X				
10	0	0	0	*Xolotrema denotatum*	Velvet Wedge	Stylommatophora	Polygyridae		X	X				
7	9	10	8	*Zonitoides arboreus*	Quick Gloss	Stylommatophora	Gastrodontidae		X	X				
8	5	0	0	*Zonitoides elliotti*	Green Dome	Stylommatophora	Gastrodontidae		X	X				
1	0	0	0	*Zonitoides nitidus*	Black Gloss	Stylommatophora	Gastrodontidae		X	X		Y		
5	0	0	0	*Zonitoides patuloides*	Appalachian Gloss	Stylommatophora	Gastrodontidae	X	X	X				

Count of Habitat Associations by Ecoregion				Number of River Basins Occupied	Table 3-18 CRAYFISH 2025 WAP Revision Aquatic SGCN - Habitat Associations		Population Segment?	SGCN Conservation Concern Priority	Knowledge Gap Priority	Management Priority	NC Endemic Species? *River Basin hydrologic endemic	Introduced or Invasive?	SEAFWA Regional SGCN M = moderate, H = high, VH = very high	Federal Status	State Status
Mountains	Piedmont	Sandhills	Coastal Plain		*Scientific Name*	Common Name									
	X			1	*Cambarus aldermanorum*	Carolina Needlenose Crayfish		X	X	X			M		
X				1	*Cambarus brimleyorum*	Valley River Crayfish		X	X	X	Y		M		
X				1	*Cambarus burchfielae*	Falls Crayfish		X		X					
X				2	*Cambarus carolinus*	Red Burrowing Crayfish		X	X	X					
	X			2	*Cambarus catagius*	Greensboro Burrowing Crayfish		X	X	X	Y		H		SC
X				1	*Cambarus cf. howardi sp. 1*	Moravian Crayfish		X	X	X					
X				1	*Cambarus chaugaensis*	Chauga Crayfish [= Oconee Stream Crayfish]		X		X	Y*		H		SC
X				3	*Cambarus eeseeohensis*	Grandfather Mountain Crayfish		X	X	X	Y		H		
X				1	*Cambarus franklini*	South Mountains Crayfish		X		X	Y				T
X				1	*Cambarus georgiae*	Little Tennessee River Crayfish		X	X	X			H		SC
		X	X	1	*Cambarus hystricosus*	Sandhills Spiny Crayfish		X	X	X	Y				
X	X			3	*Cambarus johni*	Carolina Foothills Crayfish		X	X	X	Y				
X				1	*Cambarus lapidosus*	Stony Fork Crayfish		X		X					
X	X			1	*Cambarus lenati*	Broad River Stream Crayfish		X		X	Y		H		
X				1	*Cambarus nodosus*	Knotty Burrowing Crayfish		X	X	X					
X				1	*Cambarus parrishi*	Hiwassee Headwater Crayfish		X	X	X			VH		SC
X				3	*Cambarus reburrus*	French Broad River Crayfish		X		X	Y		H		T
X				3	*Cambarus sp. A*	An undescribed crayfish		X	X	X					
X	X			1	*Cambarus spicatus*	Broad River Spiny Crayfish		X		X			M	At-Risk	T
X				1	*Cambarus tuckasegee*	Tuckaseegee Stream Crayfish		X	X	X	Y		VH		
	X		X	2	*Faxonius virginiensis*	Chowanoke Crayfish		X		X	Y				SC
X				1	*Lacunicambarus acanthura*	Thornytail Crayfish		X	X	X					
			X	2	*Procambarus ancylus*	Coastal Plain Crayfish		X	X	X					
			X	1	*Procambarus blandingii*	Santee Crayfish		X	X	X					
			X	1	*Procambarus chacei [= P. braswelli]*	Cedar Creek Crayfish [= Waccamaw Crayfish]		X	X	X			H		
	X		X	2	*Procambarus medialis*	Pamlico Crayfish		X	X	X	Y		M		T
		X	X	2	*Procambarus pearsei*	Carolina Sandhills Crayfish		X	X	X			M		T
			X	3	*Procambarus plumimanus*	Croatan Crayfish		X	X	X	Y				

Table 3-18
FRESHWATER FISH

2025 WAP Revision
Aquatic SGCN - Habitat Associations

Habitat Associations by Ecoregion				Number of River Basins Occupied	*Scientific Name*	Common Name	Population Segment?	SGCN Conservation Concern Priority	Knowledge Gap Priority	Management Priority	NC Endemic Species? *River Basin hydrologic endemic	SEAFWA Regional SGCN M = moderate, H = high, VH = very high	Federal Status	State Status
Mountains	Piedmont	Sandhills	Coastal Plain											
				0	*Acantharchus pomotis*	Mud Sunfish		X						
	X		X	6	*Acipenser brevirostrum*	Shortnose Sturgeon		X		X		VH	E	E
X				1	*Acipenser fulvescens*	Lake Sturgeon	Reintroduced	X		X		H		SC
			X	9	*Acipenser oxyrinchus*	Atlantic Sturgeon		X		X		H	E	E
	X	X	X	9	*Alburnops chalybaeus*	Ironcolor Shiner		X	X			H		T
				0	*Alosa aestivalis*	Blueback Herring (native)	Native	X		X				
				5	*Alosa mediocris*	Hickory Shad		X		X		H		
				0	*Alosa pseudoharengus*	Alewife	Native			X				
				5	*Alosa sapidissima*	American Shad		X		X		VH		
	X		X	10	*Ambloplites cavifrons*	Roanoke Bass		X		X		M		
				0	*Ambloplites rupestris*	Rock Bass				X				
			X	11	*Ameiurus brunneus*	Snail Bullhead		X		X				
				0	*Ameiurus catus*	White Catfish				X				
				0	*Ameiurus natalis*	Yellow Bullhead				X				
				17	*Ameiurus nebulosus*	Brown Bullhead		X		X				
X	X	X	X	15	*Ameiurus platycephalus*	Flat Bullhead		X		X				
				10	*Anguilla rostrata*	American Eel		X		X		VH		
X				1	*Aplodinotus grunniens*	Freshwater Drum		X	X					SC
X	X			1	*Carpiodes carpio*	River Carpsucker			X					SC
X	X		X	1	*Carpiodes cyprinus*	Quillback		X		X				
X	X			4	*Carpiodes sp.*	Carolina Quillback		X	X			H		
				0	*Centrarchus macropterus*	Flier				X				
				9	*Chologaster cornuta*	Swampfish		X				M		
X				0	*Chrosomus oreas*	Mountain Redbelly Dace			X					
X				2	*Clinostomus sp.*	Redside Daces (Hiwassee, Smoky Dace)		X				M		SC
	X			6	*Cottus caeruleomentum*	Blue Ridge Sculpin		X						SC
X				3	*Cottus carolinae*	Banded Sculpin		X	X					SC
X	X			3	*Cyprinella labrosa*	Thicklip Chub		X	X			M		T
			X	3	*Cyprinella leptocheilus*	Siouan Thinlip Chub		X		X	Y			SC
				0	*Cyprinella spiloptera*	Spotfin Shiner			X					
				2	*Cyprinella zanema*	Santee Chub		X	X			H		T
			X	2	*Elassoma boehlkei*	Carolina Pygmy Sunfish		X		X	Y*	VH		T
			X	2	*Elassoma evergladei*	Everglades Pygmy Sunfish		X						
				7	*Elassoma zonatum*	Banded Pygmy Sunfish		X						
		X	X	9	*Enneacanthus chaetodon*	Blackbanded Sunfish		X				H		
			X	8	*Enneacanthus obesus*	Banded Sunfish		X				M		
X				1	*Erimonax monachus*	Spotfin Chub		X				H	T	T
X				2	*Erimystax insignis*	Blotched Chub		X	X			M		T
				9	*Erimyzon sucetta*	Lake Chubsucker		X		X				
				0	*Esox masquinongy*	Muskellunge (Naturalized)	Naturalized			X				
X				1	*Etheostoma acuticeps*	Sharphead Darter		X				M		T
				0	*Etheostoma blennioides*	Greenside Darter			X					
X				13	*Etheostoma chlorobranchium*	Greenfin Darter			X			M		

Table 3-18
FRESHWATER FISH

2025 WAP Revision
Aquatic SGCN - Habitat Associations

Habitat Associations by Ecoregion				Number of River Basins Occupied	*Scientific Name*	Common Name	Population Segment?	SGCN Conservation Concern Priority	Knowledge Gap Priority	Management Priority	NC Endemic Species? *River Basin hydrologic endemic	SEAFWA Regional SGCN M = moderate, H = high, VH = very high	Federal Status	State Status
Mountains	Piedmont	Sandhills	Coastal Plain											
	X			7	*Etheostoma collis*	Carolina Darter		X	X			H		SC
				0	*Etheostoma flabellare*	Fantail Darter				X				
					Etheostoma fusiforme	Swamp Darter				X				
X				2	*Etheostoma gutselli*	Tuckasegee Darter			X			H		
X				1	*Etheostoma inscriptum*	Turquoise Darter		X				M		T
X				1	*Etheostoma kanawhae*	Kanawha Darter		X	X		Y*			
				0	*Etheostoma maculaticeps*	Southern Tessellated Darter			X					
		X	X	2	*Etheostoma mariae*	Pinewoods Darter		X			Y*	H		SC
			X	1	*Etheostoma perlongum*	Waccamaw Darter		X		X	Y*	M		T
				0	*Etheostoma podostemone*	Riverweed Darter			X		Y*			
				0	*Etheostoma serrifer*	Sawcheek Darter				X				
X				1	*Etheostoma simoterum*	Snubnose Darter			X					
					Etheostoma sp. cf. olmstedi	Tessellated Darter			X					
X				1	*Etheostoma swannanoa*	Swannanoa Darter			X			M		
X	X			2	*Etheostoma thalassinum*	Seagreen Darter		X	X			M		SC
				0	*Etheostoma vitreum*	Glassy Darter			X					
X				1	*Exoglossum laurae*	Tonguetied Minnow		X	X					
	X			6	*Exoglossum maxillingua*	Cutlips Minnow		X	X					SC
				0	*Fundulus chrysotus*	Golden Topminnow			X					
				0	*Fundulus diaphanus*	Banded Killifish			X					
				4	*Fundulus rathbuni*	Speckled Killifish		X				M		
			X	1	*Fundulus sp.*	Lake Phelps Killifish		X			Y*	VH		
			X	1	*Fundulus waccamensis*	Waccamaw Killifish		X		X	Y*	VH		SC
				0	*Gambusia affinis*	Western Mosquitofish			X					
			X	2	*Heterandria formosa*	Least Killifish		X						SC
X				1	*Hiodon tergisus*	Mooneye		X	X			M		SC
				0	*Hybopsis amblops*	Bigeye Chub			X					
X				3	*Hybopsis rubifrons*	Rosyface Chub		X	X			M		T
X				4	*Hydrophlox lutipinnis*	Yellowfin Shiner		X	X					SC
X				6	*Hydrophlox rubricroceus*	Saffron Shiner			X					
	X			4	*Hypentelium roanokense*	Roanoke Hog Sucker		X						
				0	*Ichthyomyzon bdellium*	Ohio Lamprey			X			H		SC
X				0	*Ichthyomyzon greeleyi*	Mountain Brook Lamprey			X			M		
				0	*Ictiobus bubalus*	Smallmouth Buffalo	Native & Introduced		X	X				
				0	*Ictiobus cyprinellus*	Bigmouth Buffalo			X					
X				1	*Ictiobus niger*	Black Buffalo		X	X					
				0	*Labidesthes sicculus*	Brook Silverside			X					
				0	*Labidesthes vanhyningi*	Green Silverside			X					
	X		X	6	*Lampetra aepyptera*	Least Brook Lamprey			X					T
				0	*Lepisosteus osseus*	Longnose Gar			X					
				0	*Lepomis auritus*	Redbreast Sunfish				X				
				0	*Lepomis gibbosus*	Pumpkinseed				X				
				0	*Lepomis gulosus*	Warmouth				X				

Table 3-18
FRESHWATER FISH

2025 WAP Revision
Aquatic SGCN - Habitat Associations

Habitat Associations by Ecoregion				Number of River Basins Occupied	*Scientific Name*	Common Name	Population Segment?	SGCN Conservation Concern Priority	Knowledge Gap Priority	Management Priority	NC Endemic Species? *River Basin hydrologic endemic	SEAFWA Regional SGCN M = moderate, H = high, VH = very high	Federal Status	State Status
Mountains	Piedmont	Sandhills	Coastal Plain											
				6	*Lepomis marginatus*	Dollar Sunfish		X	X	X				
				4	*Lepomis punctatus*	Spotted Sunfish		X						
X				1	*Lethenteron appendix*	American Brook Lamprey	Mountain pops.	X			Y*	H		SC
X				3	*Luxilus chrysocephalus*	Striped Shiner			X					SC
			X	1	*Menidia extensa*	Waccamaw Silverside		X		X	Y*	M	T	T
				0	*Micropterus dolomieu*	Smallmouth Bass				X				
				0	*Micropterus punctulatus*	Spotted Bass				X				
				0	*Micropterus salmoides*	Largemouth Bass				X				
				0	*Micropterus sp.*	Bartram's Bass				X		VH		
	X			2	*Miniellus mekistocholas*	Cape Fear Shiner		X		X	Y*	H	E	E
X				1	*Miniellus scabriceps*	New River Shiner		X	X		Y	M		
				5	*Morone saxatilis*	Striped Bass (native)	Native	X		X				
	X			1	*Moxostoma ariommum*	Bigeye Jumprock		X			Y*	M		T
X				3	*Moxostoma breviceps*	Smallmouth Redhorse		X	X					
X				3	*Moxostoma carinatum*	River Redhorse		X	X					
	X		X	3	*Moxostoma cervinum*	Blacktip Jumprock		X	X					
				6	*Moxostoma collapsum*	Notchlip Redhorse		X		X				
X	X		X	8	*Moxostoma pappillosum*	V-lip Redhorse		X				M		
	X			3	*Moxostoma robustum*	Robust Redhorse		X		X		VH	At-Risk	E
				4	*Moxostoma rupiscartes*	Striped Jumprock		X						
				8	*Moxostoma sp.*	Brassy Jumprock		X	X	X		M		
	X			4	*Moxostoma sp.*	Carolina Redhorse		X		X		VH		T
X				2	*Moxostoma sp. 2*	Sicklefin Redhorse		X		X		H		T
				0	*Mugil cephalus*	Striped Mullet				X				
X				9	*Nocomis platyrhynchus*	Bigmouth Chub			X		Y			
	X		X	4	*Nocomis raneyi*	Bull Chub		X	X					
				0	*Nothonotus rufilineatus*	Redline Darter			X					
X				1	*Nothonotus vulneratus*	Wounded Darter		X				H		SC
			X	4	*Notropis bifrenatus*	Bridle Shiner		X	X			H	E	E
				0	*Notropis maculatus*	Taillight Shiner		X						
X				3	*Notropis micropteryx*	Highland Shiner		X	X					
X				5	*Notropis photogenis*	Silver Shiner			X					
				4	*Notropis scepticus*	Sandbar Shiner		X						
X				1	*Notropis sp.*	Kanawha Rosyface Shiner			X		Y*			
X				5	*Notropis telescopus*	Telescope Shiner			X					
X				1	*Noturus eleutherus*	Mountain Madtom		X	X			H		SC
X				2	*Noturus flavus*	Stonecat		X	X	X				E
	X		X	3	*Noturus furiosus*	Carolina Madtom		X		X		VH	E	E
	X			1	*Noturus gilberti*	Orangefin Madtom		X		X	Y*	H	At-Risk	E
				9	*Noturus gyrinus*	Tadpole Madtom		X		X				
				0	*Noturus insignis*	Margined Madtom				X				
			X	2	*Noturus sp.*	Broadtail Madtom	Lake Waccamaw, (	X		X	Y*	VH		SC
X	X			4	*Paranotropis volucellus*	Mimic Shiner			X					T

Habitat Associations by Ecoregion				Number of River Basins Occupied	Table 3-18 FRESHWATER FISH 2025 WAP Revision Aquatic SGCN - Habitat Associations		Population Segment?	SGCN Conservation Concern Priority	Knowledge Gap Priority	Management Priority	NC Endemic Species? *River Basin hydrologic endemic	SEAFWA Regional SGCN M = moderate, H = high, VH = very high	Federal Status	State Status
Mountains	Piedmont	Sandhills	Coastal Plain		*Scientific Name*	Common Name								
				0	*Perca flavescens*	Yellow Perch				X				
X				8	*Percina aurantiaca*	Tangerine Darter			X			M		
X				1	*Percina burtoni*	Blotchside Logperch		X	X			M		E
X				3	*Percina caprodes*	Logperch		X	X					T
				0	*Percina crassa*	Piedmont Darter				X		M		
				0	*Percina evides*	Gilt Darter			X					
X				3	*Percina gymnocephala*	Appalachia Darter		X	X		Y	M		
				0	*Percina nevisense*	Chainback Darter			X					
				0	*Percina nigrofasciata*	Sooty-banded Darter		X						SC
X				1	*Percina oxyrhynchus*	Sharpnose Darter		X	X					E
	X			3	*Percina rex*	Roanoke Logperch		X	X		Y*	H	E*	E
				0	*Percina roanoka*	Roanoke Darter			X					
X				5	*Percina squamata*	Olive Darter			X			M		SC
	X		X	7	*Petromyzon marinus*	Sea Lamprey			X					
X				2	*Phenacobius crassilabrum*	Fatlips Minnow			X			M		
X				1	*Phenacobius teretulus*	Kanawha Minnow			X		Y*	M		SC
X				5	*Pimephales notatus*	Bluntnose Minnow			X					
				0	*Pomoxis annularis*	White Crappie				X				
				1	*Pomoxis nigromaculatus*	Black Crappie			X					
				2	*Rhinichthys atratulus*	Blacknose Dace			X					
X				10	*Salvelinus fontinalis*	Brook Trout (native **& introduced**)		X		X		H		
				0	*Sander canadensis*	Sauger			X					
				0	*Sander vitreus*	Walleye				X				
		X	X	4	*Semotilus lumbee*	Sandhills Chub		X		X		H		SC
				0	Tessellated Darter	*Etheostoma sp. cf. olmstedi*			X					
	X			3	*Thoburnia hamiltoni*	Rustyside Sucker		X	X	X	Y*	H		E

Table 3-18
FRESHWATER MUSSELS

2025 WAP Revision
Aquatic SGCN - Habitat Associations

Habitat Associations by Ecoregion				Number of River Basins Occupied			SGCN Conservation Concern Priority	Knowledge Gap Priority	Management Priority	NC Endemic Species? *River Basin hydrologic endemic	Introduced or Invasive?	SEAFWA Regional SGCN M = moderate, H = high, VH = very high	Federal Status	State Status
Mountains	Piedmont	Sandhills	Coastal Plain		*Scientific Name*	Common Name								
	X		X	2	*Utterbackiana implicata*	Alewife Floater	X	X						T
X				2	*Alasmidonta raveneliana*	Appalachian Elktoe	X		X			H	E	E
	X		X	5	*Fusconaia masoni*	Atlantic Pigtoe	X		X			VH	T	T
			X	1	*Anodonta couperiana*	Barrel Floater	X	X	X			H		E
X	X			3	*Alasmidonta varicosa*	Brook Floater	X	X	X			H		E
			X	3	*Elliptio marsupiobesa*	Cape Fear Spike	X	X	X	Y				SC
	X	X		3	*Sagittunio vaughanianus*	Carolina Creekshell	X		X			H		E
	X			2	*Lasmigona decorata*	Carolina Heelsplitter	X		X			VH	E	E
	X			3	*Lampsilis sp. 2*	Chameleon Lampmussel	X	X						
X	X		X	8	*Strophitus undulatus*	Creeper	X	X						T
	X			2	*Alasmidonta heterodon*	Dwarf Wedgemussel	X		X				E	E
X	X	X	X	4	*Villosa delumbis*	Eastern Creekshell	X	X	X					
	X		X	7	*Lampsilis radiata*	Eastern Lampmussel	X	X						T
	X	X	X	5	*Sagittunio nasutus*	Eastern Pondmussel	X	X						T
	X		X	3	*Villosa vibex*	Southern Rainbow	X	X						
X	X		X	7	*Lasmigona subviridis*	Green Floater	X	X	X			M	PT	E
	X			1	*Parvaspina collina*	James Spinymussel	X	X				H	E	E
X				1	*Pegias fabula*	Littlewing Pearlymussel	X		X			VH	E	E
X				2	*Fusconaia subrotunda*	Longsolid	X		X			H	T	E
	X		X	6	*Venustaconcha constricta*	Notched Rainbow	X	X						T
				0	*Potamilus alatus*	Pink Heelsplitter	X		X					SC
				0	*Elliptio folliculata*	Pod Lance	X		X			H		SC
X				1	*Cyclonaias tuberculata*	Purple Wartyback	X	X	X					E
X				2	*Cambarunio iris*	Rainbow	X		X					T
				2	*Lampsilis splendida*	Rayed Pink Fatmucket	X		X			H		
	X		X	5	*Elliptio roanokensis*	Roanoke Slabshell		X						SC
	X		X	3	*Toxolasma pullus*	Savannah Lilliput	X	X	X			H		E
X				2	*Alasmidonta viridis*	Slippershell Mussel	X		X			H		E
X				3	*Eurynia dilatata*	Spike	X							SC
	X		X	2	*Parvaspina steinstansana*	Tar River Spinymussel	X		X	Y		VH	E	E
X				3	*Pleurobema oviforme*	Tennessee Clubshell	X					H	PE	E
X				1	*Pleuronaia barnesiana*	Tennessee Pigtoe	X					H	PE	E
				0	*Atlanticoncha ochracea*	Tidewater Mucket	X							T
	X		X	6	*Alasmidonta undulata*	Triangle Floater	X	X						T
	X			1	*Alasmidonta uwharriensis*	Uwharrie Elktoe	X	X		Y				
			X	1	*Lampsilis fullerkati*	Waccamaw Fatmucket	X							
			X	1	*Elliptio waccamawensis*	Waccamaw Spike	X							
				0	*Lampsilis fasciola*	Wavyrayed Lampmussel	X		X					SC
	X		X	7	*Lampsilis cariosa*	Yellow Lampmussel	X							E
	X		X	2	*Elliptio lanceolata*	Yellow Lance	X	X	X			VH	T	T

Count of Habitat Associations by Ecoregion				Number of River Basins Occupied	Table 3-18 AQUATIC SNAILS SGCN - Habitat Associations 2025 NC WAP Revision				Species of Greatest Conservation Need	Knowledge Gap Priority List	Management Priority List	Endemic to NC?	Exotic? Invasive?	Federal Status	State Status
					Red Text = Update										
Mountains	Piedmont	Sandhills	Coastal Plain		*Scientific Name*	Common Name	ORDER	Family							
0	4	4	4	9	*Amnicola limosus*	Mud Amnicola	Littorinimorpha	Amnciolidae		X	X				
0	0	0	1	1	*Amnicola sp. 1*	Waccamaw Snail	Littorinimorpha	Amnciolidae	X	X		Y			SC
0	0	0	0	0	*Callinina georgiana*	Banded Mysterysnail	Architaenioglossa	Viviparidae		X	X				
0	0	0	0	0	*Callinina intertexta*	Rotund Mysterysnail	Architaenioglossa	Viviparidae		X					
0	0	0	0	0	*Campeloma decisum*	Pointed Campeloma	Architaenioglossa	Viviparidae		X					
0	0	0	0	0	*Campeloma lima*	File Campeloma	Architaenioglossa	Viviparidae		X					
0	2	0	0	2	*Cipangopaludina chinensis*	Chinese Mystery Snail	Architaenioglossa	Viviparidae		X	X		Y		
0	0	0	3	5	*Cipangopaludina japonica*	Japanese Mysterysnail	Architaenioglossa	Viviparidae		X	X		Y		
0	0	0	0	0	*Elimia catenaria*	Gravel Elimia	Caenogastropoda	Pleuroceridae		X					
1	0	0	0	1	*Elimia christyi*	Christy's Elimia	Caenogastropoda	Pleuroceridae	X	X	X				E
0	0	0	0	0	*Elimia clavaeformis*	Club Elimia	Caenogastropoda	Pleuroceridae		X	X				
0	0	0	0	0	*Elimia dislocata*	Lapped Elimia	Caenogastropoda	Pleuroceridae		X					
0	0	0	0	0	*Elimia proxima*	Sprite Elimia	Caenogastropoda	Pleuroceridae		X					
0	0	0	0	0	*Elimia semicarinata*	Fine-ridged Elimia	Caenogastropoda	Pleuroceridae		X	X				
0	0	0	0	0	*Elimia simplex*	Smooth Elimia	Caenogastropoda	Pleuroceridae		X	X				
0	0	0	0	0	*Elimia symmetrica*	Symmetrical Elimia	Caenogastropoda	Pleuroceridae		X					
0	0	0	0	0	*Elimia virginica*	Piedmont Elimia	Caenogastropoda	Pleuroceridae		X					
6	6	6	6	11	*Ferrissia californica*	Fragile Ancylid	Hygrophila	Planorbidae		X	X				
0	0	0	1	1	*Floridobia sp.*	Waccamaw Siltsnail	Littorinimorpha	Hydrobiidae	X	X		Y			SC
0	0	0	4	5	*Galba cubensis*	Carib Fossaria	Hygrophila	Lymnaeidae	X	X	X				
0	0	0	0	0	*Galba obrussa*	Golden Fossaria	Hygrophila	Lymnaeidae		X	X				
0	3	0	3	5	*Gillia altilis*	Buffalo Pebblesnail	Littorinimorpha	Lithoglyphidae		X	X				
0	0	0	0	0	*Gyraulus deflectus*	Flexed Gyro	Hygrophila	Planorbidae		X	X				
0	4	0	4	9	*Gyraulus parvus*	Ash Gyro	Hygrophila	Planorbidae		X	X				
0	0	0	0	9	*Hebetancylus excentricus*	Excentric Ancylid	Hygrophila	Planorbidae		X	X				
0	0	0	0	12	*Helisoma anceps*	Two-ridged Ramshorn	Hygrophila	Planorbidae		X					
0	0	0	3	2	*Helisoma eucosmium*	Greenfield Ramshorn	Hygrophila	Planorbidae	X	X	X	Y			E
4	6	2	1	10	*Laevapex fuscus*	Dusky Ancylid	Hygrophila	Planorbidae	X	X	X				
3	0	0	0	3	*Leptoxis carinata*	Crested Mudalia	Caenogastropoda	Pleuroceridae		X					
0	0	0	0	0	*Leptoxis dilatata*	Seep Mudalia	Caenogastropoda	Pleuroceridae	X	X	X				SC
2	0	0	0	1	*Leptoxis virgata*	Smooth Mudalia	Caenogastropoda	Pleuroceridae	X	X	X				
0	0	0	0	4	*Lioplax subcarinata*	Ridged Lioplax	Architaenioglossa	Viviparidae		X					SC
0	0	0	2	4	*Littoridinops tenuipes*	Henscomb Hydrobe	Littorinimorpha	Cochliopidae		X	X				
0	4	0	4	9	*Lyogyrus granum*	Squat Duskysnail	Littorinimorpha	Amnicolidae		X	X				
0	0	0	0	0	*Marisa cornuarietis*	Giant Ramshorn	Architaenioglossa	Ampullariidae		X	X		Y		
0	0	0	1	1	*Melanoides tuberculata*	Red-rim Melania	Caenogastropoda	Thiaridae		X	X		Y		
6	6	6	6	11	*Menetus dilatatus*	Bugle Sprite	Hygrophila	Planorbidae		X	X				
4	0	0	8	3	*Physella gyrina*	Tadpole Physa	Hygrophila	Physidae		X	X				
0	0	0	3	1	*Planorbella magnifica*	Magnificent Ramshorn	Hygrophila	Planorbidae	X	X	X	Y		E	E
0	5	3	8	10	*Planorbella trivolvis*	Marsh Ramshorn	Hygrophila	Planorbidae		X					

Count of Habitat Associations by Ecoregion				Number of River Basins Occupied	Table 3-18 AQUATIC SNAILS SGCN - Habitat Associations 2025 NC WAP Revision				Species of Greatest Conservation Need	Knowledge Gap Priority List	Management Priority List	Endemic to NC?	Exotic? Invasive?	Federal Status	State Status
					Red Text = Update										
Mountains	Piedmont	Sandhills	Coastal Plain		*Scientific Name*	Common Name	ORDER	Family							
0	0	0	1	1	*Pomacea maculata*	Giant Applesnail	Architaenioglossa	Ampullariidae		X	X		Y		
0	0	0	0	2	*Pomatiopsis lapidaria*	Slender Walker	Littorinimorpha	Pomatiopsidae	X	X	X				
6	6	6	6	12	*Psuedosuccinea columella*	Mimic Lymnaea	Hygrophila	Lymnaeidae		X					
0	0	0	0	0	*Somatogyrus sp. 1*	A Hydrobid Snail	Littorinimorpha	Lithoglyphidae	X	X					
1	3	0	0	6	*Somatogyrus virginicus*	Panhandle Pebblesnail	Littorinimorpha	Lithoglyphidae	X	X					
0	0	0	0	0	*Vitta usnea*	Olive Nerite	Cycloneritida	Neritidae		X	X				

Table 3-19 Population Targets Included in Recovery, Conservation, and Management Plans

Group	Conservation Plan	Citation/ Resource
USFWS Endangered and Threatened species (federal)	Species recovery plans	https://ecos.fws.gov/ecp/report/species-with-recovery-plans
NOAA Fisheries (federal)	Recovery Action Database	https://www.webapps.nwfsc.noaa.gov/apex/r/sdmteam/rad/home
AMPHIBIANS		
Southeast Partners in Amphibian and Reptile Conservation	Ornate Chorus Frog Conservation Action Plan	Burrow 2022 https://parcplace.org/wp-content/uploads/2022/10/CAP_Pseudacris_ornata.pdf
	Green Salamander species complex Conservation Action Plan	Soto et al. 2021 https://parcplace.org/wp-content/uploads/2022/10/CAP_Aneides_aeneus_Species_Complex.pdf
Department of Defense Legacy Resource Management Program	Best Management Practices for the Gopher Frog on DOD Installations	https://parcplace.org/wp-content/uploads/2019/12/Gopher-Frog_Final_Dec_2018.pdf
BIRDS		
Landbirds	Partners in Flight South-Atlantic Coastal Plain Bird Conservation Plan	Physiographic Area 03 https://partnersinflight.org/resources/pif-bird-conservation-plan-the-southern-atlantic-coastal-plain-physiographic-area-03/
	Cooperative Upland-habitat Restoration and Enhancement (CURE)	NCWRC 2013 (http://www.ncwildlife.org/CURE/CUREDecliningHabitatDecliningWildlife.aspx)
	South Atlantic Migratory Bird Initiative Implementation Plan	Watson and Malloy 2008 https://www.acjv.org/documents/SAMBIImplementation_Plan_12_08.pdf

Table 3-19 Population Targets Included in Recovery, Conservation, and Management Plans

Group	Conservation Plan	Citation/ Resource
	Partners in Flight Mid-Atlantic Piedmont Bird Conservation Plan	Physiographic Area 10 https://partnersinflight.org/resources/pif-bird-conservation-plan-the-mid-atlantic-piedmont-physiographic-area-10/
	Partners in Flight Southern Blue Ridge Bird Conservation Plan	Physiographic Area 23 https://partnersinflight.org/resources/pif-bird-conservation-plan-the-southern-blue-ridge-physiographic-area-23/
	Partners in Flight Landbird Conservation Plan	Rosenberg (et al.) 2016 Partners in Flight Conservation Plans - Partners in Flight
	North American Bird Conservation Initiative (NABCI)	https://nabci-us.org/
	National Bobwhite Conservation Initiative and North Carolina Biologist Ranking Index	https://storymaps.arcgis.com/stories/22dd00aff8c0404bb7092bf684934bee https://nbgi.org/conservation/state-habitat-potential-maps/
Waterbirds	North American Waterbird Conservation Plan	Kushlan et al. 2002 https://www.fws.gov/sites/default/files/documents/north-america-waterbird-conservation-plan.pdf
	Southeast US Region Waterbird Conservation Plan	Hunter et al. 2006 https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB2011113334.xhtml
Waterfowl	North American Waterfowl Management Plan	https://nawmp.org/content/north-american-waterfowl-management-plan
Shorebirds	Southeastern Coastal Plain-Caribbean Regional Shorebird Plan	Regional Shorebird Conservation Plans

Table 3-19 Population Targets Included in Recovery, Conservation, and Management Plans

Group	Conservation Plan	Citation/ Resource
MARINE SPECIES		
Coastal and Marine Fisheries	Fisheries Management Plans	Mid-Atlantic Fisheries Management Council (http://www.mafmc.org) South-Atlantic Fisheries Management Council (http://www.safmc.net)
REPTILES		
Partners in Amphibian and Reptile Conservation (PARC)	Timber Rattlesnake Conservation Action Plan	https://parcplace.org/reports/timber-rattlesnake-conservation-action-plan/
Department of Defense Legacy Resource Management Program	Best Management Practices for the Northern Red-bellied Cooter on DOD Installations	Red-bellied-Cooter_BMP_Final.pdf
	Best Management Practices for the Eastern Diamond-backed Rattlesnake on DOD Installations	https://parcplace.org/wp-content/uploads/2021/02/EDB-Rattlesnake-BMP_Final.pdf
	Best Management Practices for the Spotted Turtle on DOD Installations	https://parcplace.org/wp-content/uploads/2019/12/Spotted-Turtle_Final_March_2019.pdf

Table 3-20
PELAGIC SEABIRDS

2025 NC Wildlife Action Plan
Species of Greatest Conservation Need Priority (SGCN)

*AMBCC Level of Concern (2014)	**Common Name**	***Scientific Name***	**Family**	**Federal ESA Protection Status**
High	Razorbill	*Alca torda*	Alcidae	
–	Dovekie	*Alle alle*	Alcidae	
Medium	Cory's Shearwater	*Calonectris diomedea*	Procellariidae	
High	Atlantic Puffin	*Fratercula arctica*	Alcidae	
High	Northern Gannet	*Morus bassanus*	Sulidae	
–	Wilson's Storm-petrel	*Oceanites oceanicus*	Hydrobatidae	
Medium	Band-rumped Storm-petrel	*Oceanodroma castro*	Hydrobatidae	
Medium	Leach's Storm-petrel	*Oceanodroma leucorhoa*	Hydrobatidae	
Low	Bridled Tern	*Onychoprion anaethetus*	Laridae	
Low	Sooty Tern	*Onychoprion fuscatus*	Laridae	
Low	White-tailed Tropicbird	*Phaethon lepturus*	Phaethontidae	
Medium	Red Phalarope	*Phalaropus fulicarius*	Scolopacidae	
–	Herald (Trindade) Petrel	*Pterodroma arminjoniana*	Procellariidae	
High	Bermuda Petrel	*Pterodroma cahow*	Procellariidae	**E**
–	Fea's Petrel	*Pterodroma feae*	Procellariidae	
High	Black-capped Petrel	*Pterodroma hasitata*	Procellariidae	**E**
Medium	Great Shearwater	*Puffinus gravis*	Procellariidae	
–	Sooty Shearwater	*Puffinus griseus*	Procellariidae	
High	Audubon's Shearwater	*Puffinus lherminieri*	Procellariidae	
Medium	Manx Shearwater	*Puffinus puffinus*	Procellariidae	
–	Long-tailed Jaeger	*Stercorarius longicaudus*	Stercorariidae	
–	Parasitic Jaeger	*Stercorarius parasiticus*	Stercorariidae	
–	Pomarine Jaeger	*Stercorarius pomarinus*	Stercorariidae	
High	Roseate Tern	*Sterna dougallii*	Laridae	**E**

*Marine Bird Species Priority List (July 2014) was developed by the Atlantic Marine Bird Conservation Cooperative for State Wildlife Action Planning Process.

Available online https://atlanticmarinebirds.org/resources/priority-species-list/

Table 3-21
Marine SGCN

2025 WAP Revision

SGCN Species of Greatest Conservation Need Priority 2025	Common Name	*Scientific Name*	Order	Family	Federal ESA Protection Status	NC State Protection Status*	SEAFWA Regional SGCN	IUCN Red List Category	CITES Appendix	Mid-Atlantic Fishery Management Council	Southeast Fishery Management Council	Distinct Population Unit	Critical Habitat Designation
FISH													
X	Shortnose Sturgeon	*Acipenser brevirostrum*	Acipenseriformes	Acipenseridae	E	E	VH	V	I	X	X		None.
X	Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Acipenseriformes	Acipenseridae	E	E	H	V	II	X	X	Carolina DPS	Includes NC rivers: Roanoke, Tar-Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee
X	Smalltooth Sawfish	*Pristis pectinata*	Pristiformes	Pristidae	E		VH	CE	I		X	Atlantic Ocean	Florida southwestern coastal waters between Charlotte Harbor and Florida Bay
MAMMALS													
	Sei Whale	*Balaenoptera borealis*	Cetacea	Balaenopteridae	E			E	I	X	X		None
X	Blue Whale	*Balaenoptera musculus*	Cetacea	Balaenopteridae	E	E	M	E	I	X	X		None
X	Fin Whale	*Balaenoptera physalus*	Cetacea	Balaenopteridae	E	E	M	V	I	X	X		None
X	North Atlantic Right Whale	*Eubalaena glacialis*	Cetacea	Balaenidae	E	E	VH	CE	I	X	X		Includes marine open water habitat off the Southeast U.S. coast (Unit 2).
X	Sperm Whale	*Physeter catodon [microcephalus]*	Cetacea	Physeteridae	E	E		V	I	X	X		None
X	West Indian Manatee	*Trichechus manatus*	Sirenia	Trichechidae	T	T		V	I				Coastal Florida inshore and near shore
REPTILES													
X	Loggerhead Sea Turtle	*Caretta caretta*	Testudines	Cheloniidae	T	T	H	V	I	X	X	South Atlantic Ocean DPS	Includes nearshore reproductive habitat, winter area, breeding areas, constricted migratory corridors, and/or Sargassum habitat.
X	Green Sea Turtle	*Chelonia mydas*	Testudines	Cheloniidae	T	T	H	E	I	X	X	N. Atlantic DPS S. Atlantic DPS	Marine critical habitat in nearshore waters (from the mean high water line to 20 meters depth) off the US Atlantic coast, including NC
X	Leatherback Sea Turtle	*Dermochelys coriacea*	Testudines	Dermochelyidae	E	E	VH	V	I	X	X		US Virgin Island coastal waters
X	Hawksbill Sea Turtle	*Eretmochelys imbricata imbricata*	Testudines	Cheloniidae	E	E	VH	CE	I		X		Puerto Rico coastal waters
X	Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Testudines	Cheloniidae	E	E	VH	CE	I	X	X		None
X	Diamondback Terrapin	*Malaclemys terrapin*	Testudines	Emydidae	At-Risk		H	V	II				None
OTHER MARINE/PELAGIC SPECIES													
	Scalloped Hammerhead	*Sphyrna lewini*	Carcharhiniformes	Sphyrnidae	E		VH	CE	II				
	Oceanic Whitetip Shark	*Carcharhinus longimanus*	Carcharhiniformes	Carcharhinidae	T		VH	CE	II				
	Giant Mantaray	*Mobula birostris*	Rajiformes	Mobulidae	T		H	E	ii				

Federal ESA Protection Status
- E = Endangered
- T = Threatened
- At-Risk (under review)

***North Carolina Protection Status**
- E = Endangered
- T = Threatened
- SC = Special Concern
- Blank indicates no NC lsting

SEAFWA Regional SGCN
- VH = Very High
- H = High
- M = Moderate

IUCN Red List Category
- CE = Critically Endangered
- E = Endangered
- T = Threatened
- NT = Near Threatened
- V = Vulnerable

CITES

Appendix I includes species threatened with extinction and provides the greatest level of protection, including a prohibition on commercial trade.

Appendix II includes species that are not currently threatened with extinction, but may become so without trade controls. Regulated trade is allowed if the exporting country issues a permit based on findings that the specimens were legally acquired and the trade will not be detrimental to the survival of the species or its role in the ecosystem.

Appendix III includes species for which a country has asked other CITES Parties to help control international trade. Trade in Appendix III species is regulated using CITES export permits (issued by the country that listed the species in Appendix III) and certificates of origin (issued by all other countries).

NOAA Fisheries, Threatened and Endangered Species List for North Carolina
https://www.fisheries.noaa.gov/southeast/consultations/threatened-and-endangered-species-list-north-carolina

USFWS, Listed U.S. Species by Taxonomic Group - All Animals
https://ecos.fws.gov/ecp/report/species

Table 3-22
SGCN PLANTS

Species - Habitat Associations
2025 NC Wildlife Action Plan

Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
0	1	0	0	*Acmispon helleri*	Carolina Prairie-trefoil, Carolina Birdfoot-trefoil	Vascular Plants	Flowering Plants - Dicots	X			T
2	0	0	0	*Acrobolbus ciliatus*	a liverwort	Nonvascular Plants	Liverworts	X			SC-V
1	0	0	1	*Adiantum capillus-veneris*	Southern Maidenhair Fern (Venus Hair Fern)	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			T
2	0	0	0	*Adlumia fungosa*	Climbing Fumitory	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Aeschynomene virginica*	Sensitive Joint-vetch	Vascular Plants	Flowering Plants - Dicots	X	VH	T	T
0	0	2	2	*Agalinis virgata*	Branched Gerardia	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	0	0	0	*Agrostis mertensii*	Arctic Bentgrass	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	1	*Aletris lutea*	Yellow Colicroot	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Allium allegheniense*	Allegheny Onion	Vascular Plants	Flowering Plants - Monocots	X	H		SC-V
2	0	0	0	*Allium keeverae*	Keever's Onion	Vascular Plants	Flowering Plants - Monocots	X	VH		SC-V
2	0	0	0	*Alnus crispa*	Green Alder, Mountain Alder	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Amaranthus pumilus*	Seabeach Amaranth	Vascular Plants	Flowering Plants - Dicots	X	VH	T	T
0	0	0	1	*Amorpha confusa*	Savanna Indigo-bush	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	2	0	*Amorpha georgiana*	Georgia Indigobush	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	2	3	*Amphicarpum muehlenbergianum*	Blue Maiden-cane Florida Goober Grass	Vascular Plants	Flowering Plants - Monocots	X			E
0	2	0	0	*Anemone berlandieri*	Southern Anemone, Eastern Prairie Anemone	Vascular Plants	Flowering Plants - Dicots	X			E
0	4	0	0	*Anemone caroliniana*	Prairie Anemone, Carolina Anemone	Vascular Plants	Flowering Plants - Dicots	X			E
2	0	0	0	*Arabis adpressipilis*	Hairy Rockcress, Slender Rockcress	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Arethusa bulbosa*	Bog-rose, Dragon's-mouth	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	2	*Aristida condensata*	Big Three-awn Grass	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	2	*Aristida simpliciflora*	Southern Three-awn Grass	Vascular Plants	Flowering Plants - Monocots	X	M		E
0	0	0	2	*Arnoglossum ovatum var. lanceolatum*	Savanna Indian-plantain	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	2	*Asclepias cinerea*	Carolina Milkweed	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	1	0	2	*Asclepias pedicellata*	Savannah Milkweed	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Asplenium heteroresiliens*	Carolina Spleenwort	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X	VH		E

Table 3-22
SGCN PLANTS

Species - Habitat Associations
2025 NC Wildlife Action Plan

Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
1	0	0	0	*Asplenium monanthes*	Single-sorus Spleenwort	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
2	0	0	0	*Asplenium ruta-muraria var. cryptolepis*	American Wall-rue	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			SC-V
0	0	1	1	*Astragalus michauxii*	Sandhills Milkvetch	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
0	0	0	1	*Baccharis glomeruliflora*	Silverling	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	3	*Bacopa caroliniana*	Blue Water-hyssop	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Bacopa innominata*	Tropical Water-hyssop	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	0	0	1	*Balduina atropurpurea*	Purple-disk Honeycomb-head	Vascular Plants	Flowering Plants - Dicots	X	VH		E
0	4	0	0	*Baptisia aberrans*	Eastern Prairie Blue Wild Indigo	Vascular Plants	Flowering Plants - Dicots	X			E
0	4	3	0	*Baptisia alba*	Thick-pod White Wild Indicgo	Vascular Plants	Flowering Plants - Dicots	X			T
0	4	0	0	*Baptisia bracteata*	Creamy Wild Indigo	Vascular Plants	Flowering Plants - Dicots	X	M		SC-H
2	3	0	0	*Berberis canadensis*	American Barberry	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
1	0	0	0	*Betula cordifolia*	Mountain Paper Birch	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Bouteloua curtipendula var. curtipendula*	Sideoats Grama	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Bromus ciliatus*	Fringed Brome	Vascular Plants	Flowering Plants - Monocots	X			SC-V
2	3	0	0	*Buchnera americana*	American Bluehearts	Vascular Plants	Flowering Plants - Dicots	X			E
1	1	0	0	*Buckleya distichophylla*	Piratebush	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	2	*Bulbostylis warei*	Ware's Hair Sedge	Vascular Plants	Flowering Plants - Monocots	X	M		SC-H
1	0	0	0	*Calamagrostis cainii*	Cain's Reedgrass	Vascular Plants	Flowering Plants - Monocots	X	VH		E
1	0	0	0	*Calamagrostis canadensis var. canadensis*	Canada Reedgrass	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Calopogon multiflorus*	Many-flowered Grass-pink	Vascular Plants	Flowering Plants - Monocots	X	H		E
1	0	0	0	*Caltha palustris var. palustris*	Marsh Marigold	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Camassia scilloides*	Wild Hyacinth	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Campanula rotundifolia*	Bluebells	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Campylium stellatum*	Yellow Starry Fen Moss	Nonvascular Plants	Mosses	X			SC-V
1	0	0	0	*Cardamine dissecta*	Dissected Toothwort	Vascular Plants	Flowering Plants - Dicots	X			SC-V

Table 3-22
SGCN PLANTS

Species - Habitat Associations
2025 NC Wildlife Action Plan

Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
0	0	0	1	*Cardamine longii*	Long's Bittercress	Vascular Plants	Flowering Plants - Dicots	X	H		SC-V
0	2	0	0	*Cardamine micranthera*	Small-anthered Bittercress	Vascular Plants	Flowering Plants - Dicots	X	VH	E	E
1	0	0	0	*Carex arctata*	Black Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Carex argyrantha*	Hay Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	1	0	*Carex barrattii*	Barratt's Sedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	0	2	*Carex basiantha*	Widow Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	0	0	*Carex buxbaumii*	Brown Bog Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Carex calcifugens*	Calcium-fleeing Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
1	0	0	0	*Carex careyana*	Carey's Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
1	1	0	0	*Carex cherokeensis*	Cherokee Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Carex conoidea*	Cone-shaped Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Carex cristatella*	Crested Sedge; Small-crested Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
1	0	0	0	*Carex eburnea*	Bristle-leaf Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	3	0	*Carex exilis*	Coastal Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	1	*Carex hormathodes*	Marsh Straw Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	2	0	*Carex impressinervia*	Ravine Sedge	Vascular Plants	Flowering Plants - Monocots	X	VH		SC-V
0	0	3	2	*Carex jamesii*	James' Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
2	0	0	0	*Carex lasiocarpa var. americana*	Slender Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Carex lutea*	Golden Sedge	Vascular Plants	Flowering Plants - Monocots	X	VH	E	E
2	2	0	0	*Carex meadii*	Mead's Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	0	1	*Carex oligocarpa*	Rich-woods Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Carex oligosperma*	Few-seeded Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
3	0	0	0	*Carex pedunculata var. pedunculata*	Longstalk Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
1	0	0	0	*Carex radfordii*	Radford's Sedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	0	1	*Carex reniformis*	Kidney Sedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	1	1	0	*Carex superata*	Limestone Forest Sedge	Vascular Plants	Flowering Plants - Monocots	X			T

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Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
0	0	1	1	*Carex tenax*	Wire Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	0	0	*Carex trichocarpa*	Hairy-fruited Sedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
1	0	0	0	*Carex trisperma*	Three-seeded Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	0	0	*Carex utriculata*	Beaked Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	0	0	*Carex vesicaria*	Inflated Sedge	Vascular Plants	Flowering Plants - Monocots	X			E
0	3	0	0	*Carex vestita*	Velvet Sedge	Vascular Plants	Flowering Plants - Monocots	X			T
0	1	0	1	*Carya laciniosa*	Big Shellbark Hickory	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Carya myristiciformis*	Nutmeg Hickory	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Caulophyllum giganteum*	Northern Blue Cohosh	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Celastrus scandens*	American Bittersweet	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Cetraria arenaria*	Sand-loving Iceland Lichen	Nonvascular Plants	Lichens	X			SC-V
2	0	0	0	*Chamerion angustifolium ssp. circumvagum*	Fireweed	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	2	*Chasmanthium nitidum*	Shiny Spanglegrass	Vascular Plants	Flowering Plants - Monocots	X	M		T
1	0	0	0	*Chelone cuthbertii*	Cuthbert's Turtlehead	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
3	0	0	0	*Chenopodiastrum simplex*	Mapleleaf Goosefoot	Vascular Plants	Flowering Plants - Dicots	X			T
3	0	0	0	*Chiloscyphus appalachianus (Lophocolea appalachiana)*	A liverwort	Nonvascular Plants	Liverworts	X			SC-V
5	0	0	0	*Chiloscyphus muricatus (Lochocolea muricata)*	A liverwort	Nonvascular Plants	Liverworts	X			SC-V
0	0	0	1	*Chrysoma pauciflosculosa*	Woody Goldenrod	Vascular Plants	Flowering Plants - Dicots	X			E
0	4	0	0	*Cirsium carolinianum*	Carolina Thistle	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Cirsium lecontei*	Le Conte's Thistle	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
2	0	0	0	*Clematis occidentalis var. occidentalis*	Mountain Clematis	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	2	2	*Clinopodium georgianum*	Georgia Calamint	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Collinsonia verticillata*	Whorled Horsebalm	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	0	0	0	*Conioselinum chinense*	Hemlock-parsley	Vascular Plants	Flowering Plants - Dicots	X			T
2	0	0	0	*Coptis trifolia*	Goldthread	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Coreopsis auristulata*	Short-awned Coreopsis	Vascular Plants	Flowering Plants - Dicots	X	VH		T

Table 3-22
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2	2	0	0	*Corydalis micrantha*	Slender Corydalis	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Coryphopteris simulata*	Bog Fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
2	0	0	0	*Crataegus pallens*	Pale Hawthorn	Vascular Plants	Flowering Plants - Dicots	X	VH		T
0	0	0	1	*Crinum americanum var. americanum*	Swamp-lily	Vascular Plants	Flowering Plants - Monocots	X			SC-H
3	0	0	0	*Crocanthemum bicknellii*	Plains Sunrose	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	1	1	*Crocanthemum carolinianum*	Carolina Sunrose	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Crocanthemum corymbosum*	Pinebarren Sunrose	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Crocanthemum georgianum*	Georgia Sunrose	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Crocanthemum nashii*	Florida Scrub Sunrose	Vascular Plants	Flowering Plants - Dicots	X			E
2	1	0	0	*Crocanthemum propinquum*	Creeping Sunrose	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	2	0	*Crocanthemum rosmarinifolium*	Rosemary Sunrose	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Croton monanthogynus*	Prairie-tea Croton	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Cyperus dentatus*	Toothed Flatsedge	Vascular Plants	Flowering Plants - Monocots	X			SC-H
0	1	0	0	*Cyperus granitophilus*	Granite Flatsedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	0	1	*Cyperus lecontei*	Le Conte's Flatsedge	Vascular Plants	Flowering Plants - Monocots	X			T
0	3	0	4	*Cyperus subsquarrosus*	Small-flowered Halfchaff, Small-flowered Hemicarpha	Vascular Plants	Flowering Plants - Monocots	X			SC-H
0	0	0	2	*Cyperus tetragonus*	Four-angled Flatsedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	1	3	3	*Cyperus virens*	Green Flatsedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
1	0	0	1	*Cystopteris tennesseensis*	Tennessee Bladder-fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
2	2	0	0	*Dactylorhiza viridis*	Long-bracted Frog Orchid	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Dalibarda repens*	Robin Runaway	Vascular Plants	Flowering Plants - Dicots	X			E
2	3	0	0	*Delphinium exaltatum*	Tall Larkspur	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	0	0	0	*Deschampsia cespitosa ssp. glauca*	Tufted Hairgrass	Vascular Plants	Flowering Plants - Monocots	X			T
1	5	0	0	*Desmodium ochroleucum*	Creamy Tick-trefoil	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	3	0	0	*Desmodium sessilifolium*	Sessile Tick-trefoil	Vascular Plants	Flowering Plants - Dicots	X			SC-H

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1	0	0	0	*Diarrhena americana*	Eastern Beakgrain; Eastern Beakgrass	Vascular Plants	Flowering Plants - Monocots	X			T
3	5	4	3	*Dichanthelium annulum*	Ringed Witchgrass	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	1	*Dichanthelium caerulescens*	Blue Witchgrass	Vascular Plants	Flowering Plants - Monocots	X	H		T
0	0	0	1	*Dichanthelium hirstii*	Hirst Brothers' Witchgrass	Vascular Plants	Flowering Plants - Monocots	X	VH		E
1	0	0	1	*Dichanthelium spretum*	Eaton's Witchgrass	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	2	*Dichanthelium strigosum var. glabrescens*	Hairless Witchgrass	Vascular Plants	Flowering Plants - Monocots	X			T
9	0	0	0	*Diervilla rivularis*	Riverbank Bush-honeysuckle	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	2	2	*Dionaea muscipula*	Venus Flytrap	Vascular Plants	Flowering Plants - Dicots	X	VH		T
0	0	0	7	*Diplachne maritima*	Salt-meadow Grass	Vascular Plants	Flowering Plants - Monocots	X	M		E
0	0	0	6	*Drosera filiformis var. filiffornis*	Threadleaf Sundew	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	3	0	0	*Echinacea laevigata*	Smooth Coneflower	Vascular Plants	Flowering Plants - Dicots	X	H	E	E
0	0	0	3	*Eleocharis cellulosa*	Gulfcoast Spikerush	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Eleocharis elongata*	Florida Spikerush	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	1	*Eleocharis parvula*	Dwarf Spikerush	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	1	2	*Eleocharis robbinsii*	Robbins' Spikerush	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Eleocharis vivipara*	Viviparous Spikerush	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Elymus trachycaulus ssp. trachycaulus*	Slender Wheatgrass	Vascular Plants	Flowering Plants - Monocots	X			T
0	1	0	1	*Enemion biternatum*	Eastern Isopyrum; False Rue-anemone	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	3	*Epidendrum conopseum*	Green-fly Orchid	Vascular Plants	Flowering Plants - Monocots	X			T
1	1	0	0	*Erigenia bulbosa*	Harbinger-of-spring	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	4	7	*Eriocaulon aquaticum*	Seven-angled Pipewort	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Eriocaulon parkeri*	Estuary Pipewort	Vascular Plants	Flowering Plants - Monocots	X	H		T
0	0	1	0	*Eriocaulon texense*	Texas Hatpins	Vascular Plants	Flowering Plants - Monocots	X	M		E
0	0	0	1	*Eriogonum tomentosum*	Southern Wild-buckwheat	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	0	0	1	*Erythrina herbacea*	Coralbean	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Eupatorium leptophyllum*	Limesink Dog-fennel	Vascular Plants	Flowering Plants - Dicots	X			E

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Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
0	0	0	1	*Eupatorium paludicola*	Bay Boneset	Vascular Plants	Flowering Plants - Dicots	X	VH		E
1	1	0	0	*Euphorbia commutata*	Cliff Spurge	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	2	1	*Euphorbia cordifolia*	Heartleaf Sandmat	Vascular Plants	Flowering Plants - Dicots	X			T
2	4	0	0	*Euphorbia mercurialina*	Cumberland Spurge	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Filipendula rubra*	Queen-of-the-Prairie	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Fimbristylis perpusilla*	Harper's Fimbry	Vascular Plants	Flowering Plants - Monocots	X	VH		T
0	0	1	0	*Gaillardia aestivalis var. aestivalis*	Sandhills Blanket-flower	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	1	1	*Galactia mollis*	Soft Milk-pea	Vascular Plants	Flowering Plants - Dicots	X			T
0	2	0	0	*Gaylussacia brachycera*	Box Huckleberry	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	1	*Gaylussacia nana*	Confederate Huckleberry; Dwarf Dangleberry	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Gaylussacia orocola*	Appalachian Dwarf Huckleberry	Vascular Plants	Flowering Plants - Dicots	X	VH		E
0	0	0	1	*Gelsemium rankinii*	Swamp Jessamine	Vascular Plants	Flowering Plants - Dicots	X			SC-V
3	0	0	0	*Gentiana alba*	Pale Gentian; Yellow Gentian	Vascular Plants	Flowering Plants - Dicots	X	M		SC-H
2	0	0	0	*Gentiana latidens*	Balsalm Mountain Gentian	Vascular Plants	Flowering Plants - Dicots	X			T
2	0	0	0	*Gentianopsis crinita*	Fringed Gentian	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Geum aleppicum*	Yellow Avens	Vascular Plants	Flowering Plants - Dicots	X			E
2	0	0	0	*Geum geniculatum*	Bent Avens	Vascular Plants	Flowering Plants - Dicots	X	VH		SC-V
6	0	0	0	*Geum laciniatum*	Rough Avens	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Geum radiatum*	Spreading Avens	Vascular Plants	Flowering Plants - Dicots	X	VH	E	E
0	2	0	0	*Gillenia stipulata*	Indian Physic	Vascular Plants	Flowering Plants - Dicots	X			T
2	0	0	0	*Glyceria laxa*	Lax Mannagrass	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	6	*Gratiola lutea*	Golden Hedge-hyssop	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Gymnocarpium appalachianum*	Appalachian Oak Fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X	M		T
1	0	0	0	*Gymnoderma lineare*	Rock Gnome Lichen	Nonvascular Plants	Lichens	X		E	E
0	4	0	0	*Harperella nodosa (Ptilimnium nodosum)*	Harperella	Vascular Plants	Flowering Plants - Dicots	X		E	E

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0	0	2	5	*Helanthium tenellum*	Dwarf Burhead	Vascular Plants	Flowering Plants - Monocots	X			E
2	1	0	1	*Helenium brevifolium*	Littleleaf Sneezeweed	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Helenium vernale*	Spring Sneezeweed	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	2	*Helianthus floridanus*	Florida Sunflower	Vascular Plants	Flowering Plants - Dicots	X	M		T
2	1	4	0	*Helianthus laevigatus*	Smooth Sunflower	Vascular Plants	Flowering Plants - Dicots	X			SC-V
8	0	0	0	*Helianthus occidentalis ssp. occidentalis*	Naked-stem Sunflower	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	4	0	0	*Helianthus schweinitzii*	Schweinitz's Sunflower	Vascular Plants	Flowering Plants - Dicots	X	M	E	E
1	0	0	0	*Helonias bullata*	Swamp-pink	Vascular Plants	Flowering Plants - Monocots	X	H	T	T
4	0	0	0	*Hexastylis contracta*	Southern Heartleaf	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	5	0	0	*Hexastylis naniflora*	Dwarf-flower Heartleaf	Vascular Plants	Flowering Plants - Dicots	X	M	T	T
0	0	0	3	*Hibiscus aculeatus*	Comfortroot	Vascular Plants	Flowering Plants - Dicots	X			T
0	3	0	6	*Hottonia inflata*	Featherfoil	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
2	0	0	0	*Houstonia montana*	Roan Mountain Bluet	Vascular Plants	Flowering Plants - Dicots	X		E	E
1	0	0	0	*Hudsonia montana*	Mountain Golden-heather	Vascular Plants	Flowering Plants - Dicots	X	VH	T	T
0	0	0	2	*Hudsonia tomentosa*	Sand-heather	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Hydrastis canadensis*	Goldenseal	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
0	5	0	0	*Hymenocallis occidentalis var. occidentalis*	Hillside Spiderlily, Woodland Spiderlily	Vascular Plants	Flowering Plants - Monocots	X			SC-H
0	0	0	1	*Hymenocallis pygmaea*	Waccamaw River Spiderlily	Vascular Plants	Flowering Plants - Monocots	X	VH		SC-V
0	0	0	1	*Hypericum adpressum*	Bog St. John's-wort	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	0	0	1	*Hypericum brachyphyllum*	Coastal Plain St. John's-wort	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	1	1	*Hypericum fasciculatum*	Peelbark St. John's-wort	Vascular Plants	Flowering Plants - Dicots	X			E
2	0	0	0	*Hypericum radfordiorum*	Radford"s St. John's-word	Vascular Plants	Flowering Plants - Dicots	X	VH		SC-V
0	0	0	1	*Hypericum suffruticosum*	Pineland St. John's-wort	Vascular Plants	Flowering Plants - Dicots	X			SC-H
2	0	0	0	*Hypotrachyna virginica*	Virginia Loop Lichen	Nonvascular Plants	Lichens	X			SC-V
2	0	0	0	*Ilex collina*	Long-stalked Holly	Vascular Plants	Flowering Plants - Dicots	X	H		SC-V
0	0	0	1	*Ipomoea imperati*	Beach Morning-glory	Vascular Plants	Flowering Plants - Dicots	X			SC-V

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0	0	0	4	*Ipomoea macrorhiza*	Manroot	Vascular Plants	Flowering Plants - Dicots	X	M		SC-H
0	0	0	1	*Isoetes microvela*	Thin-wall Quillwort	Vascular Plants	Ferns and relatives - Spikemosses and Quillworts	X	VH		T
0	1	0	0	*Isoetes piedmontana*	Piedmont Quillwort	Vascular Plants	Ferns and relatives - Spikemosses and Quillworts	X			T
2	3	0	0	*Isotria medeoloides*	Small Whorled Pogonia	Vascular Plants	Flowering Plants - Monocots	X		T	T
0	0	0	1	*Iva microcephala*	Small-headed Marsh Elder	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Jeffersonia diphylla*	Twinleaf	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	2	*Juncus articulatus*	Jointleafed Rush	Vascular Plants	Flowering Plants - Monocots	X			SC-H
2	0	0	0	*Juncus caesariensis*	New Jersey Rush	Vascular Plants	Flowering Plants - Monocots	X	H		E
2	1	0	0	*Juniperus communis var. depressa*	Dwarf Juniper	Vascular Plants	Conifers and relatives - Conifers	X			T
0	0	0	1	*Kalmia angustifolia*	Sheep-laurel	Vascular Plants	Flowering Plants - Dicots	X			T
2	0	0	0	*Koeleria spicata (Koeleria spicata ssp. spicata)*	Soft Trisetum, Spike Trisetum	Vascular Plants	Flowering Plants - Monocots	X			SC-H
0	0	1	1	*Lachnocaulon minus*	Brown Bogbutton	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	0	5	*Lechea maritima var. virginica*	Maritime Pinweed	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	2	*Lechea torreyi var. congesta*	Torrey's Pinweed	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Lejeunea blomquistii*	A liverwort	Nonvascular Plants	Liverworts	X			SC-V
1	1	0	0	*Liatris aspera*	Rough Blazing-star	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
1	0	0	0	*Liatris helleri*	Heller's Blazing-star	Vascular Plants	Flowering Plants - Dicots	X	VH	T	T
1	0	0	0	*Liatris microcephala*	Small-head Blazing-star	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
5	2	0	0	*Lilium canadense*	Canada Lily	Vascular Plants	Flowering Plants - Monocots	X			E
3	0	0	0	*Lilium grayi*	Gray's Lily	Vascular Plants	Flowering Plants - Monocots	X	VH		T
2	1	0	0	*Lilium philadelphicum var. philadelphicum*	Wood Lily	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	1	1	*Lilium pyrophilum*	Sandhills Lily	Vascular Plants	Flowering Plants - Monocots	X	VH		E
0	0	0	1	*Limosella australis*	Awl-leaf Mudwort	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	2	*Lindera melissifolia*	Pondberry	Vascular Plants	Flowering Plants - Dicots	X		E	E
0	0	3	0	*Lindera subcoriacea*	Bog Spicebush	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V

Table 3-22
SGCN PLANTS

Species - Habitat Associations
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Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
0	0	0	1	*Linum floridanum var. chrysocarpum*	Yellow-fruited Flax	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	1	0	0	*Linum sulcatum*	Glade Flax	Vascular Plants	Flowering Plants - Dicots	X	VH		SC-H
2	0	0	1	*Liparis loeselii*	Fen Orchid	Vascular Plants	Flowering Plants - Monocots	X			E
0	2	0	0	*Lithospermum canescens*	Hoary Puccoon	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Litsea aestivalis*	Pondspice	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
0	0	0	1	*Lobelia boykinii*	Boykin's Lobelia	Vascular Plants	Flowering Plants - Dicots	X	H		E
0	0	0	1	*Lophiola aurea*	Golden-crest	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	1	*Ludwigia lanceolata*	Lanceleaf Seedbox	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	1	*Ludwigia linifolia*	Flaxleaf Seedbox	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	2	*Ludwigia ravenii*	Raven's Seedbox	Vascular Plants	Flowering Plants - Dicots	X	VH		E
0	0	1	2	*Ludwigia sphaerocarpa*	Globe-fruit Seedbox	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	1	3	*Ludwigia suffruticosa*	Shrubby Seedbox	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Lupinus villosus*	Lady Lupine, Pink Sandhill Lupine	Vascular Plants	Flowering Plants - Dicots	X			E
2	0	0	0	*Lycopodiella inundata*	Bog Clubmoss	Vascular Plants	Ferns and relatives - Clubmosses	X			E
0	0	2	2	*Lysimachia asperulifolia*	Rough-leaf Loosestrife	Vascular Plants	Flowering Plants - Dicots	X	M	E	E
2	0	0	0	*Lysimachia borealis (Trientalis borealis)*	Northern Starflower	Vascular Plants	Flowering Plants - Dicots	X			T
6	0	0	0	*Lysimachia fraseri*	Fraser's Loosestrife	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	2	*Macbridea caroliniana*	Carolina Birds-in-a-nest, Carolina Bogmint	Vascular Plants	Flowering Plants - Dicots	X	H		E
0	1	0	0	*Magnolia macrophylla*	Bigleaf Magnolia	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Malaxis spicata*	Florida Adder's-mouth	Vascular Plants	Flowering Plants - Monocots	X			SC-V
4	0	0	0	*Marshallia grandiflora*	Large-flowered Barbara's-buttons	Vascular Plants	Flowering Plants - Dicots	X	VH		SC-H
0	2	0	0	*Marshallia legrandii*	Oak Barrens Barbara's-buttons	Vascular Plants	Flowering Plants - Dicots	X	VH		E
2	0	0	0	*Marshallia trinervia*	Broadleaf Barbara's-buttons	Vascular Plants	Flowering Plants - Dicots	X	M		SC-H
2	0	0	0	*Melanthium woodii*	Ozark Bunchflower	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Melica nitens*	Three-flowered Melic	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	0	0	*Menyanthes trifoliata*	Buckbean	Vascular Plants	Flowering Plants - Dicots	X			T

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2	1	0	0	*Micranthes pensylvanica*	Swamp Saxifrage	Vascular Plants	Flowering Plants - Dicots	X			E
0	1	0	0	*Mnesithea cylindrica*	Carolina Jointgrass	Vascular Plants	Flowering Plants - Monocots	X			SC-H
3	1	0	0	*Mononeuria groenlandica*	Greenland Sandwort	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Mononeuria paludicola*	Godfrey's Sandwort	Vascular Plants	Flowering Plants - Dicots	X			E
0	1	0	0	*Mononeuria uniflora*	Single-flowered Sandwort	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Moranopteris nimbata*	West Indian Dwarf Polypody	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			T
3	0	0	0	*Muhlenbergia glomerata*	Spiked Muhly	Vascular Plants	Flowering Plants - Monocots	X			SC-V
1	0	0	0	*Muhlenbergia sobolifera*	Rock Muhly	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	1	1	*Muhlenbergia torreyana*	Pinebarren Smokegrass	Vascular Plants	Flowering Plants - Monocots	X	H		SC-V
1	0	0	0	*Myrica gale*	Sweet Gale	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	1	2	*Myriophyllum laxum*	Loose Water-milfoil	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	1	*Myriophyllum tenellum*	Leafless Water-milfoil	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Nabalus albus*	Northern Rattlesnake-root, White Rattlesnakeroot	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Narthecium montanum*	Appalachian Yellow Asphodel	Vascular Plants	Flowering Plants - Monocots	X	VH		SC-H
3	1	0	0	*Oenothera perennis*	Perennial Sundrops	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Oldenlandia boscii*	Bosc's Bluet	Vascular Plants	Flowering Plants - Dicots	X			T
0	3	0	0	*Oligoneuron album*	Prairie Goldenrod, White Prairie-goldenrod	Vascular Plants	Flowering Plants - Dicots	X			E
0	3	0	0	*Oligoneuron jacksonii*	Southeastern Bold Goldenrod	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Oligoneuron rigidum*	Midwestern Bold Goldenrod, Prairie Bold Goldenrod	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Orbexilum macrophyllum*	Bigleaf Scurfpea	Vascular Plants	Flowering Plants - Dicots	X	VH		SC-H
4	0	0	0	*Orbexilum onobrychis*	Lanceleaf Scurfpea	Vascular Plants	Flowering Plants - Dicots	X			SC-H
4	1	0	0	*Orbexilum pedunculatum*	Western Sampson's Snakeroot	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Oreojuncus trifidus*	Highland Rush	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	1	1	*Orthochilus ecristatus*	Spiked Medusa	Vascular Plants	Flowering Plants - Monocots	X			E
0	1	0	0	*Pachysandra procumbens*	Allegheny Spurge	Vascular Plants	Flowering Plants - Dicots	X			E

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1	0	0	1	*Packera crawfordii*	Bog Ragwort, Crawford's Ragwort	Vascular Plants	Flowering Plants - Dicots	X	VH		E
1	0	0	0	*Packera millefolium*	Blue Ridge Ragwort	Vascular Plants	Flowering Plants - Dicots	X	H		SC-V
2	0	0	0	*Packera paupercula var. appalachiana*	Appalachian Ragwort	Vascular Plants	Flowering Plants - Dicots	X			T
2	1	0	0	*Packera paupercula var. paupercula*	Balsam Ragwort	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Packera schweinitziana*	New England Ragwort	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Packera serpenticola*	Buck Creek Ragwort	Vascular Plants	Flowering Plants - Dicots	X	VH		T
1	0	0	0	*Palustricodon aparinoides var. aparinoides*	Marsh Bellflower	Vascular Plants	Flowering Plants - Dicots	X			T
1	4	0	0	*Panicum flexile*	Wiry Panic Grass	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	1	1	*Parnassia caroliniana*	Carolina Grass-of-Parnassus	Vascular Plants	Flowering Plants - Dicots	X	H		T
3	2	0	1	*Parnassia grandifolia*	Bigleaf Grass-of-Parnassus	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	1	0	*Paronychia herniarioides*	Michaux's Whitlow-wort	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	2	1	3	*Paspalum dissectum*	Mudbank Crown Grass	Vascular Plants	Flowering Plants - Monocots	X	M		E
1	0	0	0	*Pedicularis lanceolata*	Swamp Lousewort	Vascular Plants	Flowering Plants - Dicots	X			T
0	1	0	0	*Pellaea wrightiana*	Wright's Cliffbrake	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
0	0	3	3	*Persicaria hirsuta*	Hairy Smartweed	Vascular Plants	Flowering Plants - Dicots	X			E
0	1	0	0	*Phacelia maculata*	Flatrock Phacelia	Vascular Plants	Flowering Plants - Dicots	X	M		E
3	0	0	0	*Phegopteris connectilis*	Northern Beech Fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
0	1	0	0	*Phemeranthus piedmontanus*	Piedmont Rock-pink	Vascular Plants	Flowering Plants - Dicots	X	VH		E
0	0	0	1	*Pinguicula lutea*	Yellow Butterwort	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Pinguicula pumila*	Small Butterwort	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	2	*Pityopsis graminifolia*	A Silkgrass	Vascular Plants	Flowering Plants - Dicots	X			E
0	2	0	0	*Plantago cordata*	Heart-leaf Plantain	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	1	*Plantago sparsiflora*	Pineland Plantain	Vascular Plants	Flowering Plants - Dicots	X	M		T
2	0	0	0	*Platanthera herbiola*	Northern Rein Orchid, Tubercled Rein Orchid	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Platanthera integra*	Yellow Fringeless Orchid	Vascular Plants	Flowering Plants - Monocots	X	M		T

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1	0	0	0	*Platanthera integrilabia*	White Fringeless Orchid	Vascular Plants	Flowering Plants - Monocots	X	H	T	T
0	0	0	1	*Platanthera nivea*	Snowy Orchid	Vascular Plants	Flowering Plants - Monocots	X	M		E
2	2	0	0	*Platanthera peramoena*	Purple Fringeless Orchid	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Platanthera shriveri*	Shriver's Purple Fringed Orchid	Vascular Plants	Flowering Plants - Monocots	X	VH		E
1	0	0	0	*Poa saltuensis*	Old-pasture Bluegrass	Vascular Plants	Flowering Plants - Monocots	X			T
2	3	0	0	*Polemonium reptans var. reptans*	Spreading Jacob's Ladder	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Polygala hookeri*	Hooker's Milkwort	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
2	3	0	0	*Polygala senega*	Seneca Snakeroot	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Polygonella articulata*	Coast Jointweed, Northern Wireweed	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	0	0	1	*Polygonum glaucum*	Seabeach Knotweed	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	2	*Ponthieva racemosa*	Shadow-witch	Vascular Plants	Flowering Plants - Monocots	X			T
0	1	0	0	*Portulaca smallii*	Small's Portulaca	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	2	*Potamogeton illinoensis*	Illinois Pondweed	Vascular Plants	Flowering Plants - Monocots	X			E
2	2	0	0	*Primula meadia*	Eastern Shooting-star	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	2	0	0	*Pseudognaphalium helleri*	Heller's Rabbit-tobacco	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	0	1	*Ptilimnium costatum*	Big Bishopweed	Vascular Plants	Flowering Plants - Dicots	X	M		T
2	0	0	0	*Pyrola elliptica*	Elliptic Shinleaf	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	2	0	*Pyxidanthera brevifolia*	Sandhills Pyxie-moss	Vascular Plants	Flowering Plants - Dicots	X	H		T
0	1	0	1	*Quercus elliottii*	Running Oak	Vascular Plants	Flowering Plants - Dicots	X			E
0	3	0	0	*Quercus ilicifolia*	Bear Oak	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Quercus minima*	Dwarf Live Oak	Vascular Plants	Flowering Plants - Dicots	X			E
0	2	0	0	*Quercus prinoides*	Dwarf Chinquapin Oak	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Ranunculus ambigens*	Water-plantain Spearwort	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	0	0	1	*Ranunculus hederaceus*	Ivy Buttercup, Ivy-leaved Water Crowfoot	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Rhexia aristosa*	Awned Meadow-beauty	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
1	0	0	0	*Rhodiola rosea*	Roseroot	Vascular Plants	Flowering Plants - Dicots	X			E

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1	0	0	0	*Rhododendron prinophyllum*	Election Pink	Vascular Plants	Flowering Plants - Dicots	X			T
0	4	2	2	*Rhus michauxii*	Michaux's Sumac	Vascular Plants	Flowering Plants - Dicots	X	H	E	E
0	0	1	0	*Rhynchospora crinipes*	Alabama Beaksedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	0	1	*Rhynchospora decurrens*	Swamp Forest Beaksedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	0	1	*Rhynchospora harperi*	Harper's Beaksedge	Vascular Plants	Flowering Plants - Monocots	X	M		SC-V
0	0	3	3	*Rhynchospora macra*	Southern White Beaksedge	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	1	0	2	*Rhynchospora microcarpa*	Southern Beakssedge	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Rhynchospora odorata*	Fragrant Beaksedge	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Rhynchospora pleiantha*	Coastal Beaksedge	Vascular Plants	Flowering Plants - Monocots	X	H		T
0	0	0	1	*Rhynchospora thornei*	Thorne's Beaksedge	Vascular Plants	Flowering Plants - Monocots	X	H		SC-V
0	0	0	1	*Rhynchospora tracyi*	Tracy's Beaksedge	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Rubus strigosus*	American Red Raspberry	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	0	1	*Rudbeckia heliopsidis*	Sun-facing Coneflower	Vascular Plants	Flowering Plants - Dicots	X	VH		E
0	0	2	0	*Ruellia ciliosa*	Sandhills Wild-petunia	Vascular Plants	Flowering Plants - Dicots	X			T
0	2	0	0	*Ruellia humilis*	Low Wild-petunia	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	2	0	0	*Ruellia purshiana*	Pursh's Wild-petunia	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
0	0	0	1	*Ruellia strepens*	Limestone Wild Petunia	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Sabal palmetto*	Cabbage Palmetto	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Sabatia kennedyana*	Plymouth Gentian	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	4	*Sageretia minutiflora*	Small-flowered Buckthorn	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	1	*Sagittaria chapmanii*	Chapman's Arrowhead	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	0	0	0	*Sagittaria fasciculata*	Bunched Arrowhead	Vascular Plants	Flowering Plants - Monocots	X	VH	E	E
0	0	1	2	*Sagittaria isoetiformis*	Quillwort Arrowhead	Vascular Plants	Flowering Plants - Monocots	X	M		T
0	0	3	0	*Sagittaria macrocarpa*	Streamhead Arrowhead, Streamhead Sagittaria	Vascular Plants	Flowering Plants - Monocots	X	VH		T
0	0	0	2	*Sagittaria weatherbiana*	Grassleaf Arrowhead	Vascular Plants	Flowering Plants - Monocots	X	M		E
1	0	0	0	*Sarracenia jonesii*	Mountain Sweet Pitcherplant	Vascular Plants	Flowering Plants - Dicots	X	VH	E	E

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0	0	0	2	*Sarracenia minor var. minor*	Hooded Pitcherplant	Vascular Plants	Flowering Plants - Dicots	X			E
2	0	0	0	*Sarracenia oreophila*	Green Pitcherplant	Vascular Plants	Flowering Plants - Dicots	X	VH	E	E
2	0	0	0	*Sarracenia purpurea var. montana*	Southern Appalachian Purple Pitcher Plant	Vascular Plants	Flowering Plants - Dicots	X	VH		E
4	3	0	0	*Sceptridium jenmanii*	Alabama Grape-fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			SC-V
0	1	0	1	*Schisandra glabra*	Magnolia Vine	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	1	1	*Schwalbea americana*	Chaffseed, American Chaffseed	Vascular Plants	Flowering Plants - Dicots	X	VH	E	E
0	0	0	1	*Scirpus flaccidifolius*	Reclining Bulrush	Vascular Plants	Flowering Plants - Monocots	X	VH		E
0	0	0	1	*Scirpus lineatus*	Drooping Bulrush	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Scleria baldwinii*	Baldwin's Nutrush	Vascular Plants	Flowering Plants - Monocots	X			T
0	1	0	2	*Scleria bellii*	Smooth-seeded Hairy Nutrush	Vascular Plants	Flowering Plants - Monocots	X	H		E
0	0	1	1	*Scleria reticularis*	Netted Nutrush	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	2	2	*Sclerolepis uniflora*	One-flower Hardscale, Sclerolepis	Vascular Plants	Flowering Plants - Dicots	X			T
0	2	0	0	*Scutellaria australis*	Southern Skullcap	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Scutellaria galericulata*	Hooded Skullcap	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	2	0	0	*Scutellaria leonardii*	Shale-barren Skullcap	Vascular Plants	Flowering Plants - Dicots	X			E
1	1	0	0	*Scutellaria nervosa*	Veined Skullcap	Vascular Plants	Flowering Plants - Dicots	X			E
0	1	0	0	*Sedum pusillum*	Puck's Orpine	Vascular Plants	Flowering Plants - Dicots	X	M		E
2	0	0	0	*Senecio suaveolens*	Sweet Indian-plantain	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Sesuvium maritimum*	Slender Sea-purslane	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Sesuvium portulacastrum*	Shoreline Sea-purslane	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	2	*Seymeria pectinata ssp. pectinata*	Comb Seymeria	Vascular Plants	Flowering Plants - Dicots	X			SC-H
2	0	0	0	*Shortia brevistyla*	Northern Oconee Bells	Vascular Plants	Flowering Plants - Dicots	X	VH		T
2	0	0	0	*Shortia galacifolia*	Southern Oconee Bells	Vascular Plants	Flowering Plants - Dicots	X	H		SC-V
0	0	0	1	*Sideroxylon tenax*	Tough Bumelia	Vascular Plants	Flowering Plants - Dicots	X	M		T
2	0	0	0	*Silene ovata*	Mountain Catchfly	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V

Table 3-22
SGCN PLANTS

Species - Habitat Associations
2025 NC Wildlife Action Plan

Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
1	1	0	0	*Silphium connatum*	Virginia Cup-plant	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	1	0	0	*Silphium perfoliatum*	Common Cup-plant	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
2	0	0	0	*Sisyrinchium dichotomum*	White Irisette	Vascular Plants	Flowering Plants - Monocots	X	VH	E	E
0	0	0	3	*Solidago leavenworthii*	Leavenworth's Goldenrod	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	2	0	0	*Solidago plumosa*	Yadkin River Goldenrod	Vascular Plants	Flowering Plants - Dicots	X	VH		T
0	1	0	0	*Solidago radula*	Western Rough Goldenrod	Vascular Plants	Flowering Plants - Dicots	X	M		E
1	0	0	0	*Solidago spithamaea*	Blue Ridge Goldenrod	Vascular Plants	Flowering Plants - Dicots	X	VH	T	T
0	0	1	1	*Solidago tortifolia*	Twisted-leaf Goldenrod	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	2	2	*Solidago verna*	Spring-flowering Goldenrod	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	2	*Solidago villosicarpa*	Carolina Maritime Goldenrod, Coastal Goldenrod	Vascular Plants	Flowering Plants - Dicots	X	VH		T
2	0	0	0	*Sparganium acaule*	Greenfruit Bur-reed	Vascular Plants	Flowering Plants - Monocots	X			E
1	0	1	1	*Spartina pectinata*	Freshwater Cordgrass	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Sphagnum contortum*	Contorted Peatmoss	Nonvascular Plants	Mosses	X			T
1	0	0	0	*Sphagnum warnstorfii*	Fen Peatmoss	Nonvascular Plants	Mosses	X			SC-V
2	0	0	0	*Spigelia marilandica*	Pink-root	Vascular Plants	Flowering Plants - Dicots	X			T
0	4	0	0	*Spiraea corymbosa*	Rock Spirea, Shinyleaf Meadowsweet	Vascular Plants	Flowering Plants - Dicots	X			E
1	0	0	0	*Spiraea virginiana*	Virginia Spiraea	Vascular Plants	Flowering Plants - Dicots	X	VH	T	T
1	0	0	0	*Spiranthes lacera var. lacera*	Northern Slender Ladies'-tresses	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	2	*Spiranthes laciniata*	Lace-lip Ladies'-tresses	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Spiranthes longilabris*	Giant-spiral Orchid	Vascular Plants	Flowering Plants - Monocots	X	M		E
2	0	0	0	*Spiranthes lucida*	Shining Ladies'-tresses	Vascular Plants	Flowering Plants - Monocots	X	M		E
1	0	0	0	*Spiranthes ochroleuca*	Yellow Nodding Ladies'-tresses	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Sporobolus heterolepis*	Prairie Dropseed	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Sporobolus teretifolius*	Wireleaf Dropseed	Vascular Plants	Flowering Plants - Monocots	X	VH		E
0	0	0	1	*Sporobolus virginicus*	Saltmarsh Dropseed, Seashore Dropseed	Vascular Plants	Flowering Plants - Monocots	X			T
2	0	0	0	*Stachys appalachiana*	Appalachian Hedge-nettle	Vascular Plants	Flowering Plants - Dicots	X	VH		E

Table 3-22
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2025 NC Wildlife Action Plan

Habitat Associations by Ecoregion										
Mountain	Piedmont	Sandhills	Coastal Plain	*Scientific Name*	Common Name	Species Group (Broad)	Species Group (Fine)	Species of Greatest Conservation Need (SGCN) Priority	SEAFWA Regional SGCN VH= Very High, H= High, M= Moderate	FEDERAL STATUS	STATE STATUS
1	0	0	0	*Stachys eplingii*	Epling's Hedge-nettle	Vascular Plants	Flowering Plants - Dicots	X			E
0	1	0	0	*Stachys matthewsii*	Yadkin Hedge-nettle	Vascular Plants	Flowering Plants - Dicots	X	VH		E
1	0	0	0	*Stenanthium gramineum var. robustum*	Bog Featherbells	Vascular Plants	Flowering Plants - Monocots	X	H		E
1	0	0	0	*Stenanthium leimanthoides*	Pinebarrens Death-camas	Vascular Plants	Flowering Plants - Monocots	X	VH		T
0	0	0	1	*Stylisma aquatica*	Water Dawnflower	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	1	1	*Stylisma pickeringii var. pickeringii*	Pickering's Dawnflower	Vascular Plants	Flowering Plants - Dicots	X			SC-V
0	0	0	1	*Swida asperifolia*	Eastern Roughleaf Dogwood	Vascular Plants	Flowering Plants - Dicots	X			E
0	2	0	0	*Swida racemosa*	Gray Dogwood	Vascular Plants	Flowering Plants - Dicots	X			SC-V
3	4	0	0	*Symphyotrichum concinnum*	Narrow-leaved Smooth Aster	Vascular Plants	Flowering Plants - Dicots	X			E
0	3	0	0	*Symphyotrichum depauperatum*	Serpentine Aster	Vascular Plants	Flowering Plants - Dicots	X	VH		E
0	4	0	0	*Symphyotrichum georgianum*	Georgia Aster	Vascular Plants	Flowering Plants - Dicots	X	M	C	T
1	0	0	0	*Symphyotrichum oblongifolium*	Eastern Aromatic Aster	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Symphyotrichum rhiannon*	Buck Creek Aster	Vascular Plants	Flowering Plants - Dicots	X	VH		T
1	0	0	0	*Synandra hispidula*	Synandra	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	0	0	0	*Taxus canadensis*	Canada Yew	Vascular Plants	Conifers and relatives - Conifers	X			T
0	0	0	1	*Thalictrum cooleyi*	Cooley's Meadowrue	Vascular Plants	Flowering Plants - Dicots	X	VH	E	E
2	2	1	2	*Thalictrum macrostylum*	Small-leaved Meadowrue	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
0	0	0	0	*Thaspium pinnatifidum*	Mountain Thaspium	Vascular Plants	Flowering Plants - Dicots	X	H		E
2	2	0	0	*Thermopsis fraxinifolia*	Ash-leaved Golden-banner	Vascular Plants	Flowering Plants - Dicots	X	M		SC-V
0	0	0	2	*Tiedemannia canbyi (Oxypolis canbyi)*	Canby's Dropwort	Vascular Plants	Flowering Plants - Dicots	X		E	E
2	1	0	0	*Triantha glutinosa*	Sticky Bog Asphodel	Vascular Plants	Flowering Plants - Monocots	X			SC-V
2	1	0	0	*Trichostema brachiatum*	Glade Bluecurls	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Trichostema nesophilum*	Dune Bluecurls	Vascular Plants	Flowering Plants - Dicots	X	VH		SC-V
0	0	0	1	*Tridens ambiguus*	Pineland Triodia	Vascular Plants	Flowering Plants - Monocots	X			E
0	2	3	4	*Tridens chapmanii*	Chapman's Redtop, Chapman's Triodia	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	0	1	*Tridens strictus*	Spike Triodia	Vascular Plants	Flowering Plants - Monocots	X			SC-H

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0	0	0	1	*Trifolium carolinianum*	Carolina Clover	Vascular Plants	Flowering Plants - Dicots	X			SC-H
1	4	0	3	*Trifolium reflexum*	Buffalo Clover	Vascular Plants	Flowering Plants - Dicots	X	M		T
1	0	0	0	*Trillium discolor*	Mottled Trillium, Pale Yellow Trillium	Vascular Plants	Flowering Plants - Monocots	X	M		T
1	0	0	0	*Trillium flexipes*	Bent White Trillium	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Trillium pusillum var. ozarkanum*	Ozark Least Trillium	Vascular Plants	Flowering Plants - Monocots	X	M		E
0	0	0	2	*Trillium pusillum var. pusillum*	Carolina Least Trillium	Vascular Plants	Flowering Plants - Monocots	X	H		E
0	1	0	2	*Trillium pusillum var. virginianum*	Virginia Least Trillium	Vascular Plants	Flowering Plants - Monocots	X	H		E
1	1	0	0	*Trillium recurvatum*	Prairie Trillium, Recurved Trillium	Vascular Plants	Flowering Plants - Monocots	X			T
0	0	0	1	*Trillium sessile*	Sessile-flowered Trillium	Vascular Plants	Flowering Plants - Monocots	X			T
1	0	0	0	*Trillium simile*	Sweet White Trillium	Vascular Plants	Flowering Plants - Monocots	X	M		SC-V
3	0	0	0	*Turritis glabra*	Tower Mustard	Vascular Plants	Flowering Plants - Dicots	X			E
0	0	0	1	*Urtica chamaedryoides*	Dwarf Stinging Nettle	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	1	*Utricularia cornuta*	Horned Bladderwort	Vascular Plants	Flowering Plants - Dicots	X			T
0	0	1	1	*Utricularia geminiscapa*	Two-flowered Bladderwort	Vascular Plants	Flowering Plants - Dicots	X			SC-V
1	0	0	0	*Utricularia minor*	Small Bladderwort	Vascular Plants	Flowering Plants - Dicots	X			SC-H
0	0	0	1	*Utricularia olivacea*	Dwarf Bladderwort	Vascular Plants	Flowering Plants - Dicots	X	M		T
0	0	0	1	*Utricularia resupinata*	Northeastern Bladderwort	Vascular Plants	Flowering Plants - Dicots	X	M		E
2	0	0	2	*Vaccinium macrocarpon*	Cranberry	Vascular Plants	Flowering Plants - Dicots	X			T
1	0	0	0	*Vandenboschia boschiana*	Appalachian Filmy-fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
2	0	0	1	*Veronica americana*	American Speedwell	Vascular Plants	Flowering Plants - Dicots	X			T
3	0	0	0	*Waldsteinia lobata*	Lobed Barren-strawberry	Vascular Plants	Flowering Plants - Dicots	X	M		E
0	0	1	0	*Warea cuneifolia*	Carolina Pineland-cress	Vascular Plants	Flowering Plants - Dicots	X	M		E
1	0	0	0	*Woodsia ilvensis*	Rusty Cliff Fern	Vascular Plants	Ferns and relatives - Leptosporangiate Ferns	X			E
0	0	0	1	*Xyris floridana*	Florida Yellow-eyed-grass	Vascular Plants	Flowering Plants - Monocots	X			SC-V
0	0	1	0	*Xyris scabrifolia*	Harper's Yellow-eyed-grass, Roughleaf Yellow-eyed-grass	Vascular Plants	Flowering Plants - Monocots	X	M		SC-V

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SGCN PLANTS

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Habitat Associations by Ecoregion										
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0	0	0	1	*Xyris serotina*	Acid-swamp Yellow-eyed-grass	Vascular Plants	Flowering Plants - Monocots	X	M		SC-H
0	0	0	2	*Xyris stricta*	Pineland Yellow-eyed-grass	Vascular Plants	Flowering Plants - Monocots	X			E
0	0	0	1	*Zephyranthes simpsonii*	Rain Lily, Florida Atamasco-lily	Vascular Plants	Flowering Plants - Monocots	X	H		E

Reference 3-1

White Paper[1]
Wildlife Action Plan 2025 Revision Process
Ranking Criteria for Prioritizing Wildlife Species for Conservation, Research, and Management

Introduction

States use federal funds generated by excise taxes provided by the Wildlife Restoration Act (Pittman-Robertson), Sport Fisheries Restoration Act (Dingell-Johnson), and the Wallop-Breaux Act to support the conservation and management of game fish and wildlife species. The State Wildlife Grants (SWG) program was established by the U.S. Congress to provide funding for nongame species not traditionally covered under most previous federal funding programs. The U.S. Fish & Wildlife Service (USFWS) has oversight of the SWG program and gives states the authority to determine how they identify these priority species.

To qualify for SWG funds, each state is mandated to develop conservation strategies with a focus on Species of Greatest Conservation Need (SGCN). In North Carolina, SGCN have been defined as species that are currently rare or have been designated as at-risk of extinction; those for which we have knowledge deficiencies; and those that have not received adequate conservation attention in the past. In addition to these species for which there is high conservation concern, SGCN may also include those species for which we are unable to determine true status in the state and are therefore a priority for research due to these knowledge gaps.

Species that may be vulnerable to local threats; species of recreational, commercial, or tribal importance that are vulnerable; and those identified as having high management needs or for which there are management concerns are referred to as priority species. Work related to priority species may be funded from sources other than the SWG program; however, eligibility for SWG funds is restricted to SGCN which include conservation concern and knowledge gap priority species.

2015 Species Evaluation Process

In mid-2012, an Association of Fish and Wildlife Agencies (AFWA) Teaming With Wildlife (TWW) work group developed voluntary best-practice guidance for use by states during revision of their SWAPs (AFWA 2012). The AFWA-TWW guidance includes a recommendation to use clearly defined procedures for assessing conservation status and setting conservation priorities (AFWA

[1] Developed by Wildlife Action Plan Revision Technical Team Ranking Criteria Work Group (DH Allen, SK Anderson, JC Fuller, RB Nichols, C Simpson, VF Stancil, KC Weeks)

2012). The guidance suggests using formal ranking methods such as the International Union of Conservation Networks (IUCN) Red List Categories and Criteria (IUCN 2001, 2010), Florida Fish and Wildlife Conservation Commission's taxa ranking system (Millsap et al. 1990), and the NatureServe conservation status evaluation tool (NatureServe 2012a, Master et al. 2012, Faber-Langendoen et al. 2012). Benefits of using more uniform methods include consistency of the information and the ability to share data across organizations (Salafsky et al. 2008).

The 2015 SWAP Revision Technical Team formed a Ranking Criteria Work Group (Work Group) to review and evaluate ranking metrics and prioritization tools. The Work Group was comprised of biologists from the WRC who were tasked with developing recommendations for a method to identify SGCN and to prioritize conservation efforts on behalf of species. In addition to reviewing the evaluation methods recommended by AFWA-TWW (noted above), the Work Group also considered methods described by the Convention on International Trade in Endangered Species (CITES 2011), American Fisheries Society (Deacon et al. 1979, Jelks et al. 2008), Partners In Flight Species Assessment Process (Beissinger et al. 2000), and an assessment of various categorization systems conducted by deGrammont and Cuaron (2006) and Arponen (2012).

Based on the results of their review and assessment, the Work Group members determined that adopting and modifying selected ranking criteria and scoring metrics described by IUCN, Millsap (et al. 1990), and NatureServe combined with original criteria and metrics to capture knowledge gaps and management concerns, would best meet North Carolina's WAP goals for identifying SGCN and prioritizing conservation efforts. The Work Group also adopted the 10-point scoring system as described in Millsap (et al. 1990) because the application of this method is similar to the ranking criteria proposed in this white paper and a statistical analysis conducted by Millsap (et al. 1990) of their results indicated the metrics and scoring system were robust and selection bias was minimal.

Members of the Work Group coordinated with biologists at the NC Natural Heritage Program (NCNHP) to determine whether any information used in the NatureServe evaluation tool would be compatible with the proposed ranking criteria. It was determined this information is not uniformly available across all taxa groups or for species that are not tracked for reporting to NatureServe. However, the NCNHP will provide data for those species which are tracked in their database system. The NCNHP requested that the metrics be designed in a way that ranking criteria data can augment information used in designating state-level rankings as reported by NatureServe. As a result of these coordination efforts, the Work Group adopted answer scales that utilize the NatureServe evaluation tool for several metrics that address conservation concerns (NatureServe 2012a).

Other coordination efforts include a request to faculty and staff of the North Carolina Cooperative Fish & Wildlife Research Unit and staff of the Biodiversity and Spatial Information Center at NC State University (NCSU) for review of the draft ranking criteria metrics. The request asked for comments on whether statistical analysis would be needed to reduce bias in the evaluation process. Their recommendations include

- displaying answer scales without the associated scores as a means of reducing reviewer bias for selecting answers based on a preferred score outcome,
- calculating average scores for each metric that are then totaled within each evaluation category for each species, and
- using a Bayesian style analysis of the relationship between a threat's scope and severity.

Members of the Nongame Wildlife Advisory Committee (NWAC) were also asked to review and provide comments on the proposed ranking criteria. Responses were limited and comments were restricted to minor revisions, which were incorporated into the metrics.

The final species evaluation methodology uses metrics developed by the Work Group and are described in this white paper report. The metrics were developed to be a robust measure of our understanding about the status, trends, and risks of species in the state. The metrics are used to evaluate all wildlife in the amphibian, bird, crayfish, freshwater fish, freshwater mussel, mammal, reptile, and snail taxa groups found in North Carolina. The evaluation results create ranking scores that are used to identify SGCN and other priority species.

2025 Updated Species Evaluation Process

The 2025 SWAP Technical Team convened a Ranking Criteria Work Group to review the evaluation methodology and recommend any updates to improve the process. Overall, we want the evaluation process to be one that can be applied consistently when used by different people and that will facilitate an evaluation and comparison of extinction risks among all species within a taxa group.

To accomplish this goal, the evaluation is divided into three review categories: Conservation Need, Knowledge Gap, and Management Concern. While the Conservation Need metrics consider the status of species both within the state and where they occur elsewhere, the Knowledge Gap and Management Concern metrics consider only the populations found in North Carolina.

Species Ranking

The ranking process is intended to be both transparent and collaborative, with partners representing numerous state and federal agencies, education and research organizations, and private citizens knowledgeable about the taxa contributing to the process. Teams of species experts and research scientists will evaluate the species they are knowledgeable about. Their knowledge may be directly related to their own work or indirectly related through access to current research data. A peer-review analysis of the ranking results will be conducted once the Taxa Teams have completed their reviews.

Each Taxa Team considered whether adjustments to the method for calculating the Conservation Concern ranking scores would be appropriate for the taxon. The Taxa Teams were

allowed to make scoring adjustments. The following adjustments were made for the 2025 evaluation process:

- Amphibians and Reptiles (Herps): Any species listed for federal or state protection is automatically considered a North Carolina responsibility and designated SGCN. The Conservation Concern score calculation was adjusted for the Metric 9 threat assessment responses by multiplying the evaluation score total by 0.25 and adding the adjusted score to the cumulative ranking score.

- Birds: The cumulative total Conservation Concern score was calculated by using the full score for Metrics 1 through 4 and Metric 6 and adjusted scores for remaining metrics in this category. The adjustments included:
    - The Metric 5 score was multiplied by 0.5 in order to address the effect of different life histories and carrying capacities of this diverse taxon.
    - The Metric 7 score was calculated by multiplying the results by 1.5 for each species in order to emphasize the effect of population trends in North Carolina.
    - The Metric 8 score was adjusted by multiplying the results by 0.5 in order to reduce the effect of coastal species life histories.
    - The threat assessment score from Metric 9 was calculated as the maximum score reported from the evaluation categories, with 10 points being the maximum added to the cumulative score.
    - Additionally, the Bird Taxa Team added consideration for species where non-breeding, breeding, or both populations occurred in North Carolina by adding 6, 8, or 10 points (respectively) to the Conservation Concern cumulative total.

  The Bird Taxa Team also decided to include responsibility species as SGCN based on global and North Carolina importance.
    - Global Responsibility Species are those that occur in NC in the periphery of its range and are therefore rare in the state. Metric scores for Global responsibility species would likely be M2=0, M3=0, and M5=9 or 10. While they may be globally secure and abundant they may be at risk to threats that can occur elsewhere within their range, including international landscapes. An example of this type of threat is deforestation in the Amazon forests.
    - North Carolina Responsibility Species are those for which 8% or more of the global breeding or wintering population occurs in NC and the ranking evaluation score is within the 50% percentile.

- Freshwater Fish: The threat assessment score from Metric 9 was calculated as the maximum score reported from the evaluation categories, with 10 points being the maximum added to the cumulative score.

RANKING SCORES

Taxa Team members and peer-reviewers select the appropriate response for each metric as part of the ranking process. Responses are entered into an organized, relational database developed for the WRC's Portal Access to Wildlife Systems (PAWS) web site which is available to reviewers through a secured internet portal. Each metric's answer scale represents empirical responses that reflect the best available knowledge for a species and is used to calculate numeric ranking scores.

Averaged scores and cumulative totals are calculated by the PAWS database for each of the review categories. Taxa Teams will use the Conservation Concern and Knowledge Gap scores in the species prioritization process to identify SGCN. Ranking scores from all three review categories will be used to recommend priority species.

The steps involved in completing the species ranking and scoring process are described below.

1. Each Taxa Team member will review the ranking criteria metrics and evaluate species for which they are knowledgeable. Team member's evaluation selections will be entered into the PAWS Wildlife Action Plan database.
2. The metric responses for each Taxa Team member will be compiled in a preliminary report automatically generated by the PAWS database. Taxa Teams will meet to review responses and for each species where a metric response varies, team members will collaboratively determine whether calculation of an average score based on the range of responses is appropriate or if a single response should be designated.
3. Final ranking scores will be automatically calculated by the PAWS database using the final results of the Taxa Team review.
4. The Taxa Teams will review ranking scores from each of the three review categories and recommend minimum scores for a species to be considered a priority species. Conservation Concern threshold scores will be used to designate SGCN.
5. Peer-reviewers will be asked to review the metric responses and recommendations for SGCN and priority species. Peer-reviewers may submit recommendations to modify the ranking evaluations; modifications must be supported with appropriate citations or references to substantiating research.
6. Taxa Team members will evaluate all recommendations submitted by peer-reviewers to determine merit of the responses. Each Taxa Team will collaboratively determine whether to incorporate recommended changes and modify a species ranking or to retain the original ranking recommendation.
7. Final ranking recommendations made by the Taxa Teams will be published in the SWAP as a list of SGCN and priority species. The final metric responses and ranking criteria scores will be made available in spreadsheet format for public access through a website download.

The Technical Team and Ranking Criteria Work Group recommend that all species be periodically reevaluated using the ranking criteria. Future modifications to the metrics may be required to accommodate new findings and incorporate best practice recommendations.

Conclusion and Acknowledgements

The 2025 SWAP Revision Technical Team formed a Ranking Criteria Work Group to develop recommendations for updates to the species prioritization process. Peer-review and technical input was sought from technical and species experts from the Cooperative Fish and Wildlife Unit at NCSU, NWAC, NCNHP, WRC, and the 2025 WAP Revision Steering Committee. The Work Group reviewed the evaluation methodology and ranking processes and concurred with allowing individual Taxa Teams to adjust the process as needed for taxonomic groups. The Technical Team and Ranking Criteria Work Group recommend using the ranking criteria to evaluate and prioritize species for publication in the 2025 SWAP.

The following list of WRC staff and species experts were involved in review and update of the 2025 SWAP species evaluation methodology.

2025 SWAP Revision Steering Committee	**2025 SWAP Technical Team**
Shannon Deaton, Habitat Conservation Div. Heather Evans, Director's Office Rachael Hoch, Inland Fisheries Div. Lane Sauls, Chair, NWAC Sara Schweitzer, Wildlife Management Div.	Greg Batts, Wildlife Management Div. Chris Dawes, Engineering & Land Management Div. Kevin Dockendorf, Inland Fisheries Div. Luke Etchison, Inland Fisheries Div. Michael Fisk, Inland Fisheries Div. Joe Fuller, Wildlife Management Div. Chris Goudreau, Habitat Conservation Div. Jeff Hall, Wildlife Management Div. Brena Jones, Inland Fisheries Div. Chris Jordan, Engineering & Land Management Div. Philip Lucas, Wildlife Enforcement Div. Jeremy McCargo, Inland Fisheries Div. Allison Medford, Wildlife Management Div. Jake Rash, Inland Fisheries Div. TR Russ, Inland Fisheries Div. Nick Shaver, Engineering & Land Management Div. Vann Stancil, Habitat Conservation Div. Kendrick Weeks, Wildlife Management Div. Brent Wilson, Engineering & Land Management Div.
2025 SWAP Ranking Criteria Work Group	
Greg Batts, Wildlife Management Div. David Cobb, Director's Office Allison Medford, Wildlife Management Div. Lane Sauls, NWAC Vann Stancil, Habitat Conservation Div. Kendrick Weeks, Wildlife Management Div.	

2025 Ranking Criteria Metrics

The ranking criteria metrics were developed to assist with the prioritization process that identifies SGCN. There are three categories: (1) Conservation Needs, (2) Knowledge Gaps, and (3) Management Concerns/Needs. The answer scale of each metric was designed to represent empirical data that can be applied to the different taxa groups. While the Conservation Need metrics consider the status of species both within the state and where they occur elsewhere (range-wide), the Knowledge Gap and Management Concern metrics consider only the occurrences in North Carolina.

1. Conservation Need Category (Metrics 1 through 9)

The Conservation Need category is designed to evaluate biological vulnerability by considering the global and regional status and trends of a species (wherever it occurs) as well as its local status (wherever it occurs in North Carolina). Many species found in North Carolina have resident as well as migratory populations that range across a wide area outside the state. Metrics that consider the global and regional status of a species can help identify those at risk globally or regionally so we can prioritize conservation efforts to secure local populations and protect biodiversity (Wells et al. 2010).

Metric 1. Conservation Protection Status. This metric represents the current federal or state listed status of a species. Both federal and state listing processes use scientifically based evaluation and ranking methods to develop listing recommendations. In many cases, continuing species-specific conservation efforts will be required to maintain viable populations of these species (Scott et al. 2010). It is important that these species remain a priority for conservation efforts statewide. Scores have been assigned based on the highest protection status currently applied to the species.

What is the current conservation protection status?
(This information will be provided and reviewers will not need to select a status.)

(a) Federal and NC State Listed as Endangered (E) or Threatened (T)
(b) NC State Listed Endangered (E)
(c) NC State Listed Threatened (T)
(d) Federal Candidate Species (C)
(e) NC State Special Concern (SC)
(f) None

Global and Regional Status

Metrics 2 through 4 consider global and regional status that in many cases will extend beyond the state's boundaries. If a species is endemic to the state, we consider its range-wide distribution to be North Carolina.

Metric 2. Population Size, Range Wide. For our use in this evaluation, range is considered to be a geographic area represented by the outermost boundaries that encompass where a species occurs naturally (Suring et al. 2011). Efforts to evaluate a species' rarity can include measurements of population size as represented by geographic distribution and abundance (Manne and Pimm 2006, Witte and Torfs 2003, Kunin 1998). Considering population size range-wide provides a comparison of how well a species population is doing overall when compared with populations within the state (Crain et al. 2011). The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a).

This metric recognizes the importance of a species where it has overall low population sizes in other parts of its range (global or regional) but it may have a larger population within the state. For example, populations occurring within NC may be relatively large and represent a significant portion of the total known population for a species which has a range beyond the state and may be experiencing declines or have low numbers in those areas (e.g., Eastern Hellbenders, Sanderlings).

The opposite may also be true – the population size in North Carolina may be small, but the overall population range-wide is large. For example, Eastern Coral Snake populations in North Carolina are considered critically imperiled, but it is common in parts of its range outside the state and does not appear to be significantly threatened elsewhere (NatureServe 2012b). Scores are assigned based on the estimated number of adults throughout the species' range.

What is the estimated number of adults within the species' range?

(a) 1 – 50 individuals
(b) 50 - 250 individuals
(c) 250 - 1,000 individuals
(d) 1,000 - 2,500 individuals
(e) 2,500 - 10,000 individuals
(f) 10,000 - 100,000 individuals
(g) 100,000 - 1,000,000 individuals
(h) >1,000,000 individuals

Metric 3. Range Size. As noted for population size, geographic distribution is an important measurement of a species' rarity (Manne and Pimm 2006, Witte and Torfs 2003, Kunin 1998). Range size considers the most restricted area over which the species is distributed, including areas where it occurs outside NC. The intent in using this metric is to recognize the importance of species with small range sizes because they may be more at risk of extinction (Breininger et al. 1998). Where a species has distinct breeding and nonbreeding ranges (e.g., migratory birds, anadramous fish), the smaller range size should be considered during this evaluation.

The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a). Scores are assigned based on the area over which the taxon is distributed, including watershed size for aquatic species. What is the estimated area of distribution (range size)?

(a) < 100 km^2 (< about 40 mi^2)
(b) 100 - 250 km^2
(c) 250-1,000 km^2
(d) 1,000-5,000 km^2
(e) 5,000-20,000 km^2
(f) 20,000-200,000 km^2 [North Carolina has 125,920 km^2]
(g) 200,000-2,500,000 km^2
(h) >2,500,000 km^2 [The US has about 6.8 million km^2]
(i) Unknown

Metric 4. Distribution Trend (long-term). A species may be more vulnerable to extinction when its range becomes fragmented or too small to support its population. The persistence of rare species may be more limited when habitat impacts are long-term and the fragmentation leads to increased local competition between species for reduced resources (Hanski 2008, Wahlberg et al. 1996, Millsap et al. 1990). This evaluation considers changes to distribution because of habitat loss or change that may have occurred from European settlement up to recent historical periods more than 20 years ago.

For example, the fragmentation and reduction of longleaf pine acreage that began with European settlers using the forests as a resource for military naval stores (Frost 1993) has resulted in significant impacts to distribution of wildlife species adapted to this community type, especially red-cockaded woodpecker and gopher frog. Conversely, some species have adapted and thrive in urban/suburban settings (e.g., raccoon, gray squirrel) and are expanding. Another example is the frequent availability of early successional habitat associated with harvest rotations on timber plantations. This land use practice may allow larger populations of prairie warblers to occur in these areas than would have occurred historically with natural landscapes. The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a). Scores are assigned based on the estimated % change in area occupied by the species.

What is the estimated % change in area occupied by the species?

(a) Decrease of >90%
(b) Decrease of 80 - 90%
(c) Decrease of 70 - 80%
(d) Decrease of 50 - 70%
(e) Decrease of 30 - 50%
(f) Decrease of 10 - 30%
(g) Relatively Stable (≤ 10% increase or decrease)
(h) Increasing (≥ 10% increase)

North Carolina Status

Metrics 5 through 9 focus on a species' status in North Carolina.

Metric 5. Population Size in North Carolina. Species that become rare locally may serve as early warnings for declines over broader areas that are likely to occur for numerous reasons, including threatened habitats or genetic decline (Wells et al. 2010). In addition, North Carolina has numerous endemic species and some have single or small populations found only in discrete locations. Endemic species may have low reproductive potential that will contribute to small populations (Kunin and Gaston 1998). Burlakova et al. (2010) noted there is typically a high rate of endemism associated with freshwater habitats because many species have evolved within small geographic ranges (reviewed in Strayer and Dudgeon 2010).

There are some species (e.g., birds, anadromous fish) with different breeding and non-breeding populations in North Carolina or the populations may be short-term transients during migratory stop overs. For these species, separate evaluations should be done for breeding and non-breeding populations; transient populations should be included in the non-breeding category. The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a). Scores are assigned based on the estimated total number of adults found in North Carolina.

What is the estimated number of adults within North Carolina?

(a) 1 – 50 individuals
(b) 50 - 250 individuals
(c) 250 - 1,000 individuals
(d) 1,000 - 2,500 individuals
(e) 2,500 - 10,000 individuals
(f) 10,000 - 100,000 individuals
(g) 100,000 - 1,000,000 individuals
(h) >1,000,000 individuals

Metric 6. Range Size in North Carolina. A species may be widespread and secure within its total range, but populations in NC can be imperiled. This metric is intended to help differentiate the degree of imperilment for populations occurring within the state.

Range size is the most restricted area within NC over which the species is distributed and can be measured by the number of counties where the species occurs. Range size can include counties where suitable habitat is considered to be available but surveys have not been recently conducted. If a species has distinct breeding and non-breeding ranges in NC, use the smaller range to determine a score. Some species, particularly freshwater fish species, may be native to certain river basins but are considered nonnative or invasive when introduced to river basins where they would not normally be found. For aquatic species, range size is based on the number of river basins where the species is found and is native.

Assign scores based on the most restricted area (range) within NC over which the species is distributed (number of counties or river basins) or where it is expected to occur based on habitat availability. Historical occurrence is not considered if appropriate habitat is no longer available.

What is the estimated range size for the species in North Carolina?

(a) Terrestrial: 1 – 2 counties – or – Fish, Mussels, Crayfish: 1 river basin
(b) Terrestrial: 3 – 5 counties – or – Fish, Mussels, Crayfish: 2 river basins
(c) Terrestrial: 6 – 10 counties – or – Fish, Mussels, Crayfish: 3 river basins
(d) Terrestrial: 11 – 25 counties – or – Fish, Mussels, Crayfish: 4 – 6 river basins
(e) Terrestrial: 26 – 50 counties – or – Fish, Mussels, Crayfish: 7 – 10 river basins
(f) Terrestrial: More than 50 counties (or statewide) – or –
Fish, Mussels, Crayfish: 11 or more river basins (or statewide)

Metric 7. Population Trend (short-term). Long-term distribution trends for a species may document an overall decline in population; however, more recent data may indicate the population is stable or increasing in North Carolina. The short-term trend (within the last 20 to 40 years) in number of individuals throughout the range in North Carolina will recognize declining NC populations without regard to the species' population status across its entire range. Annual recruitment may not be sufficient to sustain population size or result in population growth because sexually mature adults are not able or have diminished capacity to reproduce, and/or particular age classes have abnormally low survival rates.

Examples of short-term trends that have been noted for conservation concern in the past include population declines of box turtles, long-tailed weasels, and grasshopper sparrows. Other short-term trends can represent population growth (e.g., white-tailed deer, wild turkey) or populations that have stabilized after past declines (e.g. red-cockaded woodpecker). Scores are assigned based on recent trends within the last 20 years that relate to the number of individuals throughout the species' range in NC (Millsap et al. 1990). Base the evaluation on the most restricted area (range) within NC over which the species is distributed (number of counties or river basins or HUC12s) or where it is expected to occur based on habitat availability.

What is the estimated short-term population trend for the species in North Carolina?

(a) Decline of >90%
(b) Decline of 80 - 90%
(c) Decline of 70 - 80%
(d) Decline of 50 - 70%
(e) Decline of 30 - 50%
(f) Decline of 10 - 30%
(g) Relatively Stable (≤ 10% increase or decrease)
(h) Increasing (≥ 10% increase)

Metric 8. Population Concentration. Some species tend to concentrate or aggregate at one or a few locations, especially during breeding seasons or migratory periods. These species may be at greater risk of extinction due to factors or events that can impact an entire population (Millsap et al. 1990). This is most recently evident from the extensive loss of bat populations affected by white-nosed syndrome. A species may congregate or aggregate seasonally or daily at specific locations in North Carolina (e.g., hibernacula, breeding sites, migration focal points, communal roosting, etc.) or may use the habitat year-round. Aquatic species concentrations may be based on occurrence within a single watershed or because the species tends to congregate during spawning. Populations that are so rare they are restricted to small areas can be considered aggregations.

Migratory waterfowl that use Coastal Plain communities for stop-over or wintering habitat and amphibians that breed in isolated pools are examples of populations with life histories that require they concentrate in specific areas. Wood Storks that breed in a few locations and have eggs or young on the nest could be at considerable risk from catastrophic events such as storms or fire. The reproductive success of a Gopher Frog population breeding in one location would be at risk if drought caused the pond or wetland to dry up before young matured. Another example would be the Bog Turtle, which uses discrete wetlands that are often small, concentrated patches within a larger landscape.

Is the species known or suspected to concentrate (or aggregate) in North Carolina?

(a) majority concentrates at single location or stream reach in NC
(b) majority concentrates at 2 – 10 terrestrial locations or stream reaches in NC
(c) majority concentrates at 11 – 25 terrestrial locations or stream reaches in NC
(d) majority concentrates at > 25 terrestrial locations or stream reaches in NC
(e) the species does not congregate or aggregate in NC

Metric 9. Threats. Following a best practice guide recommendation (AFWA 2012), a list of the 11 most likely threats that will impact wildlife are considered in this assessment. The list is based primarily on the definitions and hierarchical classification scheme published by Salafsky et al. (2008) and adopted by the IUCN Conservation Measures Partnership (IUCN 2012), with modifications. The threat of geologic events (volcanic, earthquake, and avalanches) was eliminated based on an expectation these events will have little to no impact at this time on wildlife in North Carolina.

Threats are evaluated based on the anticipated impact to a species and are categorized in Table 1. Each threat description includes a summary of the sub-categories described in Salafsky et al. (2008). For example, managed timber operations can be evaluated under different threat categories depending on the activity.

- **9.2** Agriculture and Aquaculture - wood and pulp plantations, includes silviculture (controlling growth and composition of a planted forest), Christmas tree farms, stands of trees planted for timber or fiber outside of natural forests, often planted with non-native or genetically modified tree species.
- **9.5** Biological Resource Use – harvesting trees and other woody vegetation for timber, fiber, or fuel; clear cutting of hardwoods or natural stands, selective commercial logging, pulp operations, fuel wood collection, charcoal production.
- **9.7** Natural System Modifications - threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems (e.g., tree thinning in parks), often to improve for human welfare.
- **9.8** Invasive and Other Problematic Species and Genes - introduced genetic material includes human-altered or transported organisms or genes such as pesticide resistant crops, hatchery raised fish species, genetically modified insects for biocontrol and other genetically modified species.

Table 1. Conservation Concern Metric 9 Threat Categories.

Threat Category Description	
9.1	**Residential & commercial development** Threats are from human settlements or other nonagricultural land uses with a substantial footprint. Includes housing and urban areas; commercial and industrial areas; and tourism and recreation areas.
9.2	**Agriculture & aquaculture** Threats are from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture. Includes annual and perennial nontimber crops; wood and pulp plantations; and livestock farming and ranching.
9.3	**Energy production & mining** Threats are from production of nonbiological resources, exploring for, developing, and producing petroleum and other liquid hydrocarbons. Includes: oil and gas drilling; mining and quarrying; and renewable energy.

Table 1. Conservation Concern Metric 9 Threat Categories.

Threat Category Description	
9.4	**Transportation & service corridors** Threats are from long, narrow transport corridors and the vehicles that use them including associated wildlife mortality. Includes roads and railroads; utility and service lines; shipping lines; and flight paths.
9.5	**Biological resource use** Threats are from Consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species. Includes hunting and collecting terrestrial animals; gathering terrestrial plants; logging and wood harvesting; and fishing and harvesting aquatic resources.
9.6	**Human intrusions & disturbance** Threats are from human activities that alter, destroy and disturb habitats and species associated with nonconsumptive uses of biological resources. Includes all recreational activities; military exercises; work and other activities (research, vandalism, law enforcement, illegal activities).
9.7	**Natural system modifications** Threats are from actions that convert or degrade habitat in service of "managing" natural or seminatural systems, often to improve human welfare. Includes fire and fire suppression; man-made dams and water management/use; other ecosystem modifications (land reclamation; shoreline hardening; beach reconstruction, snag removal from streams, etc.).
9.8	**Invasive & other problematic species & genes** Threats from non-native and native plants, animals, pathogens/ microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance. Includes invasive non-native/alien species; problematic native species (e.g., beavers); introduced genetic material (e.g., genetically modified insects; hatchery or aquaculture raised species).
9.9	**Pollution** Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources. Includes household sewage and urban waste water; industrial and military effluents; agricultural and forestry effluents; garbage and solid waste; air-borne pollutants; and excess energy (e.g., ambient noise, sonar, cold or hot water from power plants, beach lights, etc.).
9.10	**Climate change & severe weather** Long-term climatic changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation that could wipe out a vulnerable species or habitat. Includes habitat shifting and alteration; droughts; temperature extremes; storms and flooding.
9.11	**Disease & Pathogens** Threats are from bacteria, viruses, protozoa, fungi, and parasites. This category includes exotic or introduced pathogens, prion (non-viral, non-bacterial) disease, and zoonotic diseases. Wildlife species may act as hosts or reservoirs.
Classification of Threats (1 - 10) adopted from Salafsky et al. (2008).	

A threat category for wildlife disease was added and replaces the geologic events (e.g., earthquakes, volcanos) threat described in Salafsky (et al. 2008) because impacts from the spread of infectious disease (e.g., white-nosed syndrome, chronic wasting disease) pose a more significant threat in NC. Threat category 11 (Disease & Pathogens) and the sub-categories for this threat were developed by the 2015 SWAP Revision Ranking Criteria Work Group.

Table 2 describes the scope and severity of impact that each threat is likely to have on wildlife. The scope and severity descriptions are based on the scales outlined in NatureServe's evaluation assessment report (see Tables 6 and 7 in Master et al. 2012). The evaluation uses the Bayesian style analysis shown in Figure 1 to characterize the relationship between scope and severity of the threat. The relationship between scope and severity of the impact is used to assign an overall risk category of very high, high, medium, low, or not a threat.

A score will be calculated for each of the risk categories (scope, severity) and the final threat category score will reflect a calculated average for each of the 11 threats listed in Table 1.

Table 2. Threat Scope and Severity.

THREAT - SCOPE		**THREAT – SEVERITY**	
(a) Pervasive	71-100% Affects all or most of the total population or occurrences	(a) Extreme	71-100% Likely to destroy or eliminate occurrences, or reduce the population
(b) Large	31-70% Affects much of the total population or occurrences	(b) Serious	31-70% Likely to seriously degrade/reduce affected occurrences or habitat or reduce the population
(c) Restricted	11-30% Affects some of the total population or occurrences	(c) Moderate	11-30% Likely to moderately degrade/reduce affected occurrences or habitat or reduce the population
(d) Small	1-10% Affects a small proportion of the total population or occurrences	(d) Slight	1-10% Likely to only slightly degrade/reduce affected occurrences or habitat, or reduce the population
(e) Unknown	There is insufficient information to determine the scope of threats	(e) Unknown	There is insufficient information to determine the severity of threats
(f) None		(f) None	

Figure 1. Scope and severity risk categories used for assigning threat scores.

Severity \ Scope	Pervasive	Large	Restricted	Small	*Unknown*
Extreme	Very High	High	Medium	Low	Medium
Serious	High	High	Medium	Low	Medium
Moderate	Medium	Medium	Low	Low	Low
Slight	Low	Low	Low	Low	Low
Unknown	Medium	Medium	Low	Low	

2. Knowledge Gap Category (Metrics 10 through 14)

One of the obstacles to wildlife conservation and management is often a lack of scientific information about a species or taxa group. A lack of information inhibits the ability to assess a species' risk of extinction based on its distribution, population status, or other metric (IUCN 2012). Changes that occur over long time periods may be hard to detect or the reasons for a species' decline may be difficult to discern when data are insufficient. The lack of long-term data coupled with a need to develop policies that are often short-term responses can contribute to inefficient and ineffective conservation measures (Mace and Purvis 2008). Identifying where information is lacking or where uncertainty exists about the information available will improve decisions made about conservation needs and actions.

The Knowledge Gap category is similar in scope to the 'Research Needed' classification scheme outlined in the IUCN Red List Categories and Criteria (IUCN 2001). This category was developed to identify and prioritize survey, monitoring, and research needs of species in North Carolina. While it could be justified to rank every species at the highest priority there are not sufficient resources to implement and achieve this level of effort. Reviewers should evaluate the needs of each species based on what can be achieved under existing programs or given available resources to develop new programs over the next 10 years. Survey, monitoring, and research data are needed before we can develop conservation actions that benefit species and preserve biodiversity and ecosystem services (Arponen 2012). Conversely, a lack of data can also preclude preventative measures that protect a species or result in failure to restrict actions that will have a negative consequence for a species.

Metric 10. Statewide Distribution (survey priorities). This metric is an assessment of the knowledge base of a species' distribution in North Carolina and represents new and continuing survey needs. As noted in Metric 6 (Range Size in NC), suitable habitat may be available for a species but surveys have not been conducted to determine their presence. The lack of information, both current and historic, about many species affects our ability to design or implement proactive or responsive conservation or management programs. The lack of knowledge about distribution can prevent development of monitoring programs and future conservation recommendations. Scores are assigned based on the availability of data or knowledge about a species' distribution in North Carolina.

What is the level of knowledge about statewide distribution?

(a) Distribution is uncertain, has been extrapolated from a few locations, or knowledge about distribution is limited to general range maps.
(b) Broad range limits or habitat associations are known but local occurrence cannot be predicted accurately.
(c) Distribution can be easily predicted based on known locations or known habitat associations that have been documented throughout the state.

Metric 11. Statewide Population Trends (monitoring priorities). Monitoring programs can be developed after sufficient survey information is collected and statewide distribution is better understood for a species (Millsap et al. 1990). Data collected through population monitoring can be used to evaluate a species' abundance and detect population trends. Global and regional population trends can be different from what is happening in North Carolina and monitoring program data can help detect trends for both declining and increasing populations. Scores are assigned based on the availability of data or knowledge about trends in a species' abundance or population in North Carolina.

What is the status of monitoring statewide population trends?

(a) Not currently monitored.
(b) Populations in discrete locations are monitored.
(c) Monitored statewide but no statistical sensitivity.
(d) Monitored statewide with statistical sensitivity or nearly complete census.

Metric 12. Population Limitations (research priorities). When monitoring program results indicate a species is declining in North Carolina, research is likely needed to understand how and why these populations have changed (IUCN 2001, Millsap et al. 1990). Research programs can be used to investigate when declines may be related to existing or new threats, specific limiting factors, competitive forces, natural processes, or result from multiple factors that are not easily defined.

The intent of this metric is to measure the extent of what is known about factors that affect a species' population or distribution within the state. For example, marsh birds such as rails and bitterns are secretive and hard to observe; this may result in a lack of research data to document their life history in North Carolina. Scores are assigned based on the availability of research data or a body of knowledge about statewide population limitations:

What is the level of knowledge about factors that affect a species' population size or distribution in the state?

(a) There is little to no knowledge about factors affecting a species' population size or distribution.
(b) There is some knowledge, but numerous factors affecting a species' population size or distribution are unknown.
(c) There is general understanding of most factors affecting a species' population or distribution but one or more major factors are unknown.
(d) All major factors affecting a species' population size and distribution are known.

Metric 13. Population Size (survey, monitoring, and research priorities). Some populations are naturally dynamic because of life history strategies (r- selected *versus* k-selected species) while others may fluctuate on a generational, seasonal, or periodic basis depending on various environmental or biodiversity factors. Multiple strategies may be needed to understand the dynamics of a species' population size so this metric will help prioritize the survey, monitoring or research needs to understand a species' population size. Scores are assigned based on the availability of data or knowledge about statewide population size.

What is the level of knowledge about the species' population size in North Carolina?

(a) Population size is uncertain.
(b) Population size is somewhat known but estimates are expected to have high variance.
(c) Population size is somewhat known but estimates are expected to have low to moderate variance.
(d) Population size is well known.

Metric 14. Threats Assessment (research priorities). This metric is to independently prioritize each threat category described in Metric 9 (see Table 1) and listed below for importance as a research topic for the species. The maximum concern could be assigned to all threats but it would be unrealistic to expect adequate resources could be assigned or that it would be feasible to conduct research on all of the topics. A more reasonable approach is to consider how likely each threat category is to contribute to the extinction risk for a species over the next 10-year planning horizon. This time period correlates with the minimum requirement to reevaluate and revise the SWAP on a 10-year cycle.

Metric 14 Threat Categories	
1	Residential & commercial development
2	Agriculture & aquaculture
3	Energy production & mining
4	Transportation & service corridors
5	Biological resource use
6	Human intrusions & disturbance
7	Natural system modifications
8	Invasive & other problematic species & genes
9	Pollution
10	Climate change & severe weather
11	Disease & pathogens

Each of the 11 threat categories is ranked from 1 to 11 for priority as a research subject considering the expected likelihood it will impact the species. The ranking uses "1" as the lowest priority and "11" as the highest priority. For example, pollution may be considered a likely threat to a mussel species and be ranked 8 because some research is already available into the effects of pollution on mussel species. In comparison, biological resource use may be less likely to threaten a mussel species and be ranked 1 to indicate it is a low research priority.

The evaluation will rank the results in categories listed as high (ranking priorities 9 – 11), medium (ranking priorities 5 – 8), or low (ranking priorities 1 – 4). These rankings can be used to assess the need for research.

3. Management Concerns Category

The Wildlife Resources Commission has jurisdictional authority and stewardship responsibility for all wildlife as defined in G.S. 113-129 and other North Carolina statutes. Game animals and sport fish are known to be economically and culturally important in North Carolina, but it is also important to consider their role in wider biodiversity conservation issues (Arponent 2012). Conservation objectives that result in opposing recommendations for game and nongame species can minimize effectiveness of the conservation measures. The Management Concerns category was developed to assist with setting priorities for managing all wildlife species in North Carolina.

Ranking scores developed for this category can be used to identify and highlight population sustainability issues and areas where management action may be needed to mitigate impacts on both game and nongame species. While these ranking scores may be used to inform conservation priorities for game species, such as harvest limits, land management activities, and species management activities, consideration of the scores developed in all three categories of the ranking criteria can help set objectives and inform decisions that support diverse ecosystem services and biodiversity (Arponen 2012).

Metric 15. Disease Vector Concerns. Because of their ability to trigger sudden epidemics and their potential for rapid evolution, infectious agents, parasites, prions, and diseases (pathogens) are important concerns in conservation biology (Altizer et al. 2003, Lafferty and Gerber 2002, Daszak et al. 2000, Harvell et al. 1999). Pathogens can influence ecosystem diversity by impacting genetic diversity and species composition within natural communities (Altizer et al. 2003) and wildlife can be an important host or transmission vector for many different pathogens. In this metric, a vector is defined as a species that transmits a pathogen whether it is among wildlife species, between wildlife and domestic animals, or between wildlife and humans. Examples of pathogens that can be transmitted through wildlife vectors include whirling disease, rabies, canine distemper virus, West Nile virus, and bovine tuberculosis.

When a population is exposed to a pathogen, depending on an interaction of factors involving the host, agent, and environment, the population may be resistant to infection or may become a host. According to Rhyan and Spraker (2010) there are three types of hosts.

- A dead-end host is not able to maintain the infection/disease without an external source
- A spillover host is able to maintain the infection/disease for a time but requires periodic input from another source
- A maintenance host is able to maintain infection without further transmission from another species.

While dead-end and spillover hosts may become disease vectors that transmit infection to other species, the most epidemiologically significant species are maintenance hosts capable of

interspecific disease transmission. Scores are assigned based on whether a species is involved in the maintenance or transmission of pathogens to other wildlife species, domestic animals, or humans.

Does this species pose a threat as a disease vector toward other wildlife species, domestic animals, or humans?

(a) High threat, known to be a maintenance host and a source of pathogen transmission that could have significant and negative impacts to other wildlife, domestic animals, or humans. Management actions may be required to control transmission of the pathogen.
(b) May be a spill-over host, able to maintain the pathogen for a time but requires periodic re-exposure from another source. Impacts to domestic animals and humans may not be significant. Management may not be required if transmission is naturally controlled.
(c) May be a dead-end host, not able to maintain the pathogen without an external source of re-exposure. Management may not be required because transmission may be naturally controlled.
(d) Unknown at this time.
(e) Not a vector.

Metric 16. Invasive Concerns. Natural ecosystem functions reflect the interrelationships of the native species that have evolved in that system; introduced species can change community composition in ways that alter ecosystem function (Gurevitch and Padilla 2004). Often the mechanisms for this change are through competition that displaces native species or the ability of a species to exploit disturbances caused by other sources (e.g., development, pollution) (Scott et al. 2012, Didham et al. 2005). Some introduced species, such as feral swine, nutria, flathead catfish, and Asian clam, can be invasive and have considerable negative effects because of their widespread distribution in the state. Others may not be as widely invasive or they may be native species that have population concentrations that can exert competitive pressures on surrounding communities (e.g., white-tailed deer, resident Canada geese, tundra swans).

For the purposes of this metric, the term invasive species means those species that are either non-native or introduced. In addition, a native species that is highly concentrated to the point that they affect ecosystem function may create impacts from competitive pressures similar to an invasive species and should be considered under this metric.

Quantifying the effects of invasive species can be difficult because there may also be economic gains associated with their intentional introduction or value as a harvestable species (Lapointe et al. 2011). This metric is intended to identify and evaluate whether a species is considered invasive or a pest as related to ecosystem function without regard to the economic effects (positive or

negative) of their presence. Scores are assigned based on whether a species is considered invasive and creates a threat to native populations.

What is the invasive species threat concern for the species?

(a) High threat, known to have a direct impact on native species.
(b) Moderate threat, suspected to have a direct or indirect impact on native species.
(c) Unknown at this time.
(d) Low threat, suspected to have only indirect or minimal impact on native species.
(e) Has no impact on native species.

Metric 17. Economic Influence in NC. Hunting, fishing, wildlife viewing, and other wildlife related activities have an important economic influence in North Carolina. The perception of a species' economic influence, either as a single species or as part of a group of species, can be subjective and difficult to measure because both positive and negative economic influences are associated with the species. The economic influence may be broad and hard to quantify because economic value can be generated in numerous ways and associated with wildlife in general.

For instance, purchasing a hunting license could result in additional expenditures for ammunition, clothing, equipment, and travel expenses for lodging, meals, and fuel, but these purchases may also be related to other recreational activities. An individual bird species may not be associated with economic influence, but bird watching as an industry has an economic influence as demonstrated by revenues that are tracked and reported by several different interest groups. Other economic influences that may be difficult to measure include the ecosystem services provided by wildlife species, such as water filtering by mussel species that contribute to higher surface water quality thereby reducing regulatory requirements associated with impaired waters.

Depredation of crops by a pest species may have a negative economic influence on a landowner or the agriculture industry, but the need to control the pest species creates a positive economic influence on the wildlife damage control industry and may create hunting opportunities. Vehicle collisions with wildlife may be a negative economic influence on vehicle owners and insurance companies, but the need to repair or purchase a replacement vehicle contributes positively to auto towing and repair businesses and dealerships. The presence of a rare or listed species may trigger a requirement for additional environmental coordination and more stringent design standards for a construction project, which may be viewed as a negative economic influence, but the requirements support an environmental and engineering design consulting services industry.

Scores for this metric are assigned based on best professional judgment about the highest level of economic influence of the species (either individually or as part of a group) without regard to whether it is positive, negative, or both.

What is the highest level of economic influence of the species in North Carolina?

(a) This species individually has a high economic influence in NC.
(b) This species is part of a group that collectively has a high economic influence in NC.
(c) This species (individually or as part of a group) has a moderate economic influence in NC.
(d) Unknown.
(e) This species (individually or as part of a group) has a low to no economic influence in NC.

Metric 18. Cultural Value. While somewhat subjective, wildlife species can have important cultural values that may be difficult to measure, such as those associated with watchable wildlife activities, depiction in art, or cultural significance. Knowledge that a species exists and is viable or that future generations will be able to enjoy a species is a value.

Another example would be of the ecosystem services wildlife can provide because they are an integral part of biological communities and ecosystems (e.g., contribution to clean water, provide pest control). They can be culturally significant because of their iconic nature, a value they represent, or their importance to Native American culture. For instance, the Bald Eagle is emblematic of the United States and American freedom as well as an important symbol to most Native American tribes.

Other cultural values are evidenced by festivals and special events that highlight the species (Groundhog Day, East Carolina Wildlife Arts Festival, New Year's Eve Possum Drop). Scores are assigned based on whether there is a cultural value associated with a species. However, a cultural value or significance based solely on the economic value of a species is not the intent of this metric.

What is the cultural value of the species?

(a) Recognized nationally or high cultural values.
(b) Recognized statewide or moderate cultural values.
(c) May be recognized locally or have low cultural values.
(d) None.

Metric 19. Period of Occurrence. Application of management or conservation actions on behalf of a species needs to consider when it occurs in our state. In many cases, land protection measures such as fee-simple acquisition or conservation easement purchases may be the most

likely action for conservation of transient species. Other measures on behalf of short-term migrants and species that infrequently occur in North Carolina may be more difficult to execute and ineffective, either because our state is a short stop-over along a migration route or the species' range does not normally extend into North Carolina.

In addition to land protection measures, other management activities and conservation actions may be planned and implemented more readily for year-round resident species and for migratory species that occur annually for more than short periods. Scores are assigned based on a species' period of occurrence in North Carolina.

When does the species occur in the state?

(a) Permanent resident species.
(b) Resident during breeding season.
(c) Resident during winter or non-breeding season.
(d) Migrates through.
(e) Transient or rare occurrence.

Metric 20. Management for Sustainability and Species Subject to Exploitation. Designing and implementing measures to conserve biological diversity is a complex problem. In addition to the need for scientific data to make informed decisions, the planning process is also subject to prioritization as well as the availability of budget and resources (Arponen 2012, Tear et al. 2005). Given these limitations and constraints, it is important to direct efforts toward those species with the greatest need rather than focusing a majority of resources on species that will persist without conservation efforts (Arponen 2012). Populations that are most at risk of extinction will likely have the greatest management need to maintain the potential for recovery or to preserve genetic diversity of the species.

Conceptually, the sustainable use of wildlife does not lead to the long-term decline of biological diversity and maintains present and future uses of the resource (Weinbaum et al. 2013). Measures can be taken to support sustainable harvests or protect populations, including management for sustainable yields, restoration of habitats to benefit the species, propagation to supplement populations intended for harvest or collection, and targeted law enforcement oversight to detect illegal harvest or take. Species subject to exploitation through harvest are game animals and sport fish. Nongame species may be exploited through permits that allow limited collection for scientific study or for business or personal uses. Illegal taking of animals for exportation, pet trade, or food is another source of exploitation.

Ranking scores are assigned based on the extent to which management efforts are needed for conservation of at-risk populations or to sustain harvestable populations.

Is management needed and are current levels of action sufficient to maintain populations?

(a) Current high management needs and current levels of action are not sufficient to maintain long-term viable populations.
(b) Low to moderate management needs but current levels of action are not sufficient to maintain long-term viable populations.
(c) High management needs and current levels are sufficient to maintain viable populations.
(d) Low to moderate management needs and current levels are sufficient to maintain viable populations.
(e) Management needs are unknown.
(f) Management is not needed.

The following metric response "cheat sheet" consolidates all the evaluation metrics and associated responses into a single resource to use when reviewing taxa team evaluation tables (see Appendices # through #).

Metric Response Cheat Sheet

1. CONSERVATION CONCERN		
Range-Wide Populations		
Metric	**Explanation**	**Response Options**
1. Conservation Protection Status	What is the current conservation protection status? • This information will be provided	(a) Federal and State Listed as Endangered (E) or Threatened (T) (b) State Listed Endangered (E) (c) State Listed Threatened (T) (d) Federal Candidate Species (C) (e) State Special Concern (SC) (f) None
2. Range-Wide Population Size	What is the estimated number of adults within the species' range?	(a) 1 – 50 individuals (b) 50 - 250 individuals (c) 250 - 1,000 individuals (d) 1,000 - 2,500 individuals (e) 2,500 - 10,000 individuals (f) 10,000 - 100,000 individuals (g) 100,000 - 1,000,000 individuals (h) >1,000,000 individuals
3. Range Size (Global, Regional)	What is the estimated area of distribution (range size) in square kilometers? • North Carolina has 125,920 km^2 • The US has about 6.8 million km^2	(a) < 100 km^2 (< about 40 mi^2) (b) 100 - 250 km^2 (c) 250-1,000 km^2 (d) 1,000-5,000 km^2 (e) 5,000-20,000 km^2 (f) 20,000-200,000 km^2 (g) 200,000-2,500,000 km^2 (h) >2,500,000 km^2 (i) Unknown
4. Range-wide Distribution Trend (long-term)	What is the estimated **% change in area occupied** by the species. • Consider the aggregate change over time periods more than 20 years ago. • This can include the time from European settlement up to the last decade.	(a) Decline of >90% (b) Decline of 80 - 90% (c) Decline of 70 - 80% (d) Decline of 50 - 70% (e) Decline of 30 - 50% (f) Decline of 10 - 30% (g) Relatively Stable (≤ 10% increase or decrease) (h) Increasing (≥ 10% increase)

Metric Response Cheat Sheet

1. CONSERVATION CONCERN		
North Carolina Populations		
Metric	**Explanation**	**Response Options**
5. NC Population Size	What is the estimated number of adults occurring in North Carolina?	(a) 1 – 50 individuals (b) 50 - 250 individuals (c) 250 - 1,000 individuals (d) 1,000 - 2,500 individuals (e) 2,500 - 10,000 individuals (f) 10,000 - 100,000 individuals (g) 100,000 - 1,000,000 individuals (h) >1,000,000 individuals
6. NC Range Size (by number of counties or river basins)	What is the estimated range size for the species in North Carolina? • If a species has distinct breeding and non-breeding ranges in NC, use the smaller range to determine a score. • Assign scores based on the most restricted area (range) within NC over which the species is distributed (number of counties or HUCs) or where it is expected to occur based on habitat availability.	(a) Terrestrial: 1 – 2 counties or – Fish, Mussels, Crayfish: 1 river basin (b) Terrestrial: 3 – 5 counties or – Fish, Mussels, Crayfish: 2 river basins (c) Terrestrial: 6 – 10 counties or – Fish, Mussels, Crayfish: 3 river basins (d) Terrestrial: 11 – 25 counties or – Fish, Mussels, Crayfish: 4 to 6 river basins (e) Terrestrial: 26 – 50 counties or – Fish, Mussels, Crayfish: 7 to 10 river basins (f) Terrestrial: More than 50 counties (or statewide) or – Fish, Mussels, Crayfish: 11 or more river basins
7. NC Population Trend (short-term)	What is the estimated short-term **distribution trend** for the species in North Carolina? • Scores are assigned based on recent trends within the last 20 years that relate to the number of individuals throughout the species' range in NC • Assign scores based on the most restricted area (range) within NC over which the species is distributed (number of counties or river basins) or where it is expected to occur based on habitat availability.	(a) Decline of >90% (b) Decline of 80 - 90% (c) Decline of 70 - 80% (d) Decline of 50 - 70% (e) Decline of 30 - 50% (f) Decline of 10 - 30% (g) Relatively Stable (≤ 10% increase or decrease) (h) Increasing (≥ 10% increase)
8. NC Population Concentration	Is the species known or suspected of concentrating (or aggregating) in North Carolina? • Populations that are so rare they are restricted to small areas can be considered aggregations.	(a) majority concentrate at single location or stream reach in NC (b) majority concentrates at 2 – 10 terrestrial locations or stream reaches in NC (c) majority concentrates at 11 – 25 terrestrial locations or stream reaches in NC (d) majority concentrates at > 25 terrestrial locations or stream reaches in NC (e) the species does not congregate or aggregate in NC

Metric Response Cheat Sheet

1. CONSERVATION CONCERN				
Metric 9. Threats to North Carolina Populations				
Population Affected	**Threat**	**SCOPE**	**Threat**	**SEVERITY**
71 – 100 %	a. Pervasive	Affects all or most of the total population or occurrences	a. Extreme	Likely to destroy or eliminate occurrences, or reduce the population
31 – 70 %	b. Large	Affects much of the total population or occurrences	b. Serious	Likely to seriously degrade/reduce affected occurrences or habitat or reduce the population
11 – 30 %	c. Restricted	Affects some of the total population or occurrences	c. Moderate	Likely to moderately degrade/reduce affected occurrences or habitat or reduce the population
1 – 10 %	d. Small	Affects a small proportion of the total population or occurrences	d. Slight	Likely to only slightly degrade/reduce affected occurrences or habitat, or reduce the population
	e. Unknown	There is insufficient information to determine the scope of threats	e. Unknown	There is insufficient information to determine the severity of threats
	f. None		f. None	

Metric 9. Threat Categories	
9.1	**Residential and commercial development**. Threats are from human settlements or other nonagricultural land uses with a substantial footprint. Includes housing and urban areas; commercial and industrial areas; and tourism and recreation areas.
9.2	**Agriculture and aquaculture.** Threats are from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture. Includes annual and perennial nontimber crops; wood and pulp plantations; and livestock farming and ranching.
9.3	**Energy production and mining**. Threats are from production of nonbiological resources, exploring for, developing, and producing petroleum and other liquid hydrocarbons. Includes: oil and gas drilling; mining and quarrying; and renewable energy.
9.4	**Transportation and service corridors.** Threats are from long, narrow transport corridors and the vehicles that use them, including associated wildlife mortality. Includes roads and railroads; utility and service lines; shipping lines; and flight paths.
9.5	**Biological resource use.** Threats are from Consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species. Includes hunting and collecting terrestrial animals; gathering terrestrial plants; logging and wood harvesting; and fishing and harvesting aquatic resources.
9.6	**Human intrusions and disturbance.** Threats are from human activities that alter, destroy and disturb habitats and species associated with nonconsumptive uses of biological resources. Includes all recreational activities; military exercises; work and other activities (research, vandalism, law enforcement, illegal activities).
9.7	**Natural system modifications.** Threats are from actions that convert or degrade habitat in service of "managing" natural or seminatural systems, often to improve human welfare. Includes fire and fire suppression; man-made dams and water management/use; other ecosystem modifications (land reclamation; shoreline hardening; beach reconstruction, snag removal from streams, etc.).
9.8	**Invasive and other problematic species and genes**. Threats from non-native and native plants, animals, pathogens/ microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance. Includes invasive non-native/alien species; problematic native species (e.g., beavers); introduced genetic material (e.g., genetically modified insects; hatchery or aquaculture raised species).
9.9	**Pollution.** Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources. Includes household sewage and urban waste water; industrial and military effluents; agricultural and forestry effluents; garbage and solid waste; air-borne pollutants; and excess energy (e.g., ambient noise, sonar, cold or hot water from power plants, beach lights, etc.).
9.10	**Climate change and severe weather.** Long-term climatic changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation that could wipe out a vulnerable species or habitat. Includes habitat shifting and alteration; droughts; temperature extremes; storms and flooding.

9.11	**Disease and pathogens.** Bacteria, viruses, protozoa, fungi, and parasites. Exotic or introduced pathogens. Prion (non-viral, non-bacterial) disease. Hosts and reservoirs. Zoonotic diseases.

Metric Response Cheat Sheet

2. KNOWLEDGE GAPS		
Metric	**Explanation**	**Response Options**
10. Statewide Distribution (survey priorities)	What is the level of knowledge about statewide distribution?	(a) Distribution is uncertain, has been extrapolated from a few locations, or knowledge about distribution is limited to general range maps. (b) Broad range limits or habitat associations are known but local occurrence cannot be predicted accurately. (c) Distribution can be easily predicted based on known locations or known habitat associations have been documented throughout the state.
11. Statewide Population Trends (monitoring priorities).	What is the status of monitoring statewide population trends?	(a) Not currently monitored. (b) Populations in discrete locations are monitored. (c) Monitored statewide but no statistical sensitivity. (d) Monitored statewide with statistical sensitivity or nearly complete census.
12. Population Limitations (research priorities).	What is the level of knowledge about factors that affect a species' population size or distribution in the state?	(a) There is little to no knowledge about factors affecting a species' population size or distribution. (b) There is some knowledge, but numerous factors affecting a species' population size or distribution are unknown. (c) There is general understanding of most factors affecting a species' population or distribution but one or more major factors are unknown. (d) All major factors affecting a species' population size and distribution are known.
13. Population Size (survey, monitoring, and research priorities).	What is the level of knowledge about the species' population size in North Carolina?	(a) Population size is uncertain. (b) Population size somewhat known but estimates are expected to have high variance. (c) Population size somewhat known but estimates are expected to have low to moderate variance. (d) Population size is well known.
14. Threats (research priorities)	Rank each of the same 11 threat categories evaluated in Metric 9 to prioritize a need for research. • Consider how likely each threat category is to contribute to the extinction risk for a species over the next 10-year planning horizon. • Assign priorities using a scale of 1 to 11 to indicate the need for research as follows: 1- 4 = LOW Priorities 5 – 8 = MEDIUM Priorities 9 - 11 = HIGH Priorities	14.1 Residential & commercial development 14.2 Agriculture & aquaculture 14.3 Energy production & mining 14.4 Transportation & Service corridors 14.5 Biological resource use 14.6 Human intrusions & disturbance 14.7 Natural system modifications 14.8 Invasive & other problematic species & genes 14.9 Pollution 14.10 Climate change & severe weather 14.11 Disease & pathogens

Metric Response Cheat Sheet

3. MANAGEMENT INFORMATION		
Metric	**Explanation**	**Response Options**
15. Disease Vector Concerns.	Does this species pose a threat as a disease vector toward other wildlife species, domestic animals, or humans?	(a) High threat, may be a maintenance host and a source of pathogen transmission that could have significant and negative impacts to other wildlife, domestic animals, or humans. Management actions may be required to control transmission of the pathogen. (b) May be a spill-over host, able to maintain the pathogen for a time but requires periodic re-exposure from another source. Impacts to domestic animals and humans may not be significant. Management may not be required if transmission is naturally controlled. (c) May be a dead-end host, not able to maintain the pathogen without an external source of re-exposure. Management may not be required because transmission may be naturally controlled. (d) Unknown at this time. (e) Not a vector.
16. Invasive Concerns	What is the invasive threat concern for the species? • the term invasive species means those species that are either non-native or introduced • can include native species that have population concentrations that exert competitive pressures on surrounding communities	(a) High threat, known to have a direct impact on native species. (b) Moderate threat, suspected to have a direct or indirect impact on native species. (c) Unknown at this time. (d) Low threat, suspected to have only indirect or minimal impact on native species. (e) Has no impact on native species.
17. Economic Influence in NC	What is the highest level of economic influence of the species in North Carolina? • Scores for this metric are assigned based on best professional judgment about the highest level of economic influence of the species (either individually or as part of a group) without regard to whether it is positive, negative, or both.	(a) This species individually has a high economic influence in NC (b) This species is part of a group that collectively has a high economic influence in NC. (c) This species (individually or as part of a group) has a moderate economic influence in NC. (d) Unknown. (e) This species (individually or as part of a group) has a low to no economic influence in NC.
18. Cultural Value	What is the non-consumptive or cultural value of the species?	(a) Recognized nationally or high cultural values. (b) Recognized statewide or moderate cultural values. (c) May be recognized locally or have low cultural values. (d) None.
19. Period of Occurrence	When does the species occur in the state?	(a) Permanent resident species. (b) Resident during breeding season. (c) Resident during winter or non-breeding season. (d) Migrates through. (e) Transient or rare occurrence.
20. Management for Sustainability and Species Subject to Exploitation	Is management needed and are current levels of action sufficient to maintain populations?	(a) Current high management needs and current levels of action are <u>not</u> sufficient to maintain long-term viable populations. (b) Low to moderate management needs but current levels of action are <u>not</u> sufficient to maintain long-term viable populations. (c) High management needs and current levels are sufficient to maintain viable populations. (d) Low to moderate management needs and current levels are sufficient to maintain viable populations. (e) Management needs are unknown. (f) Management is not needed.

Reference 3-2

White Paper
North Carolina Protected Plant Species Evaluation Methodology

Lesley Starke, NC Plant Conservation Program
Misty Buchanan, NC Natural Heritage Program

The North Carolina Plant Conservation Board (PCP Board) is tasked with listing endangered, threatened, and special concern species of plants under the authority of the North Carolina Plant Protection and Conservation Act of 1979. The PCP Board directs their appointed Scientific Committee to assess the rare native plants of North Carolina to determine which species warrant listing, and in what category.

In 2007-2008, the North Carolina Plant Conservation Program (PCP) and North Carolina Natural Heritage Program (NHP) launched a comprehensive review of North Carolina's rare plants with the goal of identifying and assessing rarity, threats, and trends associated with all the vascular and non-vascular plant taxa tracked by the NHP. The results of this assessment were used by the PCP Scientific Committee during their 2008 review of the North Carolina Protected Plant Species List to determine which species warrant listing and to create a list that is scientifically defensible, consistent, and intuitive.

Following the update to the evaluation methodology in 2008-2009, the Scientific Committee and PCP Board set an intention to update the North Carolina Protected Plant Species List every five years to account for new data records, changes in taxonomy, and increased knowledge of emerging trends and threats. In 2008-2009, PCP staff held meetings with the Scientific Committee and botanists around the state to review criteria and assess rarity, threats, and trends for 900 plant taxa tracked by NHP. Botanists who contributed to these assessments were associated with NHP and PCP as well as US Fish and Wildlife Service, National Park Service, USDA Forest Service, NC Botanical Garden, NC Museum of Natural Sciences, University of North Carolina Herbarium (NCU), North Carolina State University Herbarium (NCSC), Appalachian State University Herbarium (BOON), and private botanists and consultants. A final proposed list was published in the state register for a 60-day public comment period to allow for additional public input. After addressing all comments, a significantly updated North Carolina Protected Plant Species List was published December 1, 2010.

Historically in North Carolina, protected plant lists have emphasized rarity as the primary factor determining extinction risk, while the current assessment methodology recognizes rarity as one of three factors (rarity, trends, and threats). The criteria for this assessment were modified from

guidelines developed by NatureServe (Master et al. 2003) and the World Conservation Union {IUCN) (Standards and Petitions Working Group 2006). The data on rarity, threats, and trends are based on data from NHP as well as expertise from more than two dozen botanists and biologists who participated in the 2008-2009 review. NHP began collecting data in 1975 and has more than 12,911 records of rare plant occurrences (NC NHP 2021). In special cases, taxa specialists were contacted directly for their input into the evaluation process.

Rarity

Measures of rarity consider the number of occurrences in the state and the viability of each occurrence (population size, habitat condition, and landscape context). NHP data are used to determine occurrence viability according to Element Occurrence Ranking Specifications developed by the NatureServe network (NatureServe 2002). The number of occurrences was determined using the NatureServe Element Occurrence Data Standard (NatureServe 2002). For the assessment, taxa were categorized according to the number of populations ranked as having good to excellent estimated viability (A-ranked or excellent viability, B-ranked or good viability, or E-ranked or verified extant) as defined by NatureServe (2002).

Trends

Each taxon was evaluated for short-term trends (including extent of occurrences, number of occurrences, and/or condition of occurrences). Short-term trends refer to fluctuations in the size and viability of an occurrence over the past 10-20 years. The number of populations known or believed to be recently extirpated was determined by NHP data and observations from experts who attended assessment meetings. Each taxon was assigned an alphabetical value based on its ranked trend assessment following the NatureServe Conservation Status Assessment Criteria (Master et al. 2003) (Table 1).

Table 1. Ranked trend categories

Rank	Change	Description
A	> 70% decline	Severely declining (decline in population, range, area occupied, and/or number or condition of occurrences)
B	50 – 70% decline	Very rapidly declining
C	30 – 50% decline	Rapidly declining
D	10 – 30% decline	Declining
E	+/- 10% fluctuation	Stable
F	> 10% increase	Increasing
U	Unknown	Unknown

Threats

NHP data and other observations collected from experts were used to rate up to three threats for each species according to the severity, scope, and immediacy of each threat. If more than three threats exist for a species, the three most severe were used in the threat assessment. This evaluation includes indirect and direct threats that are observed, inferred, or suspected to have an impact on the species. During each threat assessment, the severity, scope, and immediacy were also assigned a ranked value of high, medium, or low as described below. This evaluation also allows for the possibility of species to have no or insignificant threats.

Threat Severity

- High: Loss of species population (all individuals) or destruction of species habitat in area affected, irreversible or requiring long-term recovery (>100 yr).
- Moderate: Major reduction of species population or long-term degradation or reduction of habitat in area affected, requiring 50-100 yr for recovery.
- Low: Low but nontrivial reduction of species population or reversible degradation or reduction of habitat in area affected, with recovery expected in 10-50 yr.
- Insignificant: Essentially no reduction of population or degradation of habitat due to threats, or populations or habitats able to recover quickly (within 10 yr) from minor temporary loss. Note that effects of locally sustainable levels of hunting, fishing, logging, collecting, or other harvest from wild populations are generally considered Insignificant as defined here.

Threat Scope

- High: >60% of total population, occurrences, or area affected.
- Moderate: 20-60% of total population, occurrences, or area affected.
- Low: 5-20% of total population, occurrences, or area affected.
- Insignificant: <5% of total population or area affected.

Threat Immediacy

- High: Threat is operational (happening now) or imminent (within a year).
- Moderate: Threat is likely to be operational within 2-5 yr.
- Low: Threat is likely to be operational within 5-20 yr.
- Insignificant: Threat not likely to be operational within 20 yr.

The values assigned for the severity, scope, and immediacy of each threat were incorporated into a matrix that generated a single, consolidated threat category value for that threat (see Table 2). The highest-ranking threat value among the three threats per species was recorded as the overall threat value for that species. For example, the top three threats recorded for Venus

Flytrap (*Dionaea muscipula*) are Development (Threat value=B), Fire Suppression (Threat value=F), and Poaching (Threat value=E); therefore, the overall threat value for this species is B.

Table 2. Threat matrix with threat parameters and ranked threat values.

Threat Severity	Threat Scope	Threat Immediacy	Value	Threat Description
High	High	High	A	Moderate to severe, imminent threat for most (>60%) of population, occurrences, or area.
High	High	Moderate		
Moderate	High	High		
Moderate	High	Moderate		
High	Moderate	High	B	Moderate to severe, imminent threat for a significant portion (20 – 60%) of population, occurrences o area.
High	Moderate	Moderate		
Moderate	Moderate	High		
Moderate	Moderate	Moderate		
High	High	Low	C	Moderate to severe, non-imminent threat for most of population, occurrences, or area.
Moderate	High	Low		
High	Moderate	Low	D	Moderate to severe, non-imminent threat for a significant proportion of population, occurrences or area.
Moderate	Moderate	Low		
High	Low	High	E	Moderate to severe threat for small proportion of population, occurrences, or area.
High	Low	Moderate		
High	Low	Low		
Moderate	Low	High		
Moderate	Low	Moderate		
Moderate	Low	Low		
Low	High	High	F	Low severity threat for most or significant proportion of population, occurrences, or area.
Low	High	Moderate		
Low	High	Low		
Low	Moderate	High		
Low	Moderate	Moderate		
Low	Moderate	Low		
Low	Low	High	G	Low severity threat for a small proportion of population, occurrences, or area.
Low	Low	Moderate		
Low	Low	Low		

If these values could not be determined for a species, then the species was categorized as data deficient and was not further evaluated for potential listing. One exception to this procedure occurred for species that are limited to 1-2 populations in North Carolina. These species are considered inherently susceptible to stochastic (unpredictable) threats and were therefore assigned to the highest threat category.

Once the rarity, trend, and threats were identified or assigned for a species, the trend and overall threat values were incorporated into a listing criteria matrix associated with the number of viable populations recorded for that species. There are three protected plant listing criteria matrices and each species is assigned to one of them based on the number of populations of good viability recorded in North Carolina for that species: (A) 1-5, (B) 6-19, or (C) >20 populations of good to excellent viability.

The possible outcomes from the listing criteria matrices are Endangered, Threatened, Special Concern- Vulnerable, or Significantly Rare. Only Endangered, Threatened, and Special Concern categories warrant listing on the North Carolina Protected Plant Species List. Species evaluated as Significantly Rare through this process are not added to the state list of protected species; however, they remain on the NHP Rare Plant List which does not have any regulatory authority. The Scientific Committee determined through this process that any tracked species with extant populations in North Carolina, but none of good to excellent viability (A-, B-, or E-ranked populations) would be listed as Endangered. Further, any tracked species with only extirpated (X-), historical (H-), and failed to find (F-) ranked populations in North Carolina would be listed as Special Concern-Historical.

Protected Plant Listing Criteria Matrices

E=Endangered, T=Threatened, SC-V=Special Concern-Vulnerable, SR=Significantly Rare

(A) 1-5 populations of good to excellent viability

		Short-term trend							
		A	**B**	**C**	**D**	**E**	**F**	**U**	**Null**
Threat	**A**	E	E	E	E	E	E	E	E
	B	E	E	E	E	E	T	T	T
	C	E	E	E	T	T	T	T	T
	D	E	E	T	T	T	T	SC-V	SC-V
	E	E	E	T	T	SC-V	SC-V	SC-V	SC-V
	F	E	T	T	SC-V	SC-V	SC-V	SC-V	SC-V
	G	E	T	T	SC-V	SC-V	SC-V	SC-V	SC-V

(B) 6-19 populations of good to excellent viability

		Short-term trend							
		A	**B**	**C**	**D**	**E**	**F**	**U**	**Null**
Threat	**A**	E	E	E	E	T	T	T	T
	B	E	E	T	T	T	SC-V	SC-V	SC-V
	C	E	T	T	SC-V	SC-V	SC-V	SC-V	SC-V
	D	E	T	SC-V	SC-V	SC-V	SC-V	SR	SR
	E	T	T	SC-V	SC-V	SR	SR	SR	SR
	F	T	SC-V	SC-V	SR	SR	SR	SR	SR
	G	T	SC-V	SC-V	SR	SR	SR	SR	SR

(C) >20 populations of good to excellent viability

		Short-term trend							
		A	**B**	**C**	**D**	**E**	**F**	**U**	**Null**
Threat	**A**	T	T	T	T	SC-V	SC-V	SC-V	SC-VT
	B	T	T	SC-V	SC-V	SC-V	SR	SR	SR
	C	T	SC-V	SC-V	SR	SR	SR	SR	SR
	D	T	SC-V	SR	SR	SR	SR	SR	SR
	E	SC-V	SC-V	SR	SR	SR	SR	SR	SR
	F	SC-V	SR	SR	SR	SR	SR	SR	SR
	G	SC-V	SR	SR	SR	SR	SR	SR	SR

Updating the List

The first five-year update was delayed for unforeseen circumstances. In 2017-2019, the PCP staff worked with the Scientific Committee to propose systematic updates the North Carolina Protected Plant Species List. Keeping the evaluation methodology the same, the committee decided that rather than including all 900 tracked plant taxa, only a subset would be evaluated during this and future list updates. First, all newly named or newly documented species (in North Carolina) that were not included in previous review processes would be evaluated. Second, Special Concern-Historical species that had been rediscovered in the state would be evaluated. Lastly, a set of thresholds was established that would identify those species for which NHP had received sufficient updates since the prior evaluation period to justify reevaluation.

These thresholds refer to changes in available data from the time of the previous update to the next update period:

1. Species with <20 viable occurrences and 2+ changes in the number of viable element occurrences,

2. species with >20 viable occurrences and a 20% change in the number of viable occurrences, and

3. species with <6 viable occurrences and 1+ change in the number of viable occurrences.

During the review of this subset of plant species, the trends and threats for each species were reassessed as well. The Scientific Committee may review the trends and threats of any tracked species with the NHP at any time between listing updates and determine with the PCP Board case by case if additional rule changes are warranted in between scheduled updates. The proposed updates resulting from the 2017- 2019 reevaluation process were reviewed during a 60-day public comment period October 1-November 30, 2020. The updates were approved by the PCP Board in January 2021 and published in the NC Administrative Code on May 1, 2021.

In between listing updates, a special emphasis is placed on data deficient species and the intent to update the NHP database records for these species to facilitate listing evaluation. Fifty-seven of the 74 additions to the list between 2010 and 2021 were species that had been data deficient at the time of the 2008- 2009 review, showcasing how important the influx of new data to NHP was to this process.

The most up to date list of protected plants, laws, and regulations can be found at the Plant Conservation Program website, www.ncplant.com. For details on how the assessment was performed or specific results, contact the PCP Program Manager.

Next Steps

This evaluation process reveals where there are knowledge gaps regarding rare plant taxa in North Carolina, in particular with short-term trends that require repeat monitoring data and other site-specific knowledge. Although the 2017- 2019 reevaluation included many previously data-deficient species, we note that nearly half of the tracked species that remain data deficient are non-vascular taxa and are generally less well studied relative to vascular plant taxa. Future evaluations of these taxa will require a dedicated effort to increase the knowledge and data recording within the NHP database and herbaria records. PCP intends to assemble a non-vascular species review task force to facilitate the literature review, data collation, and data evaluation process ahead of future list reevaluations.

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APPENDIX A

PLANT CONSERVATION PROGRAM PROPOSED CHANGES TO LIST OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES

The following list summarizes proposed changes to the PCP list of protected species approved by the PCP Board in January 2021. Species which also occur on the federal list of endangered and threatened species under the Endangered Species Act are marked with two asterisks (**). Comments about the proposed changes should be directed to PCP staff. For the most up to date list of protected plants, laws, regulations, and staff contact information, visit the Plant Conservation Program website, www.ncplant.com.

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(1)	*Acmispon helleri*	Carolina Prairie-trefoil, Carolina Birdfoot-trefoil	T
(2)	*Acrobolbus ciliatus*	a liverwort	SC-V
(3)	*Adiantum capillus-veneris*	Southern Maidenhair Fern (Venus Hair Fern)	T
(4)	*Adlumia fungosa*	Climbing Fumitory	SC-V
(5)	*Aeschynomene virginica*	Sensitive Joint-vetch	T
(6)	*Agalinis virgata*	Branched Gerardia	T
(7)	*Agrostis mertensii*	Arctic Bentgrass	E
(8)	*Aletris lutea*	Yellow Colicroot	T
(9)	*Allium allegheniense*	Allegheny Onion	SC-V
(10)	*Allium keeverae*	Keever's Onion	SC-V
(11)	*Alnus crispa*	Green Alder, Mountain Alder	SC-V
(12)	*Amaranthus pumilus*	Seabeach Amaranth	T
(13)	*Amorpha confusa*	Savanna Indigo-bush	T
(14)	*Amorpha georgiana*	Georgia Indigobush	E
(15)	*Amphicarpum muehlenbergianum*	Blue Maiden-cane, Florida Goober Grass	E
(16)	*Anemone berlandieri*	Southern Anemone, Eastern Prairie Anemone	E
(17)	*Anemone caroliniana*	Prairie Anemone, Carolina Anemone	E
(18)	*Arabis adpressipilis*	Hairy Rockcress, Slender Rockcress	E

	Scientific Name	Common Name	Status
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(19)	*Arethusa bulbosa*	Bog-rose, Dragon's-mouth	E
(20)	*Aristida condensata*	Big Three-awn Grass	T
(21)	*Aristida simpliciflora*	Southern Three-awn Grass	E
(22)	*Arnoglossum ovatum var. lanceolatum*	Savanna Indian-plantain	E
(23)	*Asclepias cinerea*	Carolina Milkweed	SC-H
(24)	*Asclepias pedicellata*	Savannah Milkweed	SC-V
(25)	*Asplenium heteroresiliens*	Carolina Spleenwort	E
(26)	*Asplenium monanthes*	Single-sorus Spleenwort	E
(27)	*Asplenium ruta-muraria var. cryptolepis*	American Wall-rue	SC-V
(28)	*Astragalus michauxii*	Sandhills Milkvetch	SC-V
(29)	*Baccharis glomeruliflora*	Silverling	E
(30)	*Bacopa caroliniana*	Blue Water-hyssop	T
(31)	*Bacopa innominata*	Tropical Water-hyssop	SC-H
(32)	*Balduina atropurpurea*	Purple-disk Honeycomb-head	E
(33)	*Baptisia aberrans*	Eastern Prairie Blue Wild Indigo	E
(34)	*Baptisia alba*	Thick-pod White Wild Indicgo	T
(35)	*Baptisia bracteata*	Creamy Wild Indigo	SC-H
(36)	*Berberis canadensis*	American Barberry	SC-V
(37)	*Betula cordifolia*	Mountain Paper Birch	SC-V
(38)	*Bouteloua curtipendula var. curtipendula*	Sideoats Grama	T
(39)	*Bromus ciliatus*	Fringed Brome	SC-V
(40)	*Buchnera americana*	American Bluehearts	E
(41)	*Buckleya distichophylla*	Piratebush	T
(42)	*Bulbostylis warei*	Ware's Hair Sedge	SC-H
(43)	*Calamagrostis cainii*	Cain's Reedgrass	E
(44)	*Calamagrostis canadensis var. canadensis*	Canada Reedgrass	SC-V

	Scientific Name	Common Name	Status
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(45)	*Calopogon multiflorus*	Many-flowered Grass-pink	E
(46)	*Caltha palustris var. palustris*	Marsh Marigold	E
(47)	*Camassia scilloides*	Wild Hyacinth	T
(48)	*Campanula rotundifolia*	Bluebells	E
(49)	*Campylium stellatum*	Yellow Starry Fen Moss	SC-V
(50)	*Cardamine dissecta*	Dissected Toothwort	SC-V
(51)	*Cardamine longii*	Long's Bittercress	SC-V
(52)	*Cardamine micranthera*	Small-anthered Bittercress	E
(53)	*Carex arctata*	Black Sedge	T
(54)	*Carex argyrantha*	Hay Sedge	T
(55)	*Carex barrattii*	Barratt's Sedge	T
(56)	*Carex basiantha*	Widow Sedge	E
(57)	*Carex buxbaumii*	Brown Bog Sedge	SC-V
(58)	*Carex calcifugens*	Calcium-fleeing Sedge	SC-V
(59)	*Carex careyana*	Carey's Sedge	T
(60)	*Carex cherokeensis*	Cherokee Sedge	T
(61)	*Carex conoidea*	Cone-shaped Sedge	T
(62)	*Carex cristatella*	Crested Sedge; Small-crested Sedge	SC-V
(63)	*Carex eburnea*	Bristle-leaf Sedge	T
(64)	*Carex exilis*	Coastal Sedge	E
(65)	*Carex hormathodes*	Marsh Straw Sedge	T
(66)	*Carex impressinervia*	Ravine Sedge	SC-V
(67)	*Carex jamesii*	James' Sedge	SC-V
(68)	*Carex lasiocarpa var. americana*	Slender Sedge	SC-V
(69)	*Carex lutea*	Golden Sedge	E
(70)	*Carex meadii*	Mead's Sedge	E

	Scientific Name	Common Name	Status
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(71)	*Carex oligocarpa*	Rich-woods Sedge	T
(72)	*Carex oligosperma*	Few-seeded Sedge	E
(73)	*Carex pedunculata var. pedunculata*	Longstalk Sedge	SC-V
(74)	*Carex radfordii*	Radford's Sedge	T
(75)	*Carex reniformis*	Kidney Sedge	T
(76)	*Carex superata*	Limestone Forest Sedge	T
(77)	*Carex tenax*	Wire Sedge	E
(78)	*Carex trichocarpa*	Hairy-fruited Sedge	SC-V
(79)	*Carex trisperma*	Three-seeded Sedge	E
(80)	*Carex utriculata*	Beaked Sedge	E
(81)	*Carex vesicaria*	Inflated Sedge	E
(82)	*Carex vestita*	Velvet Sedge	T
(83)	*Carya laciniosa*	Big Shellbark Hickory	T
(84)	*Carya myristiciformis*	Nutmeg Hickory	E
(85)	*Caulophyllum giganteum*	Northern Blue Cohosh	SC-V
(86)	*Celastrus scandens*	American Bittersweet	E
(87)	*Cetraria arenaria*	Sand-loving Iceland Lichen	SC-V
(88)	*Chamerion angustifolium ssp. circumvagum*	Fireweed	E
(89)	*Chasmanthium nitidum*	Shiny Spanglegrass	T
(90)	*Chelone cuthbertii*	Cuthbert's Turtlehead	SC-V
(91)	*Chenopodiastrum simplex*	Mapleleaf Goosefoot	T
(92)	*Chrysoma pauciflosculosa*	Woody Goldenrod	E
(93)	*Cirsium carolinianum*	Carolina Thistle	E
(94)	*Cirsium lecontei*	Le Conte's Thistle	SC-V
(95)	*Clematis occidentalis var. occidentalis*	Mountain Clematis	SC-V
(96)	*Clinopodium georgianum*	Georgia Calamint	E

	Scientific Name	Common Name	Status
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(97)	*Collinsonia verticillata*	Whorled Horsebalm	T
(98)	*Conioselinum chinense*	Hemlock-parsley	T
(99)	*Coptis trifolia*	Goldthread	T
(100)	*Coreopsis auristulata*	Short-awned Coreopsis	T
(101)	*Corydalis micrantha*	Slender Corydalis	T
(102)	*Coryphopteris simulata*	Bog Fern	E
(103)	*Crataegus pallens*	Pale Hawthorn	T
(104)	*Crinum americanum var. americanum*	Swamp-lily	SC-H
(105)	*Crocanthemum bicknellii*	Plains Sunrose	SC-V
(106)	*Crocanthemum carolinianum*	Carolina Sunrose	E
(107)	*Crocanthemum corymbosum*	Pinebarren Sunrose	T
(108)	*Crocanthemum georgianum*	Georgia Sunrose	E
(109)	*Crocanthemum nashii*	Florida Scrub Sunrose	E
(110)	*Crocanthemum propinquum*	Creeping Sunrose	T
(111)	*Crocanthemum rosmarinifolium*	Rosemary Sunrose	T
(112)	*Croton monanthogynus*	Prairie-tea Croton	E
(113)	*Cyperus dentatus*	Toothed Flatsedge	SC-H
(114)	*Cyperus granitophilus*	Granite Flatsedge	T
(115)	*Cyperus lecontei*	Le Conte's Flatsedge	T
(116)	*Cyperus subsquarrosus*	Small-flowered Halfchaff, Small-flowered Hemicarpha	SC-H
(117)	*Cyperus tetragonus*	Four-angled Flatsedge	SC-V
(118)	*Cyperus virens*	Green Flatsedge	SC-V
(119)	*Cystopteris tennesseensis*	Tennessee Bladder-fern	E
(120)	*Dactylorhiza viridis*	Long-bracted Frog Orchid	T
(121)	*Dalibarda repens*	Robin Runaway	E
(122)	*Delphinium exaltatum*	Tall Larkspur	T

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(123)	*Deschampsia cespitosa ssp. glauca*	Tufted Hairgrass	T
(124)	*Desmodium ochroleucum*	Creamy Tick-trefoil	SC-H
(125)	*Desmodium sessilifolium*	Sessile Tick-trefoil	SC-H
(126)	*Diarrhena americana*	Eastern Beakgrain; Eastern Beakgrass	T
(127)	*Dichanthelium annulum*	Ringed Witchgrass	E
(128)	*Dichanthelium caerulescens*	Blue Witchgrass	T
(129)	*Dichanthelium hirstii*	Hirst Brothers' Witchgrass	E
(130)	*Dichanthelium spretum*	Eaton's Witchgrass	E
(131)	*Dichanthelium strigosum var. glabrescens*	Hairless Witchgrass	T
(132)	*Diervilla rivularis*	Riverbank Bush-honeysuckle	T
(133)	*Dionaea muscipula*	Venus Flytrap	T
(134)	*Diplachne maritima*	Salt-meadow Grass	E
(135)	*Drosera filiformis var. filiffornis*	Threadleaf Sundew	SC-V
(136)	*Echinacea laevigata*	Smooth Coneflower	E
(137)	*Eleocharis cellulosa*	Gulfcoast Spikerush	T
(138)	*Eleocharis elongata*	Florida Spikerush	E
(139)	*Eleocharis parvula*	Dwarf Spikerush	T
(140)	*Eleocharis robbinsii*	Robbins' Spikerush	SC-V
(141)	*Eleocharis vivipara*	Viviparous Spikerush	T
(142)	*Elymus trachycaulus ssp. trachycaulus*	Slender Wheatgrass	T
(143)	*Enemion biternatum*	Eastern Isopyrum; False Rue-anemone	SC-V
(144)	*Epidendrum conopseum*	Green-fly Orchid	T
(145)	*Erigenia bulbosa*	Harbinger-of-spring	T
(146)	*Eriocaulon aquaticum*	Seven-angled Pipewort	SC-V
(147)	*Eriocaulon parkeri*	Estuary Pipewort	T
(148)	*Eriocaulon texense*	Texas Hatpins	E

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(149)	*Eriogonum tomentosum*	Southern Wild-buckwheat	SC-H
(150)	*Erythrina herbacea*	Coralbean	E
(151)	*Eupatorium leptophyllum*	Limesink Dog-fennel	E
(152)	*Eupatorium paludicola*	Bay Boneset	E
(153)	*Euphorbia commutata*	Cliff Spurge	T
(154)	*Euphorbia cordifolia*	Heartleaf Sandmat	T
(155)	*Euphorbia mercurialina*	Cumberland Spurge	SC-V
(156)	*Filipendula rubra*	Queen-of-the-Prairie	E
(157)	*Fimbristylis perpusilla*	Harper's Fimbry	T
(158)	*Gaillardia aestivalis var. aestivalis*	Sandhills Blanket-flower	E
(159)	*Galactia mollis*	Soft Milk-pea	T
(160)	*Gaylussacia brachycera*	Box Huckleberry	E
(161)	*Gaylussacia nana*	Confederate Huckleberry; Dwarf Dangleberry	E
(162)	*Gaylussacia orocola*	Appalachian Dwarf Huckleberry	E
(163)	*Gelsemium rankinii*	Swamp Jessamine	SC-V
(164)	*Gentiana alba*	Pale Gentian; Yellow Gentian	SC-H
(165)	*Gentiana latidens*	Balsalm Mountain Gentian	T
(166)	*Gentianopsis crinita*	Fringed Gentian	E
(167)	*Geum aleppicum*	Yellow Avens	E
(168)	*Geum geniculatum*	Bent Avens	SC-V
(169)	*Geum laciniatum*	Rough Avens	E
(170)	*Geum radiatum*	Spreading Avens	E
(171)	*Gillenia stipulata*	Indian Physic	T
(172)	*Glyceria laxa*	Lax Mannagrass	SC-V
(173)	*Gratiola lutea*	Golden Hedge-hyssop	SC-V
(174)	*Gymnocarpium appalachianum*	Appalachian Oak Fern	T

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(175)	*Gymnoderma lineare*	Rock Gnome Lichen	E
(176)	*Harperella nodosa (Ptilimnium nodosum)*	Harperella	E
(177)	*Helanthium tenellum*	Dwarf Burhead	E
(178)	*Helenium brevifolium*	Littleleaf Sneezeweed	E
(179)	*Helenium vernale*	Spring Sneezeweed	E
(180)	*Helianthus floridanus*	Florida Sunflower	T
(181)	*Helianthus laevigatus*	Smooth Sunflower	SC-V
(182)	*Helianthus occidentalis ssp. occidentalis*	Naked-stem Sunflower	SC-H
(183)	*Helianthus schweinitzii*	Schweinitz's Sunflower	E
(184)	*Helonias bullata*	Swamp-pink	T
(185)	*Hexastylis contracta*	Southern Heartleaf	E
(186)	*Hexastylis naniflora*	Dwarf-flower Heartleaf	T
(187)	*Hibiscus aculeatus*	Comfortroot	T
(188)	*Hottonia inflata*	Featherfoil	SC-V
(189)	*Houstonia montana*	Roan Mountain Bluet	E
(190)	*Hudsonia montana*	Mountain Golden-heather	T
(191)	*Hudsonia tomentosa*	Sand-heather	T
(192)	*Hydrastis canadensis*	Goldenseal	SC-V
(193)	*Hymenocallis occidentalis var. occidentalis*	Hillside Spiderlily, Woodland Spiderlily	SC-H
(194)	*Hymenocallis pygmaea*	Waccamaw River Spiderlily	SC-V
(195)	*Hypericum adpressum*	Bog St. John's-wort	SC-H
(196)	*Hypericum brachyphyllum*	Coastal Plain St. John's-wort	SC-V
(197)	*Hypericum fasciculatum*	Peelbark St. John's-wort	E
(198)	*Hypericum radfordiorum*	Radford"s St. John's-word	SC-V
(199)	*Hypericum suffruticosum*	Pineland St. John's-wort	SC-H
(200)	*Hypotrachyna virginica*	Virginia Loop Lichen	SC-V

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(201)	*Ilex collina*	Long-stalked Holly	SC-V
(202)	*Ipomoea imperati*	Beach Morning-glory	SC-V
(203)	*Ipomoea macrorhiza*	Manroot	SC-H
(204)	*Isoetes microvela*	Thin-wall Quillwort	T
(205)	*Isoetes piedmontana*	Piedmont Quillwort	T
(206)	*Isotria medeoloides*	Small Whorled Pogonia	T
(207)	*Iva microcephala*	Small-headed Marsh Elder	T
(208)	*Jeffersonia diphylla*	Twinleaf	T
(209)	*Juncus articulatus*	Jointleafed Rush	SC-H
(210)	*Juncus caesariensis*	New Jersey Rush	E
(211)	*Juniperus communis var. depressa*	Dwarf Juniper	T
(212)	*Kalmia angustifolia*	Sheep-laurel	T
(213)	*Koeleria spicata (Koeleria spicata ssp. spicata)*	Soft Trisetum, Spike Trisetum	SC-H
(214)	*Lachnocaulon minus*	Brown Bogbutton	T
(215)	*Lechea maritima var. virginica*	Maritime Pinweed	T
(216)	*Lechea torreyi var. congesta*	Torrey's Pinweed	E
(217)	*Lejeunea blomquistii*	A liverwort	SC-V
(218)	*Liatris aspera*	Rough Blazing-star	SC-V
(219)	*Liatris helleri*	Heller's Blazing-star	T
(220)	*Liatris microcephala*	Small-head Blazing-star	SC-V
(221)	*Lilium canadense*	Canada Lily	E
(222)	*Lilium grayi*	Gray's Lily	T
(223)	*Lilium philadelphicum var. philadelphicum*	Wood Lily	E
(224)	*Lilium pyrophilum*	Sandhills Lily	E
(225)	*Limosella australis*	Awl-leaf Mudwort	T
(226)	*Lindera melissifolia*	Pondberry	E

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(227)	*Lindera subcoriacea*	Bog Spicebush	SC-V
(228)	*Linum floridanum var. chrysocarpum*	Yellow-fruited Flax	T
(229)	*Linum sulcatum*	Glade Flax	SC-H
(230)	*Liparis loeselii*	Fen Orchid	E
(231)	*Lithospermum canescens*	Hoary Puccoon	T
(232)	*Litsea aestivalis*	Pondspice	SC-V
(233)	*Lobelia boykinii*	Boykin's Lobelia	E
(234)	*Lochocolea muricata*	A liverwort	SC-V
(235)	*Lophiola aurea*	Golden-crest	E
(236)	*Lophocolea appalachiana*	A liverwort	SC-V
(237)	*Ludwigia lanceolata*	Lanceleaf Seedbox	E
(238)	*Ludwigia linifolia*	Flaxleaf Seedbox	T
(239)	*Ludwigia ravenii*	Raven's Seedbox	E
(240)	*Ludwigia sphaerocarpa*	Globe-fruit Seedbox	E
(241)	*Ludwigia suffruticosa*	Shrubby Seedbox	T
(242)	*Lupinus villosus*	Lady Lupine, Pink Sandhill Lupine	E
(243)	*Lycopodiella inundata*	Bog Clubmoss	E
(244)	*Lysimachia asperulifolia*	Rough-leaf Loosestrife	E
(245)	*Lysimachia fraseri*	Fraser's Loosestrife	E
(246)	*Macbridea caroliniana*	Carolina Birds-in-a-nest, Carolina Bogmint	E
(247)	*Magnolia macrophylla*	Bigleaf Magnolia	SC-V
(248)	*Malaxis spicata*	Florida Adder's-mouth	SC-V
(249)	*Marshallia grandiflora*	Large-flowered Barbara's-buttons	SC-H
(250)	*Marshallia legrandii*	Oak Barrens Barbara's-buttons	E
(251)	*Marshallia trinervia*	Broadleaf Barbara's-buttons	SC-H
(252)	*Melanthium woodii*	Ozark Bunchflower	T

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(253)	*Melica nitens*	Three-flowered Melic	E
(254)	*Menyanthes trifoliata*	Buckbean	T
(255)	*Micranthes pensylvanica*	Swamp Saxifrage	E
(256)	*Mnesithea cylindrica*	Carolina Jointgrass	SC-H
(257)	*Mononeuria groenlandica*	Greenland Sandwort	T
(258)	*Mononeuria paludicola*	Godfrey's Sandwort	E
(259)	*Mononeuria uniflora*	Single-flowered Sandwort	E
(260)	*Moranopteris nimbata*	West Indian Dwarf Polypody	T
(261)	*Muhlenbergia glomerata*	Spiked Muhly	SC-V
(262)	*Muhlenbergia sobolifera*	Rock Muhly	T
(263)	*Muhlenbergia torreyana*	Pinebarren Smokegrass	SC-V
(264)	*Myrica gale*	Sweet Gale	E
(265)	*Myriophyllum laxum*	Loose Water-milfoil	E
(266)	*Myriophyllum tenellum*	Leafless Water-milfoil	E
(267)	*Nabalus albus*	Northern Rattlesnake-root, White Rattlesnakeroot	SC-V
(268)	*Narthecium montanum*	Appalachian Yellow Asphodel	SC-H
(269)	*Oenothera perennis*	Perennial Sundrops	SC-V
(270)	*Oldenlandia boscii*	Bosc's Bluet	T
(271)	*Oligoneuron album*	Prairie Goldenrod, White Prairie-goldenrod	E
(272)	*Oligoneuron jacksonii*	Southeastern Bold Goldenrod	SC-V
(273)	*Oligoneuron rigidum*	Midwestern Bold Goldenrod, Prairie Bold Goldenrod	T
(274)	*Orbexilum macrophyllum*	Bigleaf Scurfpea	SC-H
(275)	*Orbexilum onobrychis*	Lanceleaf Scurfpea	SC-H
(276)	*Orbexilum pedunculatum*	Western Sampson's Snakeroot	E
(277)	*Oreojuncus trifidus*	Highland Rush	T
(278)	*Orthochilus ecristatus*	Spiked Medusa	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(279)	*Pachysandra procumbens*	Allegheny Spurge	E
(280)	*Packera crawfordii*	Bog Ragwort, Crawford's Ragwort	E
(281)	*Packera millefolium*	Blue Ridge Ragwort	SC-V
(282)	*Packera paupercula var. appalachiana*	Appalachian Ragwort	T
(283)	*Packera paupercula var. paupercula*	Balsam Ragwort	SC-V
(284)	*Packera schweinitziana*	New England Ragwort	T
(285)	*Packera serpenticola*	Buck Creek Ragwort	T
(286)	*Palustricodon aparinoides var. aparinoides*	Marsh Bellflower	T
(287)	*Panicum flexile*	Wiry Panic Grass	T
(288)	*Parnassia caroliniana*	Carolina Grass-of-Parnassus	T
(289)	*Parnassia grandifolia*	Bigleaf Grass-of-Parnassus	T
(290)	*Paronychia herniarioides*	Michaux's Whitlow-wort	E
(291)	*Paspalum dissectum*	Mudbank Crown Grass	E
(292)	*Pedicularis lanceolata*	Swamp Lousewort	T
(293)	*Pellaea wrightiana*	Wright's Cliffbrake	E
(294)	*Persicaria hirsuta*	Hairy Smartweed	E
(295)	*Phacelia maculata*	Flatrock Phacelia	E
(296)	*Phegopteris connectilis*	Northern Beech Fern	E
(297)	*Phemeranthus piedmontanus*	Piedmont Rock-pink	E
(298)	*Pinguicula lutea*	Yellow Butterwort	SC-V
(299)	*Pinguicula pumila*	Small Butterwort	T
(300)	*Pityopsis graminifolia*	A Silkgrass	E
(301)	*Plantago cordata*	Heart-leaf Plantain	E
(302)	*Plantago sparsiflora*	Pineland Plantain	T
(303)	*Platanthera herbiola*	Northern Rein Orchid, Tubercled Rein Orchid	SC-V
(304)	*Platanthera integra*	Yellow Fringeless Orchid	T

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(305)	*Platanthera integrilabia*	White Fringeless Orchid	T
(306)	*Platanthera nivea*	Snowy Orchid	E
(307)	*Platanthera peramoena*	Purple Fringeless Orchid	T
(308)	*Platanthera shriveri*	Shriver's Purple Fringed Orchid	E
(309)	*Poa saltuensis*	Old-pasture Bluegrass	T
(310)	*Polemonium reptans var. reptans*	Spreading Jacob's Ladder	T
(311)	*Polygala hookeri*	Hooker's Milkwort	SC-V
(312)	*Polygala senega*	Seneca Snakeroot	SC-V
(313)	*Polygonella articulata*	Coast Jointweed, Northern Wireweed	SC-H
(314)	*Polygonum glaucum*	Seabeach Knotweed	E
(315)	*Ponthieva racemosa*	Shadow-witch	T
(316)	*Portulaca smallii*	Small's Portulaca	T
(317)	*Potamogeton illinoensis*	Illinois Pondweed	E
(318)	*Primula meadia*	Eastern Shooting-star	SC-V
(319)	*Pseudognaphalium helleri*	Heller's Rabbit-tobacco	E
(320)	*Ptilimnium costatum*	Big Bishopweed	T
(321)	*Pyrola elliptica*	Elliptic Shinleaf	T
(322)	*Pyxidanthera brevifolia*	Sandhills Pyxie-moss	T
(323)	*Quercus elliottii*	Running Oak	E
(324)	*Quercus ilicifolia*	Bear Oak	E
(325)	*Quercus minima*	Dwarf Live Oak	E
(326)	*Quercus prinoides*	Dwarf Chinquapin Oak	E
(327)	*Ranunculus ambigens*	Water-plantain Spearwort	SC-H
(328)	*Ranunculus hederaceus*	Ivy Buttercup, Ivy-leaved Water Crowfoot	T
(329)	*Rhexia aristosa*	Awned Meadow-beauty	SC-V
(330)	*Rhodiola rosea*	Roseroot	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(331)	*Rhododendron prinophyllum*	Election Pink	T
(332)	*Rhus michauxii*	Michaux's Sumac	E
(333)	*Rhynchospora crinipes*	Alabama Beaksedge	T
(334)	*Rhynchospora decurrens*	Swamp Forest Beaksedge	T
(335)	*Rhynchospora harperi*	Harper's Beaksedge	SC-V
(336)	*Rhynchospora macra*	Southern White Beaksedge	T
(337)	*Rhynchospora microcarpa*	Southern Beakssedge	T
(338)	*Rhynchospora odorata*	Fragrant Beaksedge	SC-V
(339)	*Rhynchospora pleiantha*	Coastal Beaksedge	T
(340)	*Rhynchospora thornei*	Thorne's Beaksedge	SC-V
(341)	*Rhynchospora tracyi*	Tracy's Beaksedge	T
(342)	*Rubus strigosus*	American Red Raspberry	T
(343)	*Rudbeckia heliopsidis*	Sun-facing Coneflower	E
(344)	*Ruellia ciliosa*	Sandhills Wild-petunia	T
(345)	*Ruellia humilis*	Low Wild-petunia	T
(346)	*Ruellia purshiana*	Pursh's Wild-petunia	SC-V
(347)	*Ruellia strepens*	Limestone Wild Petunia	E
(348)	*Sabal palmetto*	Cabbage Palmetto	T
(349)	*Sabatia kennedyana*	Plymouth Gentian	T
(350)	*Sageretia minutiflora*	Small-flowered Buckthorn	T
(351)	*Sagittaria chapmanii*	Chapman's Arrowhead	T
(352)	*Sagittaria fasciculata*	Bunched Arrowhead	E
(353)	*Sagittaria isoetiformis*	Quillwort Arrowhead	T
(354)	*Sagittaria macrocarpa*	Streamhead Arrowhead, Streamhead Sagittaria	T
(355)	*Sagittaria weatherbiana*	Grassleaf Arrowhead	E
(356)	*Sarracenia jonesii*	Mountain Sweet Pitcherplant	E

	Scientific Name	Common Name	Status
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(357)	*Sarracenia minor var. minor*	Hooded Pitcherplant	E
(358)	*Sarracenia oreophila*	Green Pitcherplant	E
(359)	*Sarracenia purpurea var. montana*	Southern Appalachian Purple Pitcher Plant	E
(360)	*Sceptridium jenmanii*	Alabama Grape-fern	SC-V
(361)	*Schisandra glabra*	Magnolia Vine	T
(362)	*Schwalbea americana*	Chaffseed	E
(363)	*Scirpus flaccidifolius*	Reclining Bulrush	E
(364)	*Scirpus lineatus*	Drooping Bulrush	T
(365)	*Scleria baldwinii*	Baldwin's Nutrush	T
(366)	*Scleria bellii*	Smooth-seeded Hairy Nutrush	E
(367)	*Scleria reticularis*	Netted Nutrush	SC-V
(368)	*Sclerolepis uniflora*	One-flower Hardscale, Sclerolepis	T
(369)	*Scutellaria australis*	Southern Skullcap	E
(370)	*Scutellaria galericulata*	Hooded Skullcap	SC-H
(371)	*Scutellaria leonardii*	Shale-barren Skullcap	E
(372)	*Scutellaria nervosa*	Veined Skullcap	E
(373)	*Sedum pusillum*	Puck's Orpine	E
(374)	*Senecio suaveolens*	Sweet Indian-plantain	E
(375)	*Sesuvium maritimum*	Slender Sea-purslane	E
(376)	*Sesuvium portulacastrum*	Shoreline Sea-purslane	E
(377)	*Seymeria pectinata ssp. pectinata*	Comb Seymeria	SC-H
(378)	*Shortia brevistyla*	Northern Oconee Bells	T
(379)	*Shortia galacifolia*	Southern Oconee Bells	SC-V
(380)	*Sideroxylon tenax*	Tough Bumelia	T
(381)	*Silene ovata*	Mountain Catchfly	SC-V
(382)	*Silphium connatum*	Virginia Cup-plant	SC-V

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(383)	*Silphium perfoliatum*	Common Cup-plant	SC-V
(384)	*Sisyrinchium dichotomum*	White Irisette	E
(385)	*Solidago leavenworthii*	Leavenworth's Goldenrod	E
(386)	*Solidago plumosa*	Yadkin River Goldenrod	T
(387)	*Solidago radula*	Western Rough Goldenrod	E
(388)	*Solidago spithamaea*	Blue Ridge Goldenrod	T
(389)	*Solidago tortifolia*	Twisted-leaf Goldenrod	E
(390)	*Solidago verna*	Spring-flowering Goldenrod	T
(391)	*Solidago villosicarpa*	Carolina Maritime Goldenrod, Coastal Goldenrod	T
(392)	*Sparganium acaule*	Greenfruit Bur-reed	E
(393)	*Spartina pectinata*	Freshwater Cordgrass	T
(394)	*Sphagnum contortum*	Contorted Peatmoss	T
(395)	*Sphagnum warnstorfii*	Fen Peatmoss	SC-V
(396)	*Spigelia marilandica*	Pink-root	T
(397)	*Spiraea corymbosa*	Rock Spirea, Shinyleaf Meadowsweet	E
(398)	*Spiraea virginiana*	Virginia Spiraea	T
(399)	*Spiranthes lacera var. lacera*	Northern Slender Ladies'-tresses	E
(400)	*Spiranthes laciniata*	Lace-lip Ladies'-tresses	SC-V
(401)	*Spiranthes longilabris*	Giant-spiral Orchid	E
(402)	*Spiranthes lucida*	Shining Ladies'-tresses	E
(403)	*Spiranthes ochroleuca*	Yellow Nodding Ladies'-tresses	T
(404)	*Sporobolus heterolepis*	Prairie Dropseed	T
(405)	*Sporobolus teretifolius*	Wireleaf Dropseed	E
(406)	*Sporobolus virginicus*	Saltmarsh Dropseed, Seashore Dropseed	T
(407)	*Stachys appalachiana*	Appalachian Hedge-nettle	E
(408)	*Stachys eplingii*	Epling's Hedge-nettle	E

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(409)	*Stachys matthewsii*	Yadkin Hedge-nettle	E
(410)	*Stenanthium gramineum var. robustum*	Bog Featherbells	E
(411)	*Stenanthium leimanthoides*	Pinebarrens Death-camas	T
(412)	*Stylisma aquatica*	Water Dawnflower	E
(413)	*Stylisma pickeringii var. pickeringii*	Pickering's Dawnflower	SC-V
(414)	*Swida asperifolia*	Eastern Roughleaf Dogwood	E
(415)	*Swida racemosa*	Gray Dogwood	SC-V
(416)	*Symphyotrichum concinnum*	Narrow-leaved Smooth Aster	E
(417)	*Symphyotrichum depauperatum*	Serpentine Aster	E
(418)	*Symphyotrichum georgianum*	Georgia Aster	T
(419)	*Symphyotrichum oblongifolium*	Eastern Aromatic Aster	T
(420)	*Symphyotrichum rhiannon*	Buck Creek Aster	T
(421)	*Synandra hispidula*	Synandra	T
(422)	*Taxus canadensis*	Canada Yew	T
(423)	*Thalictrum cooleyi*	Cooley's Meadowrue	E
(424)	*Thalictrum macrostylum*	Small-leaved Meadowrue	SC-V
(425)	*Thaspium pinnatifidum*	Mountain Thaspium	E
(426)	*Thermopsis fraxinifolia*	Ash-leaved Golden-banner	SC-V
(427)	*Tiedemannia canbyi (Oxypolis canbyi)*	Canby's Dropwort	E
(428)	*Triantha glutinosa*	Sticky Bog Asphodel	SC-V
(429)	*Trichostema brachiatum*	Glade Bluecurls	E
(430)	*Trichostema nesophilum*	Dune Bluecurls	SC-V
(431)	*Tridens ambiguus*	Pineland Triodia	E
(432)	*Tridens chapmanii*	Chapman's Redtop, Chapman's Triodia	SC-V
(433)	*Tridens strictus*	Spike Triodia	SC-H
(434)	*Trientalis borealis*	Northern Starflower	T

	Scientific Name	Common Name	Status
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(435)	*Trifolium carolinianum*	Carolina Clover	SC-H
(436)	*Trifolium reflexum*	Buffalo Clover	T
(437)	*Trillium discolor*	Mottled Trillium, Pale Yellow Trillium	T
(438)	*Trillium flexipes*	Bent White Trillium	T
(439)	*Trillium pusillum var. ozarkanum*	Ozark Least Trillium	E
(440)	*Trillium pusillum var. pusillum*	Carolina Least Trillium	E
(441)	*Trillium pusillum var. virginianum*	Virginia Least Trillium	E
(442)	*Trillium recurvatum*	Prairie Trillium, Recurved Trillium	T
(443)	*Trillium sessile*	Sessile-flowered Trillium	T
(444)	*Trillium simile*	Sweet White Trillium	SC-V
(445)	*Turritis glabra*	Tower Mustard	E
(446)	*Urtica chamaedryoides*	Dwarf Stinging Nettle	T
(447)	*Utricularia cornuta*	Horned Bladderwort	T
(448)	*Utricularia geminiscapa*	Two-flowered Bladderwort	SC-V
(449)	*Utricularia minor*	Small Bladderwort	SC-H
(450)	*Utricularia olivacea*	Dwarf Bladderwort	T
(451)	*Utricularia resupinata*	Northeastern Bladderwort	E
(452)	*Vaccinium macrocarpon*	Cranberry	T
(453)	*Vandenboschia boschiana*	Appalachian Filmy-fern, Appalachian Bristle Fern	E
(454)	*Veronica americana*	American Speedwell	T
(455)	*Waldsteinia lobata*	Lobed Barren-strawberry	E
(456)	*Warea cuneifolia*	Carolina Pineland-cress	E
(457)	*Woodsia ilvensis*	Rusty Cliff Fern	E
(458)	*Xyris floridana*	Florida Yellow-eyed-grass	SC-V
(459)	*Xyris scabrifolia*	Harper's Yellow-eyed-grass, Roughleaf Yellow-eyed-grass	SC-V
(460)	*Xyris serotina*	Acid-swamp Yellow-eyed-grass	SC-H

	Scientific Name	Common Name	Status
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(461)	*Xyris stricta*	Pineland Yellow-eyed-grass	E
(462)	*Zephyranthes simpsonii*	Rain Lily, Florida Atamasco-lily	E

Reference 3-1

White Paper[1]
Wildlife Action Plan 2025 Revision Process
Ranking Criteria for Prioritizing Wildlife Species for Conservation, Research, and Management

Introduction

States use federal funds generated by excise taxes provided by the Wildlife Restoration Act (Pittman-Robertson), Sport Fisheries Restoration Act (Dingell-Johnson), and the Wallop-Breaux Act to support the conservation and management of game fish and wildlife species. The State Wildlife Grants (SWG) program was established by the U.S. Congress to provide funding for nongame species not traditionally covered under most previous federal funding programs. The U.S. Fish & Wildlife Service (USFWS) has oversight of the SWG program and gives states the authority to determine how they identify these priority species.

To qualify for SWG funds, each state is mandated to develop conservation strategies with a focus on Species of Greatest Conservation Need (SGCN). In North Carolina, SGCN have been defined as species that are currently rare or have been designated as at-risk of extinction; those for which we have knowledge deficiencies; and those that have not received adequate conservation attention in the past. In addition to these species for which there is high conservation concern, SGCN may also include those species for which we are unable to determine true status in the state and are therefore a priority for research due to these knowledge gaps.

Species that may be vulnerable to local threats; species of recreational, commercial, or tribal importance that are vulnerable; and those identified as having high management needs or for which there are management concerns are referred to as priority species. Work related to priority species may be funded from sources other than the SWG program; however, eligibility for SWG funds is restricted to SGCN which include conservation concern and knowledge gap priority species.

2015 Species Evaluation Process

In mid-2012, an Association of Fish and Wildlife Agencies (AFWA) Teaming With Wildlife (TWW) work group developed voluntary best-practice guidance for use by states during revision of their SWAPs (AFWA 2012). The AFWA-TWW guidance includes a recommendation to use clearly defined procedures for assessing conservation status and setting conservation priorities (AFWA

[1] Developed by Wildlife Action Plan Revision Technical Team Ranking Criteria Work Group (DH Allen, SK Anderson, JC Fuller, RB Nichols, C Simpson, VF Stancil, KC Weeks)

2012). The guidance suggests using formal ranking methods such as the International Union of Conservation Networks (IUCN) Red List Categories and Criteria (IUCN 2001, 2010), Florida Fish and Wildlife Conservation Commission's taxa ranking system (Millsap et al. 1990), and the NatureServe conservation status evaluation tool (NatureServe 2012a, Master et al. 2012, Faber-Langendoen et al. 2012). Benefits of using more uniform methods include consistency of the information and the ability to share data across organizations (Salafsky et al. 2008).

The 2015 SWAP Revision Technical Team formed a Ranking Criteria Work Group (Work Group) to review and evaluate ranking metrics and prioritization tools. The Work Group was comprised of biologists from the WRC who were tasked with developing recommendations for a method to identify SGCN and to prioritize conservation efforts on behalf of species. In addition to reviewing the evaluation methods recommended by AFWA-TWW (noted above), the Work Group also considered methods described by the Convention on International Trade in Endangered Species (CITES 2011), American Fisheries Society (Deacon et al. 1979, Jelks et al. 2008), Partners In Flight Species Assessment Process (Beissinger et al. 2000), and an assessment of various categorization systems conducted by deGrammont and Cuaron (2006) and Arponen (2012).

Based on the results of their review and assessment, the Work Group members determined that adopting and modifying selected ranking criteria and scoring metrics described by IUCN, Millsap (et al. 1990), and NatureServe combined with original criteria and metrics to capture knowledge gaps and management concerns, would best meet North Carolina's WAP goals for identifying SGCN and prioritizing conservation efforts. The Work Group also adopted the 10-point scoring system as described in Millsap (et al. 1990) because the application of this method is similar to the ranking criteria proposed in this white paper and a statistical analysis conducted by Millsap (et al. 1990) of their results indicated the metrics and scoring system were robust and selection bias was minimal.

Members of the Work Group coordinated with biologists at the NC Natural Heritage Program (NCNHP) to determine whether any information used in the NatureServe evaluation tool would be compatible with the proposed ranking criteria. It was determined this information is not uniformly available across all taxa groups or for species that are not tracked for reporting to NatureServe. However, the NCNHP will provide data for those species which are tracked in their database system. The NCNHP requested that the metrics be designed in a way that ranking criteria data can augment information used in designating state-level rankings as reported by NatureServe. As a result of these coordination efforts, the Work Group adopted answer scales that utilize the NatureServe evaluation tool for several metrics that address conservation concerns (NatureServe 2012a).

Other coordination efforts include a request to faculty and staff of the North Carolina Cooperative Fish & Wildlife Research Unit and staff of the Biodiversity and Spatial Information Center at NC State University (NCSU) for review of the draft ranking criteria metrics. The request asked for comments on whether statistical analysis would be needed to reduce bias in the evaluation process. Their recommendations include

- displaying answer scales without the associated scores as a means of reducing reviewer bias for selecting answers based on a preferred score outcome,
- calculating average scores for each metric that are then totaled within each evaluation category for each species, and
- using a Bayesian style analysis of the relationship between a threat's scope and severity.

Members of the Nongame Wildlife Advisory Committee (NWAC) were also asked to review and provide comments on the proposed ranking criteria. Responses were limited and comments were restricted to minor revisions, which were incorporated into the metrics.

The final species evaluation methodology uses metrics developed by the Work Group and are described in this white paper report. The metrics were developed to be a robust measure of our understanding about the status, trends, and risks of species in the state. The metrics are used to evaluate all wildlife in the amphibian, bird, crayfish, freshwater fish, freshwater mussel, mammal, reptile, and snail taxa groups found in North Carolina. The evaluation results create ranking scores that are used to identify SGCN and other priority species.

2025 Updated Species Evaluation Process

The 2025 SWAP Technical Team convened a Ranking Criteria Work Group to review the evaluation methodology and recommend any updates to improve the process. Overall, we want the evaluation process to be one that can be applied consistently when used by different people and that will facilitate an evaluation and comparison of extinction risks among all species within a taxa group.

To accomplish this goal, the evaluation is divided into three review categories: Conservation Need, Knowledge Gap, and Management Concern. While the Conservation Need metrics consider the status of species both within the state and where they occur elsewhere, the Knowledge Gap and Management Concern metrics consider only the populations found in North Carolina.

Species Ranking

The ranking process is intended to be both transparent and collaborative, with partners representing numerous state and federal agencies, education and research organizations, and private citizens knowledgeable about the taxa contributing to the process. Teams of species experts and research scientists will evaluate the species they are knowledgeable about. Their knowledge may be directly related to their own work or indirectly related through access to current research data. A peer-review analysis of the ranking results will be conducted once the Taxa Teams have completed their reviews.

Each Taxa Team considered whether adjustments to the method for calculating the Conservation Concern ranking scores would be appropriate for the taxon. The Taxa Teams were

allowed to make scoring adjustments. The following adjustments were made for the 2025 evaluation process:

- Amphibians and Reptiles (Herps): Any species listed for federal or state protection is automatically considered a North Carolina responsibility and designated SGCN. The Conservation Concern score calculation was adjusted for the Metric 9 threat assessment responses by multiplying the evaluation score total by 0.25 and adding the adjusted score to the cumulative ranking score.

- Birds: The cumulative total Conservation Concern score was calculated by using the full score for Metrics 1 through 4 and Metric 6 and adjusted scores for remaining metrics in this category. The adjustments included:
    - The Metric 5 score was multiplied by 0.5 in order to address the effect of different life histories and carrying capacities of this diverse taxon.
    - The Metric 7 score was calculated by multiplying the results by 1.5 for each species in order to emphasize the effect of population trends in North Carolina.
    - The Metric 8 score was adjusted by multiplying the results by 0.5 in order to reduce the effect of coastal species life histories.
    - The threat assessment score from Metric 9 was calculated as the maximum score reported from the evaluation categories, with 10 points being the maximum added to the cumulative score.
    - Additionally, the Bird Taxa Team added consideration for species where non-breeding, breeding, or both populations occurred in North Carolina by adding 6, 8, or 10 points (respectively) to the Conservation Concern cumulative total.

  The Bird Taxa Team also decided to include responsibility species as SGCN based on global and North Carolina importance.
    - Global Responsibility Species are those that occur in NC in the periphery of its range and are therefore rare in the state. Metric scores for Global responsibility species would likely be M2=0, M3=0, and M5=9 or 10. While they may be globally secure and abundant they may be at risk to threats that can occur elsewhere within their range, including international landscapes. An example of this type of threat is deforestation in the Amazon forests.
    - North Carolina Responsibility Species are those for which 8% or more of the global breeding or wintering population occurs in NC and the ranking evaluation score is within the 50% percentile.

- Freshwater Fish: The threat assessment score from Metric 9 was calculated as the maximum score reported from the evaluation categories, with 10 points being the maximum added to the cumulative score.

RANKING SCORES

Taxa Team members and peer-reviewers select the appropriate response for each metric as part of the ranking process. Responses are entered into an organized, relational database developed for the WRC's Portal Access to Wildlife Systems (PAWS) web site which is available to reviewers through a secured internet portal. Each metric's answer scale represents empirical responses that reflect the best available knowledge for a species and is used to calculate numeric ranking scores.

Averaged scores and cumulative totals are calculated by the PAWS database for each of the review categories. Taxa Teams will use the Conservation Concern and Knowledge Gap scores in the species prioritization process to identify SGCN. Ranking scores from all three review categories will be used to recommend priority species.

The steps involved in completing the species ranking and scoring process are described below.

1. Each Taxa Team member will review the ranking criteria metrics and evaluate species for which they are knowledgeable. Team member's evaluation selections will be entered into the PAWS Wildlife Action Plan database.
2. The metric responses for each Taxa Team member will be compiled in a preliminary report automatically generated by the PAWS database. Taxa Teams will meet to review responses and for each species where a metric response varies, team members will collaboratively determine whether calculation of an average score based on the range of responses is appropriate or if a single response should be designated.
3. Final ranking scores will be automatically calculated by the PAWS database using the final results of the Taxa Team review.
4. The Taxa Teams will review ranking scores from each of the three review categories and recommend minimum scores for a species to be considered a priority species. Conservation Concern threshold scores will be used to designate SGCN.
5. Peer-reviewers will be asked to review the metric responses and recommendations for SGCN and priority species. Peer-reviewers may submit recommendations to modify the ranking evaluations; modifications must be supported with appropriate citations or references to substantiating research.
6. Taxa Team members will evaluate all recommendations submitted by peer-reviewers to determine merit of the responses. Each Taxa Team will collaboratively determine whether to incorporate recommended changes and modify a species ranking or to retain the original ranking recommendation.
7. Final ranking recommendations made by the Taxa Teams will be published in the SWAP as a list of SGCN and priority species. The final metric responses and ranking criteria scores will be made available in spreadsheet format for public access through a website download.

The Technical Team and Ranking Criteria Work Group recommend that all species be periodically reevaluated using the ranking criteria. Future modifications to the metrics may be required to accommodate new findings and incorporate best practice recommendations.

Conclusion and Acknowledgements

The 2025 SWAP Revision Technical Team formed a Ranking Criteria Work Group to develop recommendations for updates to the species prioritization process. Peer-review and technical input was sought from technical and species experts from the Cooperative Fish and Wildlife Unit at NCSU, NWAC, NCNHP, WRC, and the 2025 WAP Revision Steering Committee. The Work Group reviewed the evaluation methodology and ranking processes and concurred with allowing individual Taxa Teams to adjust the process as needed for taxonomic groups. The Technical Team and Ranking Criteria Work Group recommend using the ranking criteria to evaluate and prioritize species for publication in the 2025 SWAP.

The following list of WRC staff and species experts were involved in review and update of the 2025 SWAP species evaluation methodology.

2025 SWAP Revision Steering Committee	**2025 SWAP Technical Team**
Shannon Deaton, Habitat Conservation Div. Heather Evans, Director's Office Rachael Hoch, Inland Fisheries Div. Lane Sauls, Chair, NWAC Sara Schweitzer, Wildlife Management Div.	Greg Batts, Wildlife Management Div. Chris Dawes, Engineering & Land Management Div. Kevin Dockendorf, Inland Fisheries Div. Luke Etchison, Inland Fisheries Div. Michael Fisk, Inland Fisheries Div. Joe Fuller, Wildlife Management Div. Chris Goudreau, Habitat Conservation Div. Jeff Hall, Wildlife Management Div. Brena Jones, Inland Fisheries Div. Chris Jordan, Engineering & Land Management Div. Philip Lucas, Wildlife Enforcement Div. Jeremy McCargo, Inland Fisheries Div. Allison Medford, Wildlife Management Div. Jake Rash, Inland Fisheries Div. TR Russ, Inland Fisheries Div. Nick Shaver, Engineering & Land Management Div. Vann Stancil, Habitat Conservation Div. Kendrick Weeks, Wildlife Management Div. Brent Wilson, Engineering & Land Management Div.
2025 SWAP Ranking Criteria Work Group	
Greg Batts, Wildlife Management Div. David Cobb, Director's Office Allison Medford, Wildlife Management Div. Lane Sauls, NWAC Vann Stancil, Habitat Conservation Div. Kendrick Weeks, Wildlife Management Div.	

2025 Ranking Criteria Metrics

The ranking criteria metrics were developed to assist with the prioritization process that identifies SGCN. There are three categories: (1) Conservation Needs, (2) Knowledge Gaps, and (3) Management Concerns/Needs. The answer scale of each metric was designed to represent empirical data that can be applied to the different taxa groups. While the Conservation Need metrics consider the status of species both within the state and where they occur elsewhere (range-wide), the Knowledge Gap and Management Concern metrics consider only the occurrences in North Carolina.

1. Conservation Need Category (Metrics 1 through 9)

The Conservation Need category is designed to evaluate biological vulnerability by considering the global and regional status and trends of a species (wherever it occurs) as well as its local status (wherever it occurs in North Carolina). Many species found in North Carolina have resident as well as migratory populations that range across a wide area outside the state. Metrics that consider the global and regional status of a species can help identify those at risk globally or regionally so we can prioritize conservation efforts to secure local populations and protect biodiversity (Wells et al. 2010).

Metric 1. Conservation Protection Status. This metric represents the current federal or state listed status of a species. Both federal and state listing processes use scientifically based evaluation and ranking methods to develop listing recommendations. In many cases, continuing species-specific conservation efforts will be required to maintain viable populations of these species (Scott et al. 2010). It is important that these species remain a priority for conservation efforts statewide. Scores have been assigned based on the highest protection status currently applied to the species.

What is the current conservation protection status?
(This information will be provided and reviewers will not need to select a status.)

(a) Federal and NC State Listed as Endangered (E) or Threatened (T)
(b) NC State Listed Endangered (E)
(c) NC State Listed Threatened (T)
(d) Federal Candidate Species (C)
(e) NC State Special Concern (SC)
(f) None

Global and Regional Status

Metrics 2 through 4 consider global and regional status that in many cases will extend beyond the state's boundaries. If a species is endemic to the state, we consider its range-wide distribution to be North Carolina.

Metric 2. Population Size, Range Wide. For our use in this evaluation, range is considered to be a geographic area represented by the outermost boundaries that encompass where a species occurs naturally (Suring et al. 2011). Efforts to evaluate a species' rarity can include measurements of population size as represented by geographic distribution and abundance (Manne and Pimm 2006, Witte and Torfs 2003, Kunin 1998). Considering population size range-wide provides a comparison of how well a species population is doing overall when compared with populations within the state (Crain et al. 2011). The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a).

This metric recognizes the importance of a species where it has overall low population sizes in other parts of its range (global or regional) but it may have a larger population within the state. For example, populations occurring within NC may be relatively large and represent a significant portion of the total known population for a species which has a range beyond the state and may be experiencing declines or have low numbers in those areas (e.g., Eastern Hellbenders, Sanderlings).

The opposite may also be true – the population size in North Carolina may be small, but the overall population range-wide is large. For example, Eastern Coral Snake populations in North Carolina are considered critically imperiled, but it is common in parts of its range outside the state and does not appear to be significantly threatened elsewhere (NatureServe 2012b). Scores are assigned based on the estimated number of adults throughout the species' range.

What is the estimated number of adults within the species' range?

(a) 1 – 50 individuals
(b) 50 - 250 individuals
(c) 250 - 1,000 individuals
(d) 1,000 - 2,500 individuals
(e) 2,500 - 10,000 individuals
(f) 10,000 - 100,000 individuals
(g) 100,000 - 1,000,000 individuals
(h) >1,000,000 individuals

Metric 3. Range Size. As noted for population size, geographic distribution is an important measurement of a species' rarity (Manne and Pimm 2006, Witte and Torfs 2003, Kunin 1998). Range size considers the most restricted area over which the species is distributed, including areas where it occurs outside NC. The intent in using this metric is to recognize the importance of species with small range sizes because they may be more at risk of extinction (Breininger et al. 1998). Where a species has distinct breeding and nonbreeding ranges (e.g., migratory birds, anadramous fish), the smaller range size should be considered during this evaluation.

The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a). Scores are assigned based on the area over which the taxon is distributed, including watershed size for aquatic species. What is the estimated area of distribution (range size)?

(a) < 100 km^2 (< about 40 mi^2)
(b) 100 - 250 km^2
(c) 250-1,000 km^2
(d) 1,000-5,000 km^2
(e) 5,000-20,000 km^2
(f) 20,000-200,000 km^2 [North Carolina has 125,920 km^2]
(g) 200,000-2,500,000 km^2
(h) >2,500,000 km^2 [The US has about 6.8 million km^2]
(i) Unknown

Metric 4. Distribution Trend (long-term). A species may be more vulnerable to extinction when its range becomes fragmented or too small to support its population. The persistence of rare species may be more limited when habitat impacts are long-term and the fragmentation leads to increased local competition between species for reduced resources (Hanski 2008, Wahlberg et al. 1996, Millsap et al. 1990). This evaluation considers changes to distribution because of habitat loss or change that may have occurred from European settlement up to recent historical periods more than 20 years ago.

For example, the fragmentation and reduction of longleaf pine acreage that began with European settlers using the forests as a resource for military naval stores (Frost 1993) has resulted in significant impacts to distribution of wildlife species adapted to this community type, especially red-cockaded woodpecker and gopher frog. Conversely, some species have adapted and thrive in urban/suburban settings (e.g., raccoon, gray squirrel) and are expanding. Another example is the frequent availability of early successional habitat associated with harvest rotations on timber plantations. This land use practice may allow larger populations of prairie warblers to occur in these areas than would have occurred historically with natural landscapes. The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a). Scores are assigned based on the estimated % change in area occupied by the species.

What is the estimated % change in area occupied by the species?

(a) Decrease of >90%
(b) Decrease of 80 - 90%
(c) Decrease of 70 - 80%
(d) Decrease of 50 - 70%
(e) Decrease of 30 - 50%
(f) Decrease of 10 - 30%
(g) Relatively Stable (≤ 10% increase or decrease)
(h) Increasing (≥ 10% increase)

North Carolina Status

Metrics 5 through 9 focus on a species' status in North Carolina.

Metric 5. Population Size in North Carolina. Species that become rare locally may serve as early warnings for declines over broader areas that are likely to occur for numerous reasons, including threatened habitats or genetic decline (Wells et al. 2010). In addition, North Carolina has numerous endemic species and some have single or small populations found only in discrete locations. Endemic species may have low reproductive potential that will contribute to small populations (Kunin and Gaston 1998). Burlakova et al. (2010) noted there is typically a high rate of endemism associated with freshwater habitats because many species have evolved within small geographic ranges (reviewed in Strayer and Dudgeon 2010).

There are some species (e.g., birds, anadromous fish) with different breeding and non-breeding populations in North Carolina or the populations may be short-term transients during migratory stop overs. For these species, separate evaluations should be done for breeding and non-breeding populations; transient populations should be included in the non-breeding category. The answer scale is adopted from the NatureServe evaluation tool (NatureServe 2012a). Scores are assigned based on the estimated total number of adults found in North Carolina.

What is the estimated number of adults within North Carolina?

(a) 1 – 50 individuals
(b) 50 - 250 individuals
(c) 250 - 1,000 individuals
(d) 1,000 - 2,500 individuals
(e) 2,500 - 10,000 individuals
(f) 10,000 - 100,000 individuals
(g) 100,000 - 1,000,000 individuals
(h) >1,000,000 individuals

Metric 6. Range Size in North Carolina. A species may be widespread and secure within its total range, but populations in NC can be imperiled. This metric is intended to help differentiate the degree of imperilment for populations occurring within the state.

Range size is the most restricted area within NC over which the species is distributed and can be measured by the number of counties where the species occurs. Range size can include counties where suitable habitat is considered to be available but surveys have not been recently conducted. If a species has distinct breeding and non-breeding ranges in NC, use the smaller range to determine a score. Some species, particularly freshwater fish species, may be native to certain river basins but are considered nonnative or invasive when introduced to river basins where they would not normally be found. For aquatic species, range size is based on the number of river basins where the species is found and is native.

Assign scores based on the most restricted area (range) within NC over which the species is distributed (number of counties or river basins) or where it is expected to occur based on habitat availability. Historical occurrence is not considered if appropriate habitat is no longer available.

What is the estimated range size for the species in North Carolina?

(a) Terrestrial: 1 – 2 counties – or – Fish, Mussels, Crayfish: 1 river basin
(b) Terrestrial: 3 – 5 counties – or – Fish, Mussels, Crayfish: 2 river basins
(c) Terrestrial: 6 – 10 counties – or – Fish, Mussels, Crayfish: 3 river basins
(d) Terrestrial: 11 – 25 counties – or – Fish, Mussels, Crayfish: 4 – 6 river basins
(e) Terrestrial: 26 – 50 counties – or – Fish, Mussels, Crayfish: 7 – 10 river basins
(f) Terrestrial: More than 50 counties (or statewide) – or –
Fish, Mussels, Crayfish: 11 or more river basins (or statewide)

Metric 7. Population Trend (short-term). Long-term distribution trends for a species may document an overall decline in population; however, more recent data may indicate the population is stable or increasing in North Carolina. The short-term trend (within the last 20 to 40 years) in number of individuals throughout the range in North Carolina will recognize declining NC populations without regard to the species' population status across its entire range. Annual recruitment may not be sufficient to sustain population size or result in population growth because sexually mature adults are not able or have diminished capacity to reproduce, and/or particular age classes have abnormally low survival rates.

Examples of short-term trends that have been noted for conservation concern in the past include population declines of box turtles, long-tailed weasels, and grasshopper sparrows. Other short-term trends can represent population growth (e.g., white-tailed deer, wild turkey) or populations that have stabilized after past declines (e.g. red-cockaded woodpecker). Scores are assigned based on recent trends within the last 20 years that relate to the number of individuals throughout the species' range in NC (Millsap et al. 1990). Base the evaluation on the most restricted area (range) within NC over which the species is distributed (number of counties or river basins or HUC12s) or where it is expected to occur based on habitat availability.

What is the estimated short-term population trend for the species in North Carolina?

(a) Decline of >90%
(b) Decline of 80 - 90%
(c) Decline of 70 - 80%
(d) Decline of 50 - 70%
(e) Decline of 30 - 50%
(f) Decline of 10 - 30%
(g) Relatively Stable (≤ 10% increase or decrease)
(h) Increasing (≥ 10% increase)

Metric 8. Population Concentration. Some species tend to concentrate or aggregate at one or a few locations, especially during breeding seasons or migratory periods. These species may be at greater risk of extinction due to factors or events that can impact an entire population (Millsap et al. 1990). This is most recently evident from the extensive loss of bat populations affected by white-nosed syndrome. A species may congregate or aggregate seasonally or daily at specific locations in North Carolina (e.g., hibernacula, breeding sites, migration focal points, communal roosting, etc.) or may use the habitat year-round. Aquatic species concentrations may be based on occurrence within a single watershed or because the species tends to congregate during spawning. Populations that are so rare they are restricted to small areas can be considered aggregations.

Migratory waterfowl that use Coastal Plain communities for stop-over or wintering habitat and amphibians that breed in isolated pools are examples of populations with life histories that require they concentrate in specific areas. Wood Storks that breed in a few locations and have eggs or young on the nest could be at considerable risk from catastrophic events such as storms or fire. The reproductive success of a Gopher Frog population breeding in one location would be at risk if drought caused the pond or wetland to dry up before young matured. Another example would be the Bog Turtle, which uses discrete wetlands that are often small, concentrated patches within a larger landscape.

Is the species known or suspected to concentrate (or aggregate) in North Carolina?

(a) majority concentrates at single location or stream reach in NC
(b) majority concentrates at 2 – 10 terrestrial locations or stream reaches in NC
(c) majority concentrates at 11 – 25 terrestrial locations or stream reaches in NC
(d) majority concentrates at > 25 terrestrial locations or stream reaches in NC
(e) the species does not congregate or aggregate in NC

Metric 9. Threats. Following a best practice guide recommendation (AFWA 2012), a list of the 11 most likely threats that will impact wildlife are considered in this assessment. The list is based primarily on the definitions and hierarchical classification scheme published by Salafsky et al. (2008) and adopted by the IUCN Conservation Measures Partnership (IUCN 2012), with modifications. The threat of geologic events (volcanic, earthquake, and avalanches) was eliminated based on an expectation these events will have little to no impact at this time on wildlife in North Carolina.

Threats are evaluated based on the anticipated impact to a species and are categorized in Table 1. Each threat description includes a summary of the sub-categories described in Salafsky et al. (2008). For example, managed timber operations can be evaluated under different threat categories depending on the activity.

- **9.2** Agriculture and Aquaculture - wood and pulp plantations, includes silviculture (controlling growth and composition of a planted forest), Christmas tree farms, stands of trees planted for timber or fiber outside of natural forests, often planted with non-native or genetically modified tree species.
- **9.5** Biological Resource Use – harvesting trees and other woody vegetation for timber, fiber, or fuel; clear cutting of hardwoods or natural stands, selective commercial logging, pulp operations, fuel wood collection, charcoal production.
- **9.7** Natural System Modifications - threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems (e.g., tree thinning in parks), often to improve for human welfare.
- **9.8** Invasive and Other Problematic Species and Genes - introduced genetic material includes human-altered or transported organisms or genes such as pesticide resistant crops, hatchery raised fish species, genetically modified insects for biocontrol and other genetically modified species.

Table 1. Conservation Concern Metric 9 Threat Categories.

Threat Category Description	
9.1	**Residential & commercial development** Threats are from human settlements or other nonagricultural land uses with a substantial footprint. Includes housing and urban areas; commercial and industrial areas; and tourism and recreation areas.
9.2	**Agriculture & aquaculture** Threats are from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture. Includes annual and perennial nontimber crops; wood and pulp plantations; and livestock farming and ranching.
9.3	**Energy production & mining** Threats are from production of nonbiological resources, exploring for, developing, and producing petroleum and other liquid hydrocarbons. Includes: oil and gas drilling; mining and quarrying; and renewable energy.

Table 1. Conservation Concern Metric 9 Threat Categories.

Threat Category Description	
9.4	**Transportation & service corridors** Threats are from long, narrow transport corridors and the vehicles that use them including associated wildlife mortality. Includes roads and railroads; utility and service lines; shipping lines; and flight paths.
9.5	**Biological resource use** Threats are from Consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species. Includes hunting and collecting terrestrial animals; gathering terrestrial plants; logging and wood harvesting; and fishing and harvesting aquatic resources.
9.6	**Human intrusions & disturbance** Threats are from human activities that alter, destroy and disturb habitats and species associated with nonconsumptive uses of biological resources. Includes all recreational activities; military exercises; work and other activities (research, vandalism, law enforcement, illegal activities).
9.7	**Natural system modifications** Threats are from actions that convert or degrade habitat in service of "managing" natural or seminatural systems, often to improve human welfare. Includes fire and fire suppression; man-made dams and water management/use; other ecosystem modifications (land reclamation; shoreline hardening; beach reconstruction, snag removal from streams, etc.).
9.8	**Invasive & other problematic species & genes** Threats from non-native and native plants, animals, pathogens/ microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance. Includes invasive non-native/alien species; problematic native species (e.g., beavers); introduced genetic material (e.g., genetically modified insects; hatchery or aquaculture raised species).
9.9	**Pollution** Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources. Includes household sewage and urban waste water; industrial and military effluents; agricultural and forestry effluents; garbage and solid waste; air-borne pollutants; and excess energy (e.g., ambient noise, sonar, cold or hot water from power plants, beach lights, etc.).
9.10	**Climate change & severe weather** Long-term climatic changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation that could wipe out a vulnerable species or habitat. Includes habitat shifting and alteration; droughts; temperature extremes; storms and flooding.
9.11	**Disease & Pathogens** Threats are from bacteria, viruses, protozoa, fungi, and parasites. This category includes exotic or introduced pathogens, prion (non-viral, non-bacterial) disease, and zoonotic diseases. Wildlife species may act as hosts or reservoirs.
Classification of Threats (1 - 10) adopted from Salafsky et al. (2008).	

A threat category for wildlife disease was added and replaces the geologic events (e.g., earthquakes, volcanos) threat described in Salafsky (et al. 2008) because impacts from the spread of infectious disease (e.g., white-nosed syndrome, chronic wasting disease) pose a more significant threat in NC. Threat category 11 (Disease & Pathogens) and the sub-categories for this threat were developed by the 2015 SWAP Revision Ranking Criteria Work Group.

Table 2 describes the scope and severity of impact that each threat is likely to have on wildlife. The scope and severity descriptions are based on the scales outlined in NatureServe's evaluation assessment report (see Tables 6 and 7 in Master et al. 2012). The evaluation uses the Bayesian style analysis shown in Figure 1 to characterize the relationship between scope and severity of the threat. The relationship between scope and severity of the impact is used to assign an overall risk category of very high, high, medium, low, or not a threat.

A score will be calculated for each of the risk categories (scope, severity) and the final threat category score will reflect a calculated average for each of the 11 threats listed in Table 1.

Table 2. Threat Scope and Severity.

THREAT - SCOPE		**THREAT – SEVERITY**	
(a) Pervasive	71-100% Affects all or most of the total population or occurrences	(a) Extreme	71-100% Likely to destroy or eliminate occurrences, or reduce the population
(b) Large	31-70% Affects much of the total population or occurrences	(b) Serious	31-70% Likely to seriously degrade/reduce affected occurrences or habitat or reduce the population
(c) Restricted	11-30% Affects some of the total population or occurrences	(c) Moderate	11-30% Likely to moderately degrade/reduce affected occurrences or habitat or reduce the population
(d) Small	1-10% Affects a small proportion of the total population or occurrences	(d) Slight	1-10% Likely to only slightly degrade/reduce affected occurrences or habitat, or reduce the population
(e) Unknown	There is insufficient information to determine the scope of threats	(e) Unknown	There is insufficient information to determine the severity of threats
(f) None		(f) None	

Figure 1. Scope and severity risk categories used for assigning threat scores.

Severity \ Scope	Pervasive	Large	Restricted	Small	*Unknown*
Extreme	Very High	High	Medium	Low	Medium
Serious	High	High	Medium	Low	Medium
Moderate	Medium	Medium	Low	Low	Low
Slight	Low	Low	Low	Low	Low
Unknown	Medium	Medium	Low	Low	

2. Knowledge Gap Category (Metrics 10 through 14)

One of the obstacles to wildlife conservation and management is often a lack of scientific information about a species or taxa group. A lack of information inhibits the ability to assess a species' risk of extinction based on its distribution, population status, or other metric (IUCN 2012). Changes that occur over long time periods may be hard to detect or the reasons for a species' decline may be difficult to discern when data are insufficient. The lack of long-term data coupled with a need to develop policies that are often short-term responses can contribute to inefficient and ineffective conservation measures (Mace and Purvis 2008). Identifying where information is lacking or where uncertainty exists about the information available will improve decisions made about conservation needs and actions.

The Knowledge Gap category is similar in scope to the 'Research Needed' classification scheme outlined in the IUCN Red List Categories and Criteria (IUCN 2001). This category was developed to identify and prioritize survey, monitoring, and research needs of species in North Carolina. While it could be justified to rank every species at the highest priority there are not sufficient resources to implement and achieve this level of effort. Reviewers should evaluate the needs of each species based on what can be achieved under existing programs or given available resources to develop new programs over the next 10 years. Survey, monitoring, and research data are needed before we can develop conservation actions that benefit species and preserve biodiversity and ecosystem services (Arponen 2012). Conversely, a lack of data can also preclude preventative measures that protect a species or result in failure to restrict actions that will have a negative consequence for a species.

Metric 10. Statewide Distribution (survey priorities). This metric is an assessment of the knowledge base of a species' distribution in North Carolina and represents new and continuing survey needs. As noted in Metric 6 (Range Size in NC), suitable habitat may be available for a species but surveys have not been conducted to determine their presence. The lack of information, both current and historic, about many species affects our ability to design or implement proactive or responsive conservation or management programs. The lack of knowledge about distribution can prevent development of monitoring programs and future conservation recommendations. Scores are assigned based on the availability of data or knowledge about a species' distribution in North Carolina.

What is the level of knowledge about statewide distribution?

(a) Distribution is uncertain, has been extrapolated from a few locations, or knowledge about distribution is limited to general range maps.
(b) Broad range limits or habitat associations are known but local occurrence cannot be predicted accurately.
(c) Distribution can be easily predicted based on known locations or known habitat associations that have been documented throughout the state.

Metric 11. Statewide Population Trends (monitoring priorities). Monitoring programs can be developed after sufficient survey information is collected and statewide distribution is better understood for a species (Millsap et al. 1990). Data collected through population monitoring can be used to evaluate a species' abundance and detect population trends. Global and regional population trends can be different from what is happening in North Carolina and monitoring program data can help detect trends for both declining and increasing populations. Scores are assigned based on the availability of data or knowledge about trends in a species' abundance or population in North Carolina.

What is the status of monitoring statewide population trends?

(a) Not currently monitored.
(b) Populations in discrete locations are monitored.
(c) Monitored statewide but no statistical sensitivity.
(d) Monitored statewide with statistical sensitivity or nearly complete census.

Metric 12. Population Limitations (research priorities). When monitoring program results indicate a species is declining in North Carolina, research is likely needed to understand how and why these populations have changed (IUCN 2001, Millsap et al. 1990). Research programs can be used to investigate when declines may be related to existing or new threats, specific limiting factors, competitive forces, natural processes, or result from multiple factors that are not easily defined.

The intent of this metric is to measure the extent of what is known about factors that affect a species' population or distribution within the state. For example, marsh birds such as rails and bitterns are secretive and hard to observe; this may result in a lack of research data to document their life history in North Carolina. Scores are assigned based on the availability of research data or a body of knowledge about statewide population limitations:

What is the level of knowledge about factors that affect a species' population size or distribution in the state?

(a) There is little to no knowledge about factors affecting a species' population size or distribution.
(b) There is some knowledge, but numerous factors affecting a species' population size or distribution are unknown.
(c) There is general understanding of most factors affecting a species' population or distribution but one or more major factors are unknown.
(d) All major factors affecting a species' population size and distribution are known.

Metric 13. Population Size (survey, monitoring, and research priorities). Some populations are naturally dynamic because of life history strategies (r- selected *versus* k-selected species) while others may fluctuate on a generational, seasonal, or periodic basis depending on various environmental or biodiversity factors. Multiple strategies may be needed to understand the dynamics of a species' population size so this metric will help prioritize the survey, monitoring or research needs to understand a species' population size. Scores are assigned based on the availability of data or knowledge about statewide population size.

What is the level of knowledge about the species' population size in North Carolina?

(a) Population size is uncertain.
(b) Population size is somewhat known but estimates are expected to have high variance.
(c) Population size is somewhat known but estimates are expected to have low to moderate variance.
(d) Population size is well known.

Metric 14. Threats Assessment (research priorities). This metric is to independently prioritize each threat category described in Metric 9 (see Table 1) and listed below for importance as a research topic for the species. The maximum concern could be assigned to all threats but it would be unrealistic to expect adequate resources could be assigned or that it would be feasible to conduct research on all of the topics. A more reasonable approach is to consider how likely each threat category is to contribute to the extinction risk for a species over the next 10-year planning horizon. This time period correlates with the minimum requirement to reevaluate and revise the SWAP on a 10-year cycle.

Metric 14 Threat Categories	
1	Residential & commercial development
2	Agriculture & aquaculture
3	Energy production & mining
4	Transportation & service corridors
5	Biological resource use
6	Human intrusions & disturbance
7	Natural system modifications
8	Invasive & other problematic species & genes
9	Pollution
10	Climate change & severe weather
11	Disease & pathogens

Each of the 11 threat categories is ranked from 1 to 11 for priority as a research subject considering the expected likelihood it will impact the species. The ranking uses "1" as the lowest priority and "11" as the highest priority. For example, pollution may be considered a likely threat to a mussel species and be ranked 8 because some research is already available into the effects of pollution on mussel species. In comparison, biological resource use may be less likely to threaten a mussel species and be ranked 1 to indicate it is a low research priority.

The evaluation will rank the results in categories listed as high (ranking priorities 9 – 11), medium (ranking priorities 5 – 8), or low (ranking priorities 1 – 4). These rankings can be used to assess the need for research.

3. Management Concerns Category

The Wildlife Resources Commission has jurisdictional authority and stewardship responsibility for all wildlife as defined in G.S. 113-129 and other North Carolina statutes. Game animals and sport fish are known to be economically and culturally important in North Carolina, but it is also important to consider their role in wider biodiversity conservation issues (Arponent 2012). Conservation objectives that result in opposing recommendations for game and nongame species can minimize effectiveness of the conservation measures. The Management Concerns category was developed to assist with setting priorities for managing all wildlife species in North Carolina.

Ranking scores developed for this category can be used to identify and highlight population sustainability issues and areas where management action may be needed to mitigate impacts on both game and nongame species. While these ranking scores may be used to inform conservation priorities for game species, such as harvest limits, land management activities, and species management activities, consideration of the scores developed in all three categories of the ranking criteria can help set objectives and inform decisions that support diverse ecosystem services and biodiversity (Arponen 2012).

Metric 15. Disease Vector Concerns. Because of their ability to trigger sudden epidemics and their potential for rapid evolution, infectious agents, parasites, prions, and diseases (pathogens) are important concerns in conservation biology (Altizer et al. 2003, Lafferty and Gerber 2002, Daszak et al. 2000, Harvell et al. 1999). Pathogens can influence ecosystem diversity by impacting genetic diversity and species composition within natural communities (Altizer et al. 2003) and wildlife can be an important host or transmission vector for many different pathogens. In this metric, a vector is defined as a species that transmits a pathogen whether it is among wildlife species, between wildlife and domestic animals, or between wildlife and humans. Examples of pathogens that can be transmitted through wildlife vectors include whirling disease, rabies, canine distemper virus, West Nile virus, and bovine tuberculosis.

When a population is exposed to a pathogen, depending on an interaction of factors involving the host, agent, and environment, the population may be resistant to infection or may become a host. According to Rhyan and Spraker (2010) there are three types of hosts.

- A dead-end host is not able to maintain the infection/disease without an external source
- A spillover host is able to maintain the infection/disease for a time but requires periodic input from another source
- A maintenance host is able to maintain infection without further transmission from another species.

While dead-end and spillover hosts may become disease vectors that transmit infection to other species, the most epidemiologically significant species are maintenance hosts capable of

interspecific disease transmission. Scores are assigned based on whether a species is involved in the maintenance or transmission of pathogens to other wildlife species, domestic animals, or humans.

Does this species pose a threat as a disease vector toward other wildlife species, domestic animals, or humans?

(a) High threat, known to be a maintenance host and a source of pathogen transmission that could have significant and negative impacts to other wildlife, domestic animals, or humans. Management actions may be required to control transmission of the pathogen.
(b) May be a spill-over host, able to maintain the pathogen for a time but requires periodic re-exposure from another source. Impacts to domestic animals and humans may not be significant. Management may not be required if transmission is naturally controlled.
(c) May be a dead-end host, not able to maintain the pathogen without an external source of re-exposure. Management may not be required because transmission may be naturally controlled.
(d) Unknown at this time.
(e) Not a vector.

Metric 16. Invasive Concerns. Natural ecosystem functions reflect the interrelationships of the native species that have evolved in that system; introduced species can change community composition in ways that alter ecosystem function (Gurevitch and Padilla 2004). Often the mechanisms for this change are through competition that displaces native species or the ability of a species to exploit disturbances caused by other sources (e.g., development, pollution) (Scott et al. 2012, Didham et al. 2005). Some introduced species, such as feral swine, nutria, flathead catfish, and Asian clam, can be invasive and have considerable negative effects because of their widespread distribution in the state. Others may not be as widely invasive or they may be native species that have population concentrations that can exert competitive pressures on surrounding communities (e.g., white-tailed deer, resident Canada geese, tundra swans).

For the purposes of this metric, the term invasive species means those species that are either non-native or introduced. In addition, a native species that is highly concentrated to the point that they affect ecosystem function may create impacts from competitive pressures similar to an invasive species and should be considered under this metric.

Quantifying the effects of invasive species can be difficult because there may also be economic gains associated with their intentional introduction or value as a harvestable species (Lapointe et al. 2011). This metric is intended to identify and evaluate whether a species is considered invasive or a pest as related to ecosystem function without regard to the economic effects (positive or

negative) of their presence. Scores are assigned based on whether a species is considered invasive and creates a threat to native populations.

What is the invasive species threat concern for the species?

(a) High threat, known to have a direct impact on native species.
(b) Moderate threat, suspected to have a direct or indirect impact on native species.
(c) Unknown at this time.
(d) Low threat, suspected to have only indirect or minimal impact on native species.
(e) Has no impact on native species.

Metric 17. Economic Influence in NC. Hunting, fishing, wildlife viewing, and other wildlife related activities have an important economic influence in North Carolina. The perception of a species' economic influence, either as a single species or as part of a group of species, can be subjective and difficult to measure because both positive and negative economic influences are associated with the species. The economic influence may be broad and hard to quantify because economic value can be generated in numerous ways and associated with wildlife in general.

For instance, purchasing a hunting license could result in additional expenditures for ammunition, clothing, equipment, and travel expenses for lodging, meals, and fuel, but these purchases may also be related to other recreational activities. An individual bird species may not be associated with economic influence, but bird watching as an industry has an economic influence as demonstrated by revenues that are tracked and reported by several different interest groups. Other economic influences that may be difficult to measure include the ecosystem services provided by wildlife species, such as water filtering by mussel species that contribute to higher surface water quality thereby reducing regulatory requirements associated with impaired waters.

Depredation of crops by a pest species may have a negative economic influence on a landowner or the agriculture industry, but the need to control the pest species creates a positive economic influence on the wildlife damage control industry and may create hunting opportunities. Vehicle collisions with wildlife may be a negative economic influence on vehicle owners and insurance companies, but the need to repair or purchase a replacement vehicle contributes positively to auto towing and repair businesses and dealerships. The presence of a rare or listed species may trigger a requirement for additional environmental coordination and more stringent design standards for a construction project, which may be viewed as a negative economic influence, but the requirements support an environmental and engineering design consulting services industry.

Scores for this metric are assigned based on best professional judgment about the highest level of economic influence of the species (either individually or as part of a group) without regard to whether it is positive, negative, or both.

What is the highest level of economic influence of the species in North Carolina?

(a) This species individually has a high economic influence in NC.
(b) This species is part of a group that collectively has a high economic influence in NC.
(c) This species (individually or as part of a group) has a moderate economic influence in NC.
(d) Unknown.
(e) This species (individually or as part of a group) has a low to no economic influence in NC.

Metric 18. Cultural Value. While somewhat subjective, wildlife species can have important cultural values that may be difficult to measure, such as those associated with watchable wildlife activities, depiction in art, or cultural significance. Knowledge that a species exists and is viable or that future generations will be able to enjoy a species is a value.

Another example would be of the ecosystem services wildlife can provide because they are an integral part of biological communities and ecosystems (e.g., contribution to clean water, provide pest control). They can be culturally significant because of their iconic nature, a value they represent, or their importance to Native American culture. For instance, the Bald Eagle is emblematic of the United States and American freedom as well as an important symbol to most Native American tribes.

Other cultural values are evidenced by festivals and special events that highlight the species (Groundhog Day, East Carolina Wildlife Arts Festival, New Year's Eve Possum Drop). Scores are assigned based on whether there is a cultural value associated with a species. However, a cultural value or significance based solely on the economic value of a species is not the intent of this metric.

What is the cultural value of the species?

(a) Recognized nationally or high cultural values.
(b) Recognized statewide or moderate cultural values.
(c) May be recognized locally or have low cultural values.
(d) None.

Metric 19. Period of Occurrence. Application of management or conservation actions on behalf of a species needs to consider when it occurs in our state. In many cases, land protection measures such as fee-simple acquisition or conservation easement purchases may be the most

likely action for conservation of transient species. Other measures on behalf of short-term migrants and species that infrequently occur in North Carolina may be more difficult to execute and ineffective, either because our state is a short stop-over along a migration route or the species' range does not normally extend into North Carolina.

In addition to land protection measures, other management activities and conservation actions may be planned and implemented more readily for year-round resident species and for migratory species that occur annually for more than short periods. Scores are assigned based on a species' period of occurrence in North Carolina.

When does the species occur in the state?

(a) Permanent resident species.
(b) Resident during breeding season.
(c) Resident during winter or non-breeding season.
(d) Migrates through.
(e) Transient or rare occurrence.

Metric 20. Management for Sustainability and Species Subject to Exploitation. Designing and implementing measures to conserve biological diversity is a complex problem. In addition to the need for scientific data to make informed decisions, the planning process is also subject to prioritization as well as the availability of budget and resources (Arponen 2012, Tear et al. 2005). Given these limitations and constraints, it is important to direct efforts toward those species with the greatest need rather than focusing a majority of resources on species that will persist without conservation efforts (Arponen 2012). Populations that are most at risk of extinction will likely have the greatest management need to maintain the potential for recovery or to preserve genetic diversity of the species.

Conceptually, the sustainable use of wildlife does not lead to the long-term decline of biological diversity and maintains present and future uses of the resource (Weinbaum et al. 2013). Measures can be taken to support sustainable harvests or protect populations, including management for sustainable yields, restoration of habitats to benefit the species, propagation to supplement populations intended for harvest or collection, and targeted law enforcement oversight to detect illegal harvest or take. Species subject to exploitation through harvest are game animals and sport fish. Nongame species may be exploited through permits that allow limited collection for scientific study or for business or personal uses. Illegal taking of animals for exportation, pet trade, or food is another source of exploitation.

Ranking scores are assigned based on the extent to which management efforts are needed for conservation of at-risk populations or to sustain harvestable populations.

Is management needed and are current levels of action sufficient to maintain populations?

(a) Current high management needs and current levels of action are not sufficient to maintain long-term viable populations.
(b) Low to moderate management needs but current levels of action are not sufficient to maintain long-term viable populations.
(c) High management needs and current levels are sufficient to maintain viable populations.
(d) Low to moderate management needs and current levels are sufficient to maintain viable populations.
(e) Management needs are unknown.
(f) Management is not needed.

The following metric response "cheat sheet" consolidates all the evaluation metrics and associated responses into a single resource to use when reviewing taxa team evaluation tables (see Appendices # through #).

Metric Response Cheat Sheet

1. CONSERVATION CONCERN		
Range-Wide Populations		
Metric	**Explanation**	**Response Options**
1. Conservation Protection Status	What is the current conservation protection status? • This information will be provided	(a) Federal and State Listed as Endangered (E) or Threatened (T) (b) State Listed Endangered (E) (c) State Listed Threatened (T) (d) Federal Candidate Species (C) (e) State Special Concern (SC) (f) None
2. Range-Wide Population Size	What is the estimated number of adults within the species' range?	(a) 1 – 50 individuals (b) 50 - 250 individuals (c) 250 - 1,000 individuals (d) 1,000 - 2,500 individuals (e) 2,500 - 10,000 individuals (f) 10,000 - 100,000 individuals (g) 100,000 - 1,000,000 individuals (h) >1,000,000 individuals
3. Range Size (Global, Regional)	What is the estimated area of distribution (range size) in square kilometers? • North Carolina has 125,920 km^2 • The US has about 6.8 million km^2	(a) < 100 km^2 (< about 40 mi^2) (b) 100 - 250 km^2 (c) 250-1,000 km^2 (d) 1,000-5,000 km^2 (e) 5,000-20,000 km^2 (f) 20,000-200,000 km^2 (g) 200,000-2,500,000 km^2 (h) >2,500,000 km^2 (i) Unknown
4. Range-wide Distribution Trend (long-term)	What is the estimated **% change in area occupied** by the species. • Consider the aggregate change over time periods more than 20 years ago. • This can include the time from European settlement up to the last decade.	(a) Decline of >90% (b) Decline of 80 - 90% (c) Decline of 70 - 80% (d) Decline of 50 - 70% (e) Decline of 30 - 50% (f) Decline of 10 - 30% (g) Relatively Stable (≤ 10% increase or decrease) (h) Increasing (≥ 10% increase)

Metric Response Cheat Sheet

1. CONSERVATION CONCERN		
North Carolina Populations		
Metric	**Explanation**	**Response Options**
5. NC Population Size	What is the estimated number of adults occurring in North Carolina?	(a) 1 – 50 individuals (b) 50 - 250 individuals (c) 250 - 1,000 individuals (d) 1,000 - 2,500 individuals (e) 2,500 - 10,000 individuals (f) 10,000 - 100,000 individuals (g) 100,000 - 1,000,000 individuals (h) >1,000,000 individuals
6. NC Range Size (by number of counties or river basins)	What is the estimated range size for the species in North Carolina? • If a species has distinct breeding and non-breeding ranges in NC, use the smaller range to determine a score. • Assign scores based on the most restricted area (range) within NC over which the species is distributed (number of counties or HUCs) or where it is expected to occur based on habitat availability.	(a) Terrestrial: 1 – 2 counties or – Fish, Mussels, Crayfish: 1 river basin (b) Terrestrial: 3 – 5 counties or – Fish, Mussels, Crayfish: 2 river basins (c) Terrestrial: 6 – 10 counties or – Fish, Mussels, Crayfish: 3 river basins (d) Terrestrial: 11 – 25 counties or – Fish, Mussels, Crayfish: 4 to 6 river basins (e) Terrestrial: 26 – 50 counties or – Fish, Mussels, Crayfish: 7 to 10 river basins (f) Terrestrial: More than 50 counties (or statewide) or – Fish, Mussels, Crayfish: 11 or more river basins
7. NC Population Trend (short-term)	What is the estimated short-term **distribution trend** for the species in North Carolina? • Scores are assigned based on recent trends within the last 20 years that relate to the number of individuals throughout the species' range in NC • Assign scores based on the most restricted area (range) within NC over which the species is distributed (number of counties or river basins) or where it is expected to occur based on habitat availability.	(a) Decline of >90% (b) Decline of 80 - 90% (c) Decline of 70 - 80% (d) Decline of 50 - 70% (e) Decline of 30 - 50% (f) Decline of 10 - 30% (g) Relatively Stable (≤ 10% increase or decrease) (h) Increasing (≥ 10% increase)
8. NC Population Concentration	Is the species known or suspected of concentrating (or aggregating) in North Carolina? • Populations that are so rare they are restricted to small areas can be considered aggregations.	(a) majority concentrate at single location or stream reach in NC (b) majority concentrates at 2 – 10 terrestrial locations or stream reaches in NC (c) majority concentrates at 11 – 25 terrestrial locations or stream reaches in NC (d) majority concentrates at > 25 terrestrial locations or stream reaches in NC (e) the species does not congregate or aggregate in NC

Metric Response Cheat Sheet

1. CONSERVATION CONCERN				
Metric 9. Threats to North Carolina Populations				
Population Affected	**Threat**	**SCOPE**	**Threat**	**SEVERITY**
71 – 100 %	a. Pervasive	Affects all or most of the total population or occurrences	a. Extreme	Likely to destroy or eliminate occurrences, or reduce the population
31 – 70 %	b. Large	Affects much of the total population or occurrences	b. Serious	Likely to seriously degrade/reduce affected occurrences or habitat or reduce the population
11 – 30 %	c. Restricted	Affects some of the total population or occurrences	c. Moderate	Likely to moderately degrade/reduce affected occurrences or habitat or reduce the population
1 – 10 %	d. Small	Affects a small proportion of the total population or occurrences	d. Slight	Likely to only slightly degrade/reduce affected occurrences or habitat, or reduce the population
	e. Unknown	There is insufficient information to determine the scope of threats	e. Unknown	There is insufficient information to determine the severity of threats
	f. None		f. None	

Metric 9. Threat Categories	
9.1	**Residential and commercial development**. Threats are from human settlements or other nonagricultural land uses with a substantial footprint. Includes housing and urban areas; commercial and industrial areas; and tourism and recreation areas.
9.2	**Agriculture and aquaculture.** Threats are from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture. Includes annual and perennial nontimber crops; wood and pulp plantations; and livestock farming and ranching.
9.3	**Energy production and mining**. Threats are from production of nonbiological resources, exploring for, developing, and producing petroleum and other liquid hydrocarbons. Includes: oil and gas drilling; mining and quarrying; and renewable energy.
9.4	**Transportation and service corridors.** Threats are from long, narrow transport corridors and the vehicles that use them, including associated wildlife mortality. Includes roads and railroads; utility and service lines; shipping lines; and flight paths.
9.5	**Biological resource use.** Threats are from Consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also persecution or control of specific species. Includes hunting and collecting terrestrial animals; gathering terrestrial plants; logging and wood harvesting; and fishing and harvesting aquatic resources.
9.6	**Human intrusions and disturbance.** Threats are from human activities that alter, destroy and disturb habitats and species associated with nonconsumptive uses of biological resources. Includes all recreational activities; military exercises; work and other activities (research, vandalism, law enforcement, illegal activities).
9.7	**Natural system modifications.** Threats are from actions that convert or degrade habitat in service of "managing" natural or seminatural systems, often to improve human welfare. Includes fire and fire suppression; man-made dams and water management/use; other ecosystem modifications (land reclamation; shoreline hardening; beach reconstruction, snag removal from streams, etc.).
9.8	**Invasive and other problematic species and genes**. Threats from non-native and native plants, animals, pathogens/ microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance. Includes invasive non-native/alien species; problematic native species (e.g., beavers); introduced genetic material (e.g., genetically modified insects; hatchery or aquaculture raised species).
9.9	**Pollution.** Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources. Includes household sewage and urban waste water; industrial and military effluents; agricultural and forestry effluents; garbage and solid waste; air-borne pollutants; and excess energy (e.g., ambient noise, sonar, cold or hot water from power plants, beach lights, etc.).
9.10	**Climate change and severe weather.** Long-term climatic changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation that could wipe out a vulnerable species or habitat. Includes habitat shifting and alteration; droughts; temperature extremes; storms and flooding.

9.11	**Disease and pathogens.** Bacteria, viruses, protozoa, fungi, and parasites. Exotic or introduced pathogens. Prion (non-viral, non-bacterial) disease. Hosts and reservoirs. Zoonotic diseases.

Metric Response Cheat Sheet

2. KNOWLEDGE GAPS		
Metric	**Explanation**	**Response Options**
10. Statewide Distribution (survey priorities)	What is the level of knowledge about statewide distribution?	(a) Distribution is uncertain, has been extrapolated from a few locations, or knowledge about distribution is limited to general range maps. (b) Broad range limits or habitat associations are known but local occurrence cannot be predicted accurately. (c) Distribution can be easily predicted based on known locations or known habitat associations have been documented throughout the state.
11. Statewide Population Trends (monitoring priorities).	What is the status of monitoring statewide population trends?	(a) Not currently monitored. (b) Populations in discrete locations are monitored. (c) Monitored statewide but no statistical sensitivity. (d) Monitored statewide with statistical sensitivity or nearly complete census.
12. Population Limitations (research priorities).	What is the level of knowledge about factors that affect a species' population size or distribution in the state?	(a) There is little to no knowledge about factors affecting a species' population size or distribution. (b) There is some knowledge, but numerous factors affecting a species' population size or distribution are unknown. (c) There is general understanding of most factors affecting a species' population or distribution but one or more major factors are unknown. (d) All major factors affecting a species' population size and distribution are known.
13. Population Size (survey, monitoring, and research priorities).	What is the level of knowledge about the species' population size in North Carolina?	(a) Population size is uncertain. (b) Population size somewhat known but estimates are expected to have high variance. (c) Population size somewhat known but estimates are expected to have low to moderate variance. (d) Population size is well known.
14. Threats (research priorities)	Rank each of the same 11 threat categories evaluated in Metric 9 to prioritize a need for research. • Consider how likely each threat category is to contribute to the extinction risk for a species over the next 10-year planning horizon. • Assign priorities using a scale of 1 to 11 to indicate the need for research as follows: 1- 4 = LOW Priorities 5 – 8 = MEDIUM Priorities 9 - 11 = HIGH Priorities	14.1 Residential & commercial development 14.2 Agriculture & aquaculture 14.3 Energy production & mining 14.4 Transportation & Service corridors 14.5 Biological resource use 14.6 Human intrusions & disturbance 14.7 Natural system modifications 14.8 Invasive & other problematic species & genes 14.9 Pollution 14.10 Climate change & severe weather 14.11 Disease & pathogens

Metric Response Cheat Sheet

3. MANAGEMENT INFORMATION		
Metric	**Explanation**	**Response Options**
15. Disease Vector Concerns.	Does this species pose a threat as a disease vector toward other wildlife species, domestic animals, or humans?	(a) High threat, may be a maintenance host and a source of pathogen transmission that could have significant and negative impacts to other wildlife, domestic animals, or humans. Management actions may be required to control transmission of the pathogen. (b) May be a spill-over host, able to maintain the pathogen for a time but requires periodic re-exposure from another source. Impacts to domestic animals and humans may not be significant. Management may not be required if transmission is naturally controlled. (c) May be a dead-end host, not able to maintain the pathogen without an external source of re-exposure. Management may not be required because transmission may be naturally controlled. (d) Unknown at this time. (e) Not a vector.
16. Invasive Concerns	What is the invasive threat concern for the species? • the term invasive species means those species that are either non-native or introduced • can include native species that have population concentrations that exert competitive pressures on surrounding communities	(a) High threat, known to have a direct impact on native species. (b) Moderate threat, suspected to have a direct or indirect impact on native species. (c) Unknown at this time. (d) Low threat, suspected to have only indirect or minimal impact on native species. (e) Has no impact on native species.
17. Economic Influence in NC	What is the highest level of economic influence of the species in North Carolina? • Scores for this metric are assigned based on best professional judgment about the highest level of economic influence of the species (either individually or as part of a group) without regard to whether it is positive, negative, or both.	(a) This species individually has a high economic influence in NC (b) This species is part of a group that collectively has a high economic influence in NC. (c) This species (individually or as part of a group) has a moderate economic influence in NC. (d) Unknown. (e) This species (individually or as part of a group) has a low to no economic influence in NC.
18. Cultural Value	What is the non-consumptive or cultural value of the species?	(a) Recognized nationally or high cultural values. (b) Recognized statewide or moderate cultural values. (c) May be recognized locally or have low cultural values. (d) None.
19. Period of Occurrence	When does the species occur in the state?	(a) Permanent resident species. (b) Resident during breeding season. (c) Resident during winter or non-breeding season. (d) Migrates through. (e) Transient or rare occurrence.
20. Management for Sustainability and Species Subject to Exploitation	Is management needed and are current levels of action sufficient to maintain populations?	(a) Current high management needs and current levels of action are <u>not</u> sufficient to maintain long-term viable populations. (b) Low to moderate management needs but current levels of action are <u>not</u> sufficient to maintain long-term viable populations. (c) High management needs and current levels are sufficient to maintain viable populations. (d) Low to moderate management needs and current levels are sufficient to maintain viable populations. (e) Management needs are unknown. (f) Management is not needed.

Reference 3-2

White Paper
North Carolina Protected Plant Species Evaluation Methodology

Lesley Starke, NC Plant Conservation Program
Misty Buchanan, NC Natural Heritage Program

The North Carolina Plant Conservation Board (PCP Board) is tasked with listing endangered, threatened, and special concern species of plants under the authority of the North Carolina Plant Protection and Conservation Act of 1979. The PCP Board directs their appointed Scientific Committee to assess the rare native plants of North Carolina to determine which species warrant listing, and in what category.

In 2007-2008, the North Carolina Plant Conservation Program (PCP) and North Carolina Natural Heritage Program (NHP) launched a comprehensive review of North Carolina's rare plants with the goal of identifying and assessing rarity, threats, and trends associated with all the vascular and non-vascular plant taxa tracked by the NHP. The results of this assessment were used by the PCP Scientific Committee during their 2008 review of the North Carolina Protected Plant Species List to determine which species warrant listing and to create a list that is scientifically defensible, consistent, and intuitive.

Following the update to the evaluation methodology in 2008-2009, the Scientific Committee and PCP Board set an intention to update the North Carolina Protected Plant Species List every five years to account for new data records, changes in taxonomy, and increased knowledge of emerging trends and threats. In 2008-2009, PCP staff held meetings with the Scientific Committee and botanists around the state to review criteria and assess rarity, threats, and trends for 900 plant taxa tracked by NHP. Botanists who contributed to these assessments were associated with NHP and PCP as well as US Fish and Wildlife Service, National Park Service, USDA Forest Service, NC Botanical Garden, NC Museum of Natural Sciences, University of North Carolina Herbarium (NCU), North Carolina State University Herbarium (NCSC), Appalachian State University Herbarium (BOON), and private botanists and consultants. A final proposed list was published in the state register for a 60-day public comment period to allow for additional public input. After addressing all comments, a significantly updated North Carolina Protected Plant Species List was published December 1, 2010.

Historically in North Carolina, protected plant lists have emphasized rarity as the primary factor determining extinction risk, while the current assessment methodology recognizes rarity as one of three factors (rarity, trends, and threats). The criteria for this assessment were modified from

guidelines developed by NatureServe (Master et al. 2003) and the World Conservation Union {IUCN) (Standards and Petitions Working Group 2006). The data on rarity, threats, and trends are based on data from NHP as well as expertise from more than two dozen botanists and biologists who participated in the 2008-2009 review. NHP began collecting data in 1975 and has more than 12,911 records of rare plant occurrences (NC NHP 2021). In special cases, taxa specialists were contacted directly for their input into the evaluation process.

Rarity

Measures of rarity consider the number of occurrences in the state and the viability of each occurrence (population size, habitat condition, and landscape context). NHP data are used to determine occurrence viability according to Element Occurrence Ranking Specifications developed by the NatureServe network (NatureServe 2002). The number of occurrences was determined using the NatureServe Element Occurrence Data Standard (NatureServe 2002). For the assessment, taxa were categorized according to the number of populations ranked as having good to excellent estimated viability (A-ranked or excellent viability, B-ranked or good viability, or E-ranked or verified extant) as defined by NatureServe (2002).

Trends

Each taxon was evaluated for short-term trends (including extent of occurrences, number of occurrences, and/or condition of occurrences). Short-term trends refer to fluctuations in the size and viability of an occurrence over the past 10-20 years. The number of populations known or believed to be recently extirpated was determined by NHP data and observations from experts who attended assessment meetings. Each taxon was assigned an alphabetical value based on its ranked trend assessment following the NatureServe Conservation Status Assessment Criteria (Master et al. 2003) (Table 1).

Table 1. Ranked trend categories

Rank	Change	Description
A	> 70% decline	Severely declining (decline in population, range, area occupied, and/or number or condition of occurrences)
B	50 – 70% decline	Very rapidly declining
C	30 – 50% decline	Rapidly declining
D	10 – 30% decline	Declining
E	+/- 10% fluctuation	Stable
F	> 10% increase	Increasing
U	Unknown	Unknown

Threats

NHP data and other observations collected from experts were used to rate up to three threats for each species according to the severity, scope, and immediacy of each threat. If more than three threats exist for a species, the three most severe were used in the threat assessment. This evaluation includes indirect and direct threats that are observed, inferred, or suspected to have an impact on the species. During each threat assessment, the severity, scope, and immediacy were also assigned a ranked value of high, medium, or low as described below. This evaluation also allows for the possibility of species to have no or insignificant threats.

Threat Severity

- High: Loss of species population (all individuals) or destruction of species habitat in area affected, irreversible or requiring long-term recovery (>100 yr).
- Moderate: Major reduction of species population or long-term degradation or reduction of habitat in area affected, requiring 50-100 yr for recovery.
- Low: Low but nontrivial reduction of species population or reversible degradation or reduction of habitat in area affected, with recovery expected in 10-50 yr.
- Insignificant: Essentially no reduction of population or degradation of habitat due to threats, or populations or habitats able to recover quickly (within 10 yr) from minor temporary loss. Note that effects of locally sustainable levels of hunting, fishing, logging, collecting, or other harvest from wild populations are generally considered Insignificant as defined here.

Threat Scope

- High: >60% of total population, occurrences, or area affected.
- Moderate: 20-60% of total population, occurrences, or area affected.
- Low: 5-20% of total population, occurrences, or area affected.
- Insignificant: <5% of total population or area affected.

Threat Immediacy

- High: Threat is operational (happening now) or imminent (within a year).
- Moderate: Threat is likely to be operational within 2-5 yr.
- Low: Threat is likely to be operational within 5-20 yr.
- Insignificant: Threat not likely to be operational within 20 yr.

The values assigned for the severity, scope, and immediacy of each threat were incorporated into a matrix that generated a single, consolidated threat category value for that threat (see Table 2). The highest-ranking threat value among the three threats per species was recorded as the overall threat value for that species. For example, the top three threats recorded for Venus

Flytrap (*Dionaea muscipula*) are Development (Threat value=B), Fire Suppression (Threat value=F), and Poaching (Threat value=E); therefore, the overall threat value for this species is B.

Table 2. Threat matrix with threat parameters and ranked threat values.

Threat Severity	Threat Scope	Threat Immediacy	Value	Threat Description
High	High	High	A	Moderate to severe, imminent threat for most (>60%) of population, occurrences, or area.
High	High	Moderate		
Moderate	High	High		
Moderate	High	Moderate		
High	Moderate	High	B	Moderate to severe, imminent threat for a significant portion (20 – 60%) of population, occurrences o area.
High	Moderate	Moderate		
Moderate	Moderate	High		
Moderate	Moderate	Moderate		
High	High	Low	C	Moderate to severe, non-imminent threat for most of population, occurrences, or area.
Moderate	High	Low		
High	Moderate	Low	D	Moderate to severe, non-imminent threat for a significant proportion of population, occurrences or area.
Moderate	Moderate	Low		
High	Low	High	E	Moderate to severe threat for small proportion of population, occurrences, or area.
High	Low	Moderate		
High	Low	Low		
Moderate	Low	High		
Moderate	Low	Moderate		
Moderate	Low	Low		
Low	High	High	F	Low severity threat for most or significant proportion of population, occurrences, or area.
Low	High	Moderate		
Low	High	Low		
Low	Moderate	High		
Low	Moderate	Moderate		
Low	Moderate	Low		
Low	Low	High	G	Low severity threat for a small proportion of population, occurrences, or area.
Low	Low	Moderate		
Low	Low	Low		

If these values could not be determined for a species, then the species was categorized as data deficient and was not further evaluated for potential listing. One exception to this procedure occurred for species that are limited to 1-2 populations in North Carolina. These species are considered inherently susceptible to stochastic (unpredictable) threats and were therefore assigned to the highest threat category.

Once the rarity, trend, and threats were identified or assigned for a species, the trend and overall threat values were incorporated into a listing criteria matrix associated with the number of viable populations recorded for that species. There are three protected plant listing criteria matrices and each species is assigned to one of them based on the number of populations of good viability recorded in North Carolina for that species: (A) 1-5, (B) 6-19, or (C) >20 populations of good to excellent viability.

The possible outcomes from the listing criteria matrices are Endangered, Threatened, Special Concern- Vulnerable, or Significantly Rare. Only Endangered, Threatened, and Special Concern categories warrant listing on the North Carolina Protected Plant Species List. Species evaluated as Significantly Rare through this process are not added to the state list of protected species; however, they remain on the NHP Rare Plant List which does not have any regulatory authority. The Scientific Committee determined through this process that any tracked species with extant populations in North Carolina, but none of good to excellent viability (A-, B-, or E-ranked populations) would be listed as Endangered. Further, any tracked species with only extirpated (X-), historical (H-), and failed to find (F-) ranked populations in North Carolina would be listed as Special Concern-Historical.

Protected Plant Listing Criteria Matrices

E=Endangered, T=Threatened, SC-V=Special Concern-Vulnerable, SR=Significantly Rare

(A) 1-5 populations of good to excellent viability

		Short-term trend							
		A	**B**	**C**	**D**	**E**	**F**	**U**	**Null**
Threat	**A**	E	E	E	E	E	E	E	E
	B	E	E	E	E	E	T	T	T
	C	E	E	E	T	T	T	T	T
	D	E	E	T	T	T	T	SC-V	SC-V
	E	E	E	T	T	SC-V	SC-V	SC-V	SC-V
	F	E	T	T	SC-V	SC-V	SC-V	SC-V	SC-V
	G	E	T	T	SC-V	SC-V	SC-V	SC-V	SC-V

(B) 6-19 populations of good to excellent viability

		Short-term trend							
		A	**B**	**C**	**D**	**E**	**F**	**U**	**Null**
Threat	**A**	E	E	E	E	T	T	T	T
	B	E	E	T	T	T	SC-V	SC-V	SC-V
	C	E	T	T	SC-V	SC-V	SC-V	SC-V	SC-V
	D	E	T	SC-V	SC-V	SC-V	SC-V	SR	SR
	E	T	T	SC-V	SC-V	SR	SR	SR	SR
	F	T	SC-V	SC-V	SR	SR	SR	SR	SR
	G	T	SC-V	SC-V	SR	SR	SR	SR	SR

(C) >20 populations of good to excellent viability

		Short-term trend							
		A	**B**	**C**	**D**	**E**	**F**	**U**	**Null**
Threat	**A**	T	T	T	T	SC-V	SC-V	SC-V	SC-VT
	B	T	T	SC-V	SC-V	SC-V	SR	SR	SR
	C	T	SC-V	SC-V	SR	SR	SR	SR	SR
	D	T	SC-V	SR	SR	SR	SR	SR	SR
	E	SC-V	SC-V	SR	SR	SR	SR	SR	SR
	F	SC-V	SR	SR	SR	SR	SR	SR	SR
	G	SC-V	SR	SR	SR	SR	SR	SR	SR

Updating the List

The first five-year update was delayed for unforeseen circumstances. In 2017-2019, the PCP staff worked with the Scientific Committee to propose systematic updates the North Carolina Protected Plant Species List. Keeping the evaluation methodology the same, the committee decided that rather than including all 900 tracked plant taxa, only a subset would be evaluated during this and future list updates. First, all newly named or newly documented species (in North Carolina) that were not included in previous review processes would be evaluated. Second, Special Concern-Historical species that had been rediscovered in the state would be evaluated. Lastly, a set of thresholds was established that would identify those species for which NHP had received sufficient updates since the prior evaluation period to justify reevaluation.

These thresholds refer to changes in available data from the time of the previous update to the next update period:

1. Species with <20 viable occurrences and 2+ changes in the number of viable element occurrences,

2. species with >20 viable occurrences and a 20% change in the number of viable occurrences, and

3. species with <6 viable occurrences and 1+ change in the number of viable occurrences.

During the review of this subset of plant species, the trends and threats for each species were reassessed as well. The Scientific Committee may review the trends and threats of any tracked species with the NHP at any time between listing updates and determine with the PCP Board case by case if additional rule changes are warranted in between scheduled updates. The proposed updates resulting from the 2017- 2019 reevaluation process were reviewed during a 60-day public comment period October 1-November 30, 2020. The updates were approved by the PCP Board in January 2021 and published in the NC Administrative Code on May 1, 2021.

In between listing updates, a special emphasis is placed on data deficient species and the intent to update the NHP database records for these species to facilitate listing evaluation. Fifty-seven of the 74 additions to the list between 2010 and 2021 were species that had been data deficient at the time of the 2008- 2009 review, showcasing how important the influx of new data to NHP was to this process.

The most up to date list of protected plants, laws, and regulations can be found at the Plant Conservation Program website, www.ncplant.com. For details on how the assessment was performed or specific results, contact the PCP Program Manager.

Next Steps

This evaluation process reveals where there are knowledge gaps regarding rare plant taxa in North Carolina, in particular with short-term trends that require repeat monitoring data and other site-specific knowledge. Although the 2017- 2019 reevaluation included many previously data-deficient species, we note that nearly half of the tracked species that remain data deficient are non-vascular taxa and are generally less well studied relative to vascular plant taxa. Future evaluations of these taxa will require a dedicated effort to increase the knowledge and data recording within the NHP database and herbaria records. PCP intends to assemble a non-vascular species review task force to facilitate the literature review, data collation, and data evaluation process ahead of future list reevaluations.

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APPENDIX A

PLANT CONSERVATION PROGRAM PROPOSED CHANGES TO LIST OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES

The following list summarizes proposed changes to the PCP list of protected species approved by the PCP Board in January 2021. Species which also occur on the federal list of endangered and threatened species under the Endangered Species Act are marked with two asterisks (**). Comments about the proposed changes should be directed to PCP staff. For the most up to date list of protected plants, laws, regulations, and staff contact information, visit the Plant Conservation Program website, www.ncplant.com.

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(1)	*Acmispon helleri*	Carolina Prairie-trefoil, Carolina Birdfoot-trefoil	T
(2)	*Acrobolbus ciliatus*	a liverwort	SC-V
(3)	*Adiantum capillus-veneris*	Southern Maidenhair Fern (Venus Hair Fern)	T
(4)	*Adlumia fungosa*	Climbing Fumitory	SC-V
(5)	*Aeschynomene virginica*	Sensitive Joint-vetch	T
(6)	*Agalinis virgata*	Branched Gerardia	T
(7)	*Agrostis mertensii*	Arctic Bentgrass	E
(8)	*Aletris lutea*	Yellow Colicroot	T
(9)	*Allium allegheniense*	Allegheny Onion	SC-V
(10)	*Allium keeverae*	Keever's Onion	SC-V
(11)	*Alnus crispa*	Green Alder, Mountain Alder	SC-V
(12)	*Amaranthus pumilus*	Seabeach Amaranth	T
(13)	*Amorpha confusa*	Savanna Indigo-bush	T
(14)	*Amorpha georgiana*	Georgia Indigobush	E
(15)	*Amphicarpum muehlenbergianum*	Blue Maiden-cane, Florida Goober Grass	E
(16)	*Anemone berlandieri*	Southern Anemone, Eastern Prairie Anemone	E
(17)	*Anemone caroliniana*	Prairie Anemone, Carolina Anemone	E
(18)	*Arabis adpressipilis*	Hairy Rockcress, Slender Rockcress	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(19)	*Arethusa bulbosa*	Bog-rose, Dragon's-mouth	E
(20)	*Aristida condensata*	Big Three-awn Grass	T
(21)	*Aristida simpliciflora*	Southern Three-awn Grass	E
(22)	*Arnoglossum ovatum var. lanceolatum*	Savanna Indian-plantain	E
(23)	*Asclepias cinerea*	Carolina Milkweed	SC-H
(24)	*Asclepias pedicellata*	Savannah Milkweed	SC-V
(25)	*Asplenium heteroresiliens*	Carolina Spleenwort	E
(26)	*Asplenium monanthes*	Single-sorus Spleenwort	E
(27)	*Asplenium ruta-muraria var. cryptolepis*	American Wall-rue	SC-V
(28)	*Astragalus michauxii*	Sandhills Milkvetch	SC-V
(29)	*Baccharis glomeruliflora*	Silverling	E
(30)	*Bacopa caroliniana*	Blue Water-hyssop	T
(31)	*Bacopa innominata*	Tropical Water-hyssop	SC-H
(32)	*Balduina atropurpurea*	Purple-disk Honeycomb-head	E
(33)	*Baptisia aberrans*	Eastern Prairie Blue Wild Indigo	E
(34)	*Baptisia alba*	Thick-pod White Wild Indicgo	T
(35)	*Baptisia bracteata*	Creamy Wild Indigo	SC-H
(36)	*Berberis canadensis*	American Barberry	SC-V
(37)	*Betula cordifolia*	Mountain Paper Birch	SC-V
(38)	*Bouteloua curtipendula var. curtipendula*	Sideoats Grama	T
(39)	*Bromus ciliatus*	Fringed Brome	SC-V
(40)	*Buchnera americana*	American Bluehearts	E
(41)	*Buckleya distichophylla*	Piratebush	T
(42)	*Bulbostylis warei*	Ware's Hair Sedge	SC-H
(43)	*Calamagrostis cainii*	Cain's Reedgrass	E
(44)	*Calamagrostis canadensis var. canadensis*	Canada Reedgrass	SC-V

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(45)	*Calopogon multiflorus*	Many-flowered Grass-pink	E
(46)	*Caltha palustris var. palustris*	Marsh Marigold	E
(47)	*Camassia scilloides*	Wild Hyacinth	T
(48)	*Campanula rotundifolia*	Bluebells	E
(49)	*Campylium stellatum*	Yellow Starry Fen Moss	SC-V
(50)	*Cardamine dissecta*	Dissected Toothwort	SC-V
(51)	*Cardamine longii*	Long's Bittercress	SC-V
(52)	*Cardamine micranthera*	Small-anthered Bittercress	E
(53)	*Carex arctata*	Black Sedge	T
(54)	*Carex argyrantha*	Hay Sedge	T
(55)	*Carex barrattii*	Barratt's Sedge	T
(56)	*Carex basiantha*	Widow Sedge	E
(57)	*Carex buxbaumii*	Brown Bog Sedge	SC-V
(58)	*Carex calcifugens*	Calcium-fleeing Sedge	SC-V
(59)	*Carex careyana*	Carey's Sedge	T
(60)	*Carex cherokeensis*	Cherokee Sedge	T
(61)	*Carex conoidea*	Cone-shaped Sedge	T
(62)	*Carex cristatella*	Crested Sedge; Small-crested Sedge	SC-V
(63)	*Carex eburnea*	Bristle-leaf Sedge	T
(64)	*Carex exilis*	Coastal Sedge	E
(65)	*Carex hormathodes*	Marsh Straw Sedge	T
(66)	*Carex impressinervia*	Ravine Sedge	SC-V
(67)	*Carex jamesii*	James' Sedge	SC-V
(68)	*Carex lasiocarpa var. americana*	Slender Sedge	SC-V
(69)	*Carex lutea*	Golden Sedge	E
(70)	*Carex meadii*	Mead's Sedge	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(71)	*Carex oligocarpa*	Rich-woods Sedge	T
(72)	*Carex oligosperma*	Few-seeded Sedge	E
(73)	*Carex pedunculata var. pedunculata*	Longstalk Sedge	SC-V
(74)	*Carex radfordii*	Radford's Sedge	T
(75)	*Carex reniformis*	Kidney Sedge	T
(76)	*Carex superata*	Limestone Forest Sedge	T
(77)	*Carex tenax*	Wire Sedge	E
(78)	*Carex trichocarpa*	Hairy-fruited Sedge	SC-V
(79)	*Carex trisperma*	Three-seeded Sedge	E
(80)	*Carex utriculata*	Beaked Sedge	E
(81)	*Carex vesicaria*	Inflated Sedge	E
(82)	*Carex vestita*	Velvet Sedge	T
(83)	*Carya laciniosa*	Big Shellbark Hickory	T
(84)	*Carya myristiciformis*	Nutmeg Hickory	E
(85)	*Caulophyllum giganteum*	Northern Blue Cohosh	SC-V
(86)	*Celastrus scandens*	American Bittersweet	E
(87)	*Cetraria arenaria*	Sand-loving Iceland Lichen	SC-V
(88)	*Chamerion angustifolium ssp. circumvagum*	Fireweed	E
(89)	*Chasmanthium nitidum*	Shiny Spanglegrass	T
(90)	*Chelone cuthbertii*	Cuthbert's Turtlehead	SC-V
(91)	*Chenopodiastrum simplex*	Mapleleaf Goosefoot	T
(92)	*Chrysoma pauciflosculosa*	Woody Goldenrod	E
(93)	*Cirsium carolinianum*	Carolina Thistle	E
(94)	*Cirsium lecontei*	Le Conte's Thistle	SC-V
(95)	*Clematis occidentalis var. occidentalis*	Mountain Clematis	SC-V
(96)	*Clinopodium georgianum*	Georgia Calamint	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(97)	*Collinsonia verticillata*	Whorled Horsebalm	T
(98)	*Conioselinum chinense*	Hemlock-parsley	T
(99)	*Coptis trifolia*	Goldthread	T
(100)	*Coreopsis auristulata*	Short-awned Coreopsis	T
(101)	*Corydalis micrantha*	Slender Corydalis	T
(102)	*Coryphopteris simulata*	Bog Fern	E
(103)	*Crataegus pallens*	Pale Hawthorn	T
(104)	*Crinum americanum var. americanum*	Swamp-lily	SC-H
(105)	*Crocanthemum bicknellii*	Plains Sunrose	SC-V
(106)	*Crocanthemum carolinianum*	Carolina Sunrose	E
(107)	*Crocanthemum corymbosum*	Pinebarren Sunrose	T
(108)	*Crocanthemum georgianum*	Georgia Sunrose	E
(109)	*Crocanthemum nashii*	Florida Scrub Sunrose	E
(110)	*Crocanthemum propinquum*	Creeping Sunrose	T
(111)	*Crocanthemum rosmarinifolium*	Rosemary Sunrose	T
(112)	*Croton monanthogynus*	Prairie-tea Croton	E
(113)	*Cyperus dentatus*	Toothed Flatsedge	SC-H
(114)	*Cyperus granitophilus*	Granite Flatsedge	T
(115)	*Cyperus lecontei*	Le Conte's Flatsedge	T
(116)	*Cyperus subsquarrosus*	Small-flowered Halfchaff, Small-flowered Hemicarpha	SC-H
(117)	*Cyperus tetragonus*	Four-angled Flatsedge	SC-V
(118)	*Cyperus virens*	Green Flatsedge	SC-V
(119)	*Cystopteris tennesseensis*	Tennessee Bladder-fern	E
(120)	*Dactylorhiza viridis*	Long-bracted Frog Orchid	T
(121)	*Dalibarda repens*	Robin Runaway	E
(122)	*Delphinium exaltatum*	Tall Larkspur	T

	Scientific Name	Common Name	Status
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(123)	*Deschampsia cespitosa ssp. glauca*	Tufted Hairgrass	T
(124)	*Desmodium ochroleucum*	Creamy Tick-trefoil	SC-H
(125)	*Desmodium sessilifolium*	Sessile Tick-trefoil	SC-H
(126)	*Diarrhena americana*	Eastern Beakgrain; Eastern Beakgrass	T
(127)	*Dichanthelium annulum*	Ringed Witchgrass	E
(128)	*Dichanthelium caerulescens*	Blue Witchgrass	T
(129)	*Dichanthelium hirstii*	Hirst Brothers' Witchgrass	E
(130)	*Dichanthelium spretum*	Eaton's Witchgrass	E
(131)	*Dichanthelium strigosum var. glabrescens*	Hairless Witchgrass	T
(132)	*Diervilla rivularis*	Riverbank Bush-honeysuckle	T
(133)	*Dionaea muscipula*	Venus Flytrap	T
(134)	*Diplachne maritima*	Salt-meadow Grass	E
(135)	*Drosera filiformis var. filiffornis*	Threadleaf Sundew	SC-V
(136)	*Echinacea laevigata*	Smooth Coneflower	E
(137)	*Eleocharis cellulosa*	Gulfcoast Spikerush	T
(138)	*Eleocharis elongata*	Florida Spikerush	E
(139)	*Eleocharis parvula*	Dwarf Spikerush	T
(140)	*Eleocharis robbinsii*	Robbins' Spikerush	SC-V
(141)	*Eleocharis vivipara*	Viviparous Spikerush	T
(142)	*Elymus trachycaulus ssp. trachycaulus*	Slender Wheatgrass	T
(143)	*Enemion biternatum*	Eastern Isopyrum; False Rue-anemone	SC-V
(144)	*Epidendrum conopseum*	Green-fly Orchid	T
(145)	*Erigenia bulbosa*	Harbinger-of-spring	T
(146)	*Eriocaulon aquaticum*	Seven-angled Pipewort	SC-V
(147)	*Eriocaulon parkeri*	Estuary Pipewort	T
(148)	*Eriocaulon texense*	Texas Hatpins	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(149)	*Eriogonum tomentosum*	Southern Wild-buckwheat	SC-H
(150)	*Erythrina herbacea*	Coralbean	E
(151)	*Eupatorium leptophyllum*	Limesink Dog-fennel	E
(152)	*Eupatorium paludicola*	Bay Boneset	E
(153)	*Euphorbia commutata*	Cliff Spurge	T
(154)	*Euphorbia cordifolia*	Heartleaf Sandmat	T
(155)	*Euphorbia mercurialina*	Cumberland Spurge	SC-V
(156)	*Filipendula rubra*	Queen-of-the-Prairie	E
(157)	*Fimbristylis perpusilla*	Harper's Fimbry	T
(158)	*Gaillardia aestivalis var. aestivalis*	Sandhills Blanket-flower	E
(159)	*Galactia mollis*	Soft Milk-pea	T
(160)	*Gaylussacia brachycera*	Box Huckleberry	E
(161)	*Gaylussacia nana*	Confederate Huckleberry; Dwarf Dangleberry	E
(162)	*Gaylussacia orocola*	Appalachian Dwarf Huckleberry	E
(163)	*Gelsemium rankinii*	Swamp Jessamine	SC-V
(164)	*Gentiana alba*	Pale Gentian; Yellow Gentian	SC-H
(165)	*Gentiana latidens*	Balsalm Mountain Gentian	T
(166)	*Gentianopsis crinita*	Fringed Gentian	E
(167)	*Geum aleppicum*	Yellow Avens	E
(168)	*Geum geniculatum*	Bent Avens	SC-V
(169)	*Geum laciniatum*	Rough Avens	E
(170)	*Geum radiatum*	Spreading Avens	E
(171)	*Gillenia stipulata*	Indian Physic	T
(172)	*Glyceria laxa*	Lax Mannagrass	SC-V
(173)	*Gratiola lutea*	Golden Hedge-hyssop	SC-V
(174)	*Gymnocarpium appalachianum*	Appalachian Oak Fern	T

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(175)	*Gymnoderma lineare*	Rock Gnome Lichen	E
(176)	*Harperella nodosa (Ptilimnium nodosum)*	Harperella	E
(177)	*Helanthium tenellum*	Dwarf Burhead	E
(178)	*Helenium brevifolium*	Littleleaf Sneezeweed	E
(179)	*Helenium vernale*	Spring Sneezeweed	E
(180)	*Helianthus floridanus*	Florida Sunflower	T
(181)	*Helianthus laevigatus*	Smooth Sunflower	SC-V
(182)	*Helianthus occidentalis ssp. occidentalis*	Naked-stem Sunflower	SC-H
(183)	*Helianthus schweinitzii*	Schweinitz's Sunflower	E
(184)	*Helonias bullata*	Swamp-pink	T
(185)	*Hexastylis contracta*	Southern Heartleaf	E
(186)	*Hexastylis naniflora*	Dwarf-flower Heartleaf	T
(187)	*Hibiscus aculeatus*	Comfortroot	T
(188)	*Hottonia inflata*	Featherfoil	SC-V
(189)	*Houstonia montana*	Roan Mountain Bluet	E
(190)	*Hudsonia montana*	Mountain Golden-heather	T
(191)	*Hudsonia tomentosa*	Sand-heather	T
(192)	*Hydrastis canadensis*	Goldenseal	SC-V
(193)	*Hymenocallis occidentalis var. occidentalis*	Hillside Spiderlily, Woodland Spiderlily	SC-H
(194)	*Hymenocallis pygmaea*	Waccamaw River Spiderlily	SC-V
(195)	*Hypericum adpressum*	Bog St. John's-wort	SC-H
(196)	*Hypericum brachyphyllum*	Coastal Plain St. John's-wort	SC-V
(197)	*Hypericum fasciculatum*	Peelbark St. John's-wort	E
(198)	*Hypericum radfordiorum*	Radford"s St. John's-word	SC-V
(199)	*Hypericum suffruticosum*	Pineland St. John's-wort	SC-H
(200)	*Hypotrachyna virginica*	Virginia Loop Lichen	SC-V

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(201)	*Ilex collina*	Long-stalked Holly	SC-V
(202)	*Ipomoea imperati*	Beach Morning-glory	SC-V
(203)	*Ipomoea macrorhiza*	Manroot	SC-H
(204)	*Isoetes microvela*	Thin-wall Quillwort	T
(205)	*Isoetes piedmontana*	Piedmont Quillwort	T
(206)	*Isotria medeoloides*	Small Whorled Pogonia	T
(207)	*Iva microcephala*	Small-headed Marsh Elder	T
(208)	*Jeffersonia diphylla*	Twinleaf	T
(209)	*Juncus articulatus*	Jointleafed Rush	SC-H
(210)	*Juncus caesariensis*	New Jersey Rush	E
(211)	*Juniperus communis var. depressa*	Dwarf Juniper	T
(212)	*Kalmia angustifolia*	Sheep-laurel	T
(213)	*Koeleria spicata (Koeleria spicata ssp. spicata)*	Soft Trisetum, Spike Trisetum	SC-H
(214)	*Lachnocaulon minus*	Brown Bogbutton	T
(215)	*Lechea maritima var. virginica*	Maritime Pinweed	T
(216)	*Lechea torreyi var. congesta*	Torrey's Pinweed	E
(217)	*Lejeunea blomquistii*	A liverwort	SC-V
(218)	*Liatris aspera*	Rough Blazing-star	SC-V
(219)	*Liatris helleri*	Heller's Blazing-star	T
(220)	*Liatris microcephala*	Small-head Blazing-star	SC-V
(221)	*Lilium canadense*	Canada Lily	E
(222)	*Lilium grayi*	Gray's Lily	T
(223)	*Lilium philadelphicum var. philadelphicum*	Wood Lily	E
(224)	*Lilium pyrophilum*	Sandhills Lily	E
(225)	*Limosella australis*	Awl-leaf Mudwort	T
(226)	*Lindera melissifolia*	Pondberry	E

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(227)	*Lindera subcoriacea*	Bog Spicebush	SC-V
(228)	*Linum floridanum var. chrysocarpum*	Yellow-fruited Flax	T
(229)	*Linum sulcatum*	Glade Flax	SC-H
(230)	*Liparis loeselii*	Fen Orchid	E
(231)	*Lithospermum canescens*	Hoary Puccoon	T
(232)	*Litsea aestivalis*	Pondspice	SC-V
(233)	*Lobelia boykinii*	Boykin's Lobelia	E
(234)	*Lochocolea muricata*	A liverwort	SC-V
(235)	*Lophiola aurea*	Golden-crest	E
(236)	*Lophocolea appalachiana*	A liverwort	SC-V
(237)	*Ludwigia lanceolata*	Lanceleaf Seedbox	E
(238)	*Ludwigia linifolia*	Flaxleaf Seedbox	T
(239)	*Ludwigia ravenii*	Raven's Seedbox	E
(240)	*Ludwigia sphaerocarpa*	Globe-fruit Seedbox	E
(241)	*Ludwigia suffruticosa*	Shrubby Seedbox	T
(242)	*Lupinus villosus*	Lady Lupine, Pink Sandhill Lupine	E
(243)	*Lycopodiella inundata*	Bog Clubmoss	E
(244)	*Lysimachia asperulifolia*	Rough-leaf Loosestrife	E
(245)	*Lysimachia fraseri*	Fraser's Loosestrife	E
(246)	*Macbridea caroliniana*	Carolina Birds-in-a-nest, Carolina Bogmint	E
(247)	*Magnolia macrophylla*	Bigleaf Magnolia	SC-V
(248)	*Malaxis spicata*	Florida Adder's-mouth	SC-V
(249)	*Marshallia grandiflora*	Large-flowered Barbara's-buttons	SC-H
(250)	*Marshallia legrandii*	Oak Barrens Barbara's-buttons	E
(251)	*Marshallia trinervia*	Broadleaf Barbara's-buttons	SC-H
(252)	*Melanthium woodii*	Ozark Bunchflower	T

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(253)	*Melica nitens*	Three-flowered Melic	E
(254)	*Menyanthes trifoliata*	Buckbean	T
(255)	*Micranthes pensylvanica*	Swamp Saxifrage	E
(256)	*Mnesithea cylindrica*	Carolina Jointgrass	SC-H
(257)	*Mononeuria groenlandica*	Greenland Sandwort	T
(258)	*Mononeuria paludicola*	Godfrey's Sandwort	E
(259)	*Mononeuria uniflora*	Single-flowered Sandwort	E
(260)	*Moranopteris nimbata*	West Indian Dwarf Polypody	T
(261)	*Muhlenbergia glomerata*	Spiked Muhly	SC-V
(262)	*Muhlenbergia sobolifera*	Rock Muhly	T
(263)	*Muhlenbergia torreyana*	Pinebarren Smokegrass	SC-V
(264)	*Myrica gale*	Sweet Gale	E
(265)	*Myriophyllum laxum*	Loose Water-milfoil	E
(266)	*Myriophyllum tenellum*	Leafless Water-milfoil	E
(267)	*Nabalus albus*	Northern Rattlesnake-root, White Rattlesnakeroot	SC-V
(268)	*Narthecium montanum*	Appalachian Yellow Asphodel	SC-H
(269)	*Oenothera perennis*	Perennial Sundrops	SC-V
(270)	*Oldenlandia boscii*	Bosc's Bluet	T
(271)	*Oligoneuron album*	Prairie Goldenrod, White Prairie-goldenrod	E
(272)	*Oligoneuron jacksonii*	Southeastern Bold Goldenrod	SC-V
(273)	*Oligoneuron rigidum*	Midwestern Bold Goldenrod, Prairie Bold Goldenrod	T
(274)	*Orbexilum macrophyllum*	Bigleaf Scurfpea	SC-H
(275)	*Orbexilum onobrychis*	Lanceleaf Scurfpea	SC-H
(276)	*Orbexilum pedunculatum*	Western Sampson's Snakeroot	E
(277)	*Oreojuncus trifidus*	Highland Rush	T
(278)	*Orthochilus ecristatus*	Spiked Medusa	E

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(279)	*Pachysandra procumbens*	Allegheny Spurge	E
(280)	*Packera crawfordii*	Bog Ragwort, Crawford's Ragwort	E
(281)	*Packera millefolium*	Blue Ridge Ragwort	SC-V
(282)	*Packera paupercula var. appalachiana*	Appalachian Ragwort	T
(283)	*Packera paupercula var. paupercula*	Balsam Ragwort	SC-V
(284)	*Packera schweinitziana*	New England Ragwort	T
(285)	*Packera serpenticola*	Buck Creek Ragwort	T
(286)	*Palustricodon aparinoides var. aparinoides*	Marsh Bellflower	T
(287)	*Panicum flexile*	Wiry Panic Grass	T
(288)	*Parnassia caroliniana*	Carolina Grass-of-Parnassus	T
(289)	*Parnassia grandifolia*	Bigleaf Grass-of-Parnassus	T
(290)	*Paronychia herniarioides*	Michaux's Whitlow-wort	E
(291)	*Paspalum dissectum*	Mudbank Crown Grass	E
(292)	*Pedicularis lanceolata*	Swamp Lousewort	T
(293)	*Pellaea wrightiana*	Wright's Cliffbrake	E
(294)	*Persicaria hirsuta*	Hairy Smartweed	E
(295)	*Phacelia maculata*	Flatrock Phacelia	E
(296)	*Phegopteris connectilis*	Northern Beech Fern	E
(297)	*Phemeranthus piedmontanus*	Piedmont Rock-pink	E
(298)	*Pinguicula lutea*	Yellow Butterwort	SC-V
(299)	*Pinguicula pumila*	Small Butterwort	T
(300)	*Pityopsis graminifolia*	A Silkgrass	E
(301)	*Plantago cordata*	Heart-leaf Plantain	E
(302)	*Plantago sparsiflora*	Pineland Plantain	T
(303)	*Platanthera herbiola*	Northern Rein Orchid, Tubercled Rein Orchid	SC-V
(304)	*Platanthera integra*	Yellow Fringeless Orchid	T

	Scientific Name	Common Name	Status
E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(305)	*Platanthera integrilabia*	White Fringeless Orchid	T
(306)	*Platanthera nivea*	Snowy Orchid	E
(307)	*Platanthera peramoena*	Purple Fringeless Orchid	T
(308)	*Platanthera shriveri*	Shriver's Purple Fringed Orchid	E
(309)	*Poa saltuensis*	Old-pasture Bluegrass	T
(310)	*Polemonium reptans var. reptans*	Spreading Jacob's Ladder	T
(311)	*Polygala hookeri*	Hooker's Milkwort	SC-V
(312)	*Polygala senega*	Seneca Snakeroot	SC-V
(313)	*Polygonella articulata*	Coast Jointweed, Northern Wireweed	SC-H
(314)	*Polygonum glaucum*	Seabeach Knotweed	E
(315)	*Ponthieva racemosa*	Shadow-witch	T
(316)	*Portulaca smallii*	Small's Portulaca	T
(317)	*Potamogeton illinoensis*	Illinois Pondweed	E
(318)	*Primula meadia*	Eastern Shooting-star	SC-V
(319)	*Pseudognaphalium helleri*	Heller's Rabbit-tobacco	E
(320)	*Ptilimnium costatum*	Big Bishopweed	T
(321)	*Pyrola elliptica*	Elliptic Shinleaf	T
(322)	*Pyxidanthera brevifolia*	Sandhills Pyxie-moss	T
(323)	*Quercus elliottii*	Running Oak	E
(324)	*Quercus ilicifolia*	Bear Oak	E
(325)	*Quercus minima*	Dwarf Live Oak	E
(326)	*Quercus prinoides*	Dwarf Chinquapin Oak	E
(327)	*Ranunculus ambigens*	Water-plantain Spearwort	SC-H
(328)	*Ranunculus hederaceus*	Ivy Buttercup, Ivy-leaved Water Crowfoot	T
(329)	*Rhexia aristosa*	Awned Meadow-beauty	SC-V
(330)	*Rhodiola rosea*	Roseroot	E

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(331)	*Rhododendron prinophyllum*	Election Pink	T
(332)	*Rhus michauxii*	Michaux's Sumac	E
(333)	*Rhynchospora crinipes*	Alabama Beaksedge	T
(334)	*Rhynchospora decurrens*	Swamp Forest Beaksedge	T
(335)	*Rhynchospora harperi*	Harper's Beaksedge	SC-V
(336)	*Rhynchospora macra*	Southern White Beaksedge	T
(337)	*Rhynchospora microcarpa*	Southern Beakssedge	T
(338)	*Rhynchospora odorata*	Fragrant Beaksedge	SC-V
(339)	*Rhynchospora pleiantha*	Coastal Beaksedge	T
(340)	*Rhynchospora thornei*	Thorne's Beaksedge	SC-V
(341)	*Rhynchospora tracyi*	Tracy's Beaksedge	T
(342)	*Rubus strigosus*	American Red Raspberry	T
(343)	*Rudbeckia heliopsidis*	Sun-facing Coneflower	E
(344)	*Ruellia ciliosa*	Sandhills Wild-petunia	T
(345)	*Ruellia humilis*	Low Wild-petunia	T
(346)	*Ruellia purshiana*	Pursh's Wild-petunia	SC-V
(347)	*Ruellia strepens*	Limestone Wild Petunia	E
(348)	*Sabal palmetto*	Cabbage Palmetto	T
(349)	*Sabatia kennedyana*	Plymouth Gentian	T
(350)	*Sageretia minutiflora*	Small-flowered Buckthorn	T
(351)	*Sagittaria chapmanii*	Chapman's Arrowhead	T
(352)	*Sagittaria fasciculata*	Bunched Arrowhead	E
(353)	*Sagittaria isoetiformis*	Quillwort Arrowhead	T
(354)	*Sagittaria macrocarpa*	Streamhead Arrowhead, Streamhead Sagittaria	T
(355)	*Sagittaria weatherbiana*	Grassleaf Arrowhead	E
(356)	*Sarracenia jonesii*	Mountain Sweet Pitcherplant	E

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E=Endangered, **T**=Threatened, **SC-V**=Special Concern-Vulnerable, **SC-H** = Special Concern-Historical			
(357)	*Sarracenia minor var. minor*	Hooded Pitcherplant	E
(358)	*Sarracenia oreophila*	Green Pitcherplant	E
(359)	*Sarracenia purpurea var. montana*	Southern Appalachian Purple Pitcher Plant	E
(360)	*Sceptridium jenmanii*	Alabama Grape-fern	SC-V
(361)	*Schisandra glabra*	Magnolia Vine	T
(362)	*Schwalbea americana*	Chaffseed	E
(363)	*Scirpus flaccidifolius*	Reclining Bulrush	E
(364)	*Scirpus lineatus*	Drooping Bulrush	T
(365)	*Scleria baldwinii*	Baldwin's Nutrush	T
(366)	*Scleria bellii*	Smooth-seeded Hairy Nutrush	E
(367)	*Scleria reticularis*	Netted Nutrush	SC-V
(368)	*Sclerolepis uniflora*	One-flower Hardscale, Sclerolepis	T
(369)	*Scutellaria australis*	Southern Skullcap	E
(370)	*Scutellaria galericulata*	Hooded Skullcap	SC-H
(371)	*Scutellaria leonardii*	Shale-barren Skullcap	E
(372)	*Scutellaria nervosa*	Veined Skullcap	E
(373)	*Sedum pusillum*	Puck's Orpine	E
(374)	*Senecio suaveolens*	Sweet Indian-plantain	E
(375)	*Sesuvium maritimum*	Slender Sea-purslane	E
(376)	*Sesuvium portulacastrum*	Shoreline Sea-purslane	E
(377)	*Seymeria pectinata ssp. pectinata*	Comb Seymeria	SC-H
(378)	*Shortia brevistyla*	Northern Oconee Bells	T
(379)	*Shortia galacifolia*	Southern Oconee Bells	SC-V
(380)	*Sideroxylon tenax*	Tough Bumelia	T
(381)	*Silene ovata*	Mountain Catchfly	SC-V
(382)	*Silphium connatum*	Virginia Cup-plant	SC-V

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(383)	*Silphium perfoliatum*	Common Cup-plant	SC-V
(384)	*Sisyrinchium dichotomum*	White Irisette	E
(385)	*Solidago leavenworthii*	Leavenworth's Goldenrod	E
(386)	*Solidago plumosa*	Yadkin River Goldenrod	T
(387)	*Solidago radula*	Western Rough Goldenrod	E
(388)	*Solidago spithamaea*	Blue Ridge Goldenrod	T
(389)	*Solidago tortifolia*	Twisted-leaf Goldenrod	E
(390)	*Solidago verna*	Spring-flowering Goldenrod	T
(391)	*Solidago villosicarpa*	Carolina Maritime Goldenrod, Coastal Goldenrod	T
(392)	*Sparganium acaule*	Greenfruit Bur-reed	E
(393)	*Spartina pectinata*	Freshwater Cordgrass	T
(394)	*Sphagnum contortum*	Contorted Peatmoss	T
(395)	*Sphagnum warnstorfii*	Fen Peatmoss	SC-V
(396)	*Spigelia marilandica*	Pink-root	T
(397)	*Spiraea corymbosa*	Rock Spirea, Shinyleaf Meadowsweet	E
(398)	*Spiraea virginiana*	Virginia Spiraea	T
(399)	*Spiranthes lacera var. lacera*	Northern Slender Ladies'-tresses	E
(400)	*Spiranthes laciniata*	Lace-lip Ladies'-tresses	SC-V
(401)	*Spiranthes longilabris*	Giant-spiral Orchid	E
(402)	*Spiranthes lucida*	Shining Ladies'-tresses	E
(403)	*Spiranthes ochroleuca*	Yellow Nodding Ladies'-tresses	T
(404)	*Sporobolus heterolepis*	Prairie Dropseed	T
(405)	*Sporobolus teretifolius*	Wireleaf Dropseed	E
(406)	*Sporobolus virginicus*	Saltmarsh Dropseed, Seashore Dropseed	T
(407)	*Stachys appalachiana*	Appalachian Hedge-nettle	E
(408)	*Stachys eplingii*	Epling's Hedge-nettle	E

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(409)	*Stachys matthewsii*	Yadkin Hedge-nettle	E
(410)	*Stenanthium gramineum var. robustum*	Bog Featherbells	E
(411)	*Stenanthium leimanthoides*	Pinebarrens Death-camas	T
(412)	*Stylisma aquatica*	Water Dawnflower	E
(413)	*Stylisma pickeringii var. pickeringii*	Pickering's Dawnflower	SC-V
(414)	*Swida asperifolia*	Eastern Roughleaf Dogwood	E
(415)	*Swida racemosa*	Gray Dogwood	SC-V
(416)	*Symphyotrichum concinnum*	Narrow-leaved Smooth Aster	E
(417)	*Symphyotrichum depauperatum*	Serpentine Aster	E
(418)	*Symphyotrichum georgianum*	Georgia Aster	T
(419)	*Symphyotrichum oblongifolium*	Eastern Aromatic Aster	T
(420)	*Symphyotrichum rhiannon*	Buck Creek Aster	T
(421)	*Synandra hispidula*	Synandra	T
(422)	*Taxus canadensis*	Canada Yew	T
(423)	*Thalictrum cooleyi*	Cooley's Meadowrue	E
(424)	*Thalictrum macrostylum*	Small-leaved Meadowrue	SC-V
(425)	*Thaspium pinnatifidum*	Mountain Thaspium	E
(426)	*Thermopsis fraxinifolia*	Ash-leaved Golden-banner	SC-V
(427)	*Tiedemannia canbyi (Oxypolis canbyi)*	Canby's Dropwort	E
(428)	*Triantha glutinosa*	Sticky Bog Asphodel	SC-V
(429)	*Trichostema brachiatum*	Glade Bluecurls	E
(430)	*Trichostema nesophilum*	Dune Bluecurls	SC-V
(431)	*Tridens ambiguus*	Pineland Triodia	E
(432)	*Tridens chapmanii*	Chapman's Redtop, Chapman's Triodia	SC-V
(433)	*Tridens strictus*	Spike Triodia	SC-H
(434)	*Trientalis borealis*	Northern Starflower	T

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(435)	*Trifolium carolinianum*	Carolina Clover	SC-H
(436)	*Trifolium reflexum*	Buffalo Clover	T
(437)	*Trillium discolor*	Mottled Trillium, Pale Yellow Trillium	T
(438)	*Trillium flexipes*	Bent White Trillium	T
(439)	*Trillium pusillum var. ozarkanum*	Ozark Least Trillium	E
(440)	*Trillium pusillum var. pusillum*	Carolina Least Trillium	E
(441)	*Trillium pusillum var. virginianum*	Virginia Least Trillium	E
(442)	*Trillium recurvatum*	Prairie Trillium, Recurved Trillium	T
(443)	*Trillium sessile*	Sessile-flowered Trillium	T
(444)	*Trillium simile*	Sweet White Trillium	SC-V
(445)	*Turritis glabra*	Tower Mustard	E
(446)	*Urtica chamaedryoides*	Dwarf Stinging Nettle	T
(447)	*Utricularia cornuta*	Horned Bladderwort	T
(448)	*Utricularia geminiscapa*	Two-flowered Bladderwort	SC-V
(449)	*Utricularia minor*	Small Bladderwort	SC-H
(450)	*Utricularia olivacea*	Dwarf Bladderwort	T
(451)	*Utricularia resupinata*	Northeastern Bladderwort	E
(452)	*Vaccinium macrocarpon*	Cranberry	T
(453)	*Vandenboschia boschiana*	Appalachian Filmy-fern, Appalachian Bristle Fern	E
(454)	*Veronica americana*	American Speedwell	T
(455)	*Waldsteinia lobata*	Lobed Barren-strawberry	E
(456)	*Warea cuneifolia*	Carolina Pineland-cress	E
(457)	*Woodsia ilvensis*	Rusty Cliff Fern	E
(458)	*Xyris floridana*	Florida Yellow-eyed-grass	SC-V
(459)	*Xyris scabrifolia*	Harper's Yellow-eyed-grass, Roughleaf Yellow-eyed-grass	SC-V
(460)	*Xyris serotina*	Acid-swamp Yellow-eyed-grass	SC-H

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(461)	*Xyris stricta*	Pineland Yellow-eyed-grass	E
(462)	*Zephyranthes simpsonii*	Rain Lily, Florida Atamasco-lily	E

Reference 3-3

Eastern Band Cherokee Indians
Wildlife Action Plan

A SOCIAL-ECOLOGICAL FRAMEWORK TO ADAPTIVELY MANAGE AND CONSERVE FISH AND WILDLIFE

Year End Update-2022

Natural Resources Program
Fisheries and Wildlife Management Office

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MISSION & VISION

The mission of the Eastern Band of Cherokee Indians (EBCI) Fisheries and Wildlife Management office is to sustainably manage aquatic and terrestrial species and ecosystems for the present-day Cherokee community and future generations. We envision a Cherokee landscape that sustains abundant and healthy wildlife populations that maintain ecosystem services, cultural traditions, along with economic and recreational opportunities for the Cherokee community. Our program works to manage fish and game populations for subsistence and cultural uses, restore and protect both culturally significant and rare non-game species, and promote the connection between conservation and cultural values. Responsibly managing resources of value for the Cherokee community requires a sustainable focus that seeks an understanding of how conservation actions and stressors affect the quality of life for both present and future Cherokee generations.

HISTORY

Cherokee aboriginal territory historically encompassed hundreds of thousands of square miles across eight southeastern U.S. states. Lands stretched from southern Appalachian mountaintops to productive Tennessee River valleys providing for a rich agricultural and subsistence lifestyle. The wide range of elevations, diverse landforms, mild temperatures, and abundant rainfall found on aboriginal Cherokee lands provided for diverse and productive aquatic and terrestrial habitats (Vick 2011). The Cherokee people possess a long history of natural resource stewardship dating back thousands of years. Traditional management actions such as the use of fire to improve habitat, wildlife-friendly agricultural practices, and traditional hunting and fishing methods were implemented to improve natural resource conditions and sustain resources. The fish, wildlife, and plants found within this land base were intricately tied to cultural identity and the livelihood of the Cherokee people (Mooney 1900, Cooley 2002, Altman 2006, Vick 2011, EBCI 2013).

The gradual shrinking of Cherokee's aboriginal homeland began in 1721 with land cessions culminating in the Treaty of New Echota, which initiated the systematic removal of the Cherokee people from their homelands. By 1860, Cherokee that resisted removal were able to develop a contiguous land-base in the region of Jackson, Swain, Graham, and Cherokee Counties (North Carolina) by purchasing lands through William Holland Thomas (Starr 1922). The Qualla Boundary and other outlying parcels were surveyed in 1875 and in turn held in

trust by the US government. The resulting elimination of access to historically abundant and diverse natural resources within historic homelands and additional disturbances by European settlers had substantial long term impacts to traditional Cherokee ways of life (Cooley 2002, Vick 2011).

Although today's EBCI land base is extremely diminished in size, comprised of approximately 56,000 acres in western North Carolina, these lands and waters continue to support diverse communities of fish, mammals, birds, amphibians, reptiles, and invertebrates. This biological diversity continues to shape Cherokee identity with many species playing critical roles in recreation, arts, medicine, ceremonies, and stories. Fully functioning ecosystems supported by diverse wildlife also provide many tangible and lucrative benefits to the Cherokee community collectively known as "ecosystem services". These services include processes such as the production of food, maintenance of clean drinking water, decomposition of wastes and pollutants, nutrient cycling and soil formation, pest and disease control, and crop pollination (Millenium Ecosystem Assessment 2005). When natural systems are not functioning properly due to degraded wildlife populations and their habitats, they lose the ability to provide these benefits, which can be very costly to Cherokee society. Therefore, sustaining fish and wildlife populations and their interrelationships with the environment in a changing world, both within and outside of modern political boundaries, is an integral part of sustaining the welfare of the Cherokee community.

The continued preservation of ecosystem integrity is increasingly challenging as human populations grow and associated pressures on fish and wildlife resources expand. Major threats to fish and wildlife include habitat loss and fragmentation, invasive species and disease, pollution, over-exploitation, and climate change (Millenium Ecosystem Assessment 2005, Yang et al. 2015). Collectively, these conservation challenges not only continue to pose risks to EBCI fish and wildlife populations, but increasingly jeopardize the ecological, cultural, and economic benefits they provide to the EBCI community. Meeting these modern challenges through the implementation of strategic planning initiatives, informed by science and traditional ecological knowledge, will be critical to sustaining the benefits fish and wildlife resources provide to the people of Cherokee.

In 2007, the EBCI Fisheries and Wildlife Management office was created with a mission to sustainably manage aquatic and terrestrial species and ecosystems for the present-day Cherokee community and future generations. Today the program builds upon generations of Cherokee natural resource stewardship to manage diverse biological resources on EBCI lands. The program envisions a Cherokee landscape that sustains abundant and healthy wildlife populations that maintain ecosystem services, cultural traditions, and recreational opportunities for the Cherokee community. Our program works to manage fish and game populations for subsistence and cultural uses, restore and protect both culturally significant and rare non-game species, and promote the connection between conservation and cultural values. Responsibly managing resources of value for the Cherokee community is dependent upon informed planning initiatives with a sustainable focus that relies on understanding conservation actions and stressors affect the quality of life for both present and future Cherokee generations.

INTRODUCTION

In areas where humans exist, wildlife and fisheries managers encounter design challenges when creating comprehensive plans to protect animals and their ecosystems. To address challenges for protecting biodiversity, congress facilitated funding and an organized strategy for managers of states and territories to develop Wildlife Action Plans (WAPs). These WAPs identify species in greatest conservation need while addressing a full array of game and non-game wildlife and wildlife-related issues on state lands. These state plans often prioritize top down human control over populations and ecosystems without consideration of feedback-loops to people. Federal land management agencies also have unique planning frameworks based upon agency missions and the application of federal laws and statutes. Federal land management focus is most often on limiting human influence on natural processes based on agency-centric conservation goals. However, the organizational structure of state and federal plans may not be transferrable to federally recognized tribal territories because management policies for sovereign tribal governments are very different from that of federal, state, and territorial lands.

Tribal governments have a unique legal relationship with the United States and can exercise inherent sovereign governmental powers over their natural resources and tribal members. The United States is a legal trustee for lands and resources held in trust for the benefit of tribal communities and have a fiduciary duty to protect the health and productivity tribal resources. The first people of the American continent were the original environmental stewards. These native people continue to sustain their cultures and economies today by acting as interdependent components of the natural world. Conserving natural resources on sovereign tribal lands poses a unique challenge where managers must consider balancing the maintenance of a unique culture and a productive economy with complex natural resource management challenges. In addition, because the federal government maintains a fiduciary relationship with tribes, obtaining federal funding and permitting often poses additional complexities related to the application of federal environmental laws (i.e. Endangered Species Act of 1973 and National Environmental Policy Act), which is especially challenging within a human inhabited landscape. Compliance with federal regulations also potentially supplants tribal priorities as tribes may recognize other species or ecosystems outside of federal protection as deserving primary conservation focus.

With several millennia of established interests in the local environment, the Eastern Band of Cherokee Indians (EBCI) has set a priority to conserve southern Appalachian natural resources. In recognition of both a long history of natural resources stewardship, and a renewed need to lead the region in preserving environmental integrity, the tribe developed a document called the Legacy Plan, also known as the Integrated Resource Management Plan (IRMP) (EBCI 2013). This plan included 14 EBCI programs and a professional analysis of community perspectives through a detailed survey of EBCI citizens. The EBCI Legacy Plan reviewed the landscape and ecosystems through information about watersheds and zones of influence. Through reviewing citizens and professional input, a clear perspective of the linkage between cultural values and natural resources was created, which included relationships related to subsistence, art, ceremony, language, aesthetics, and medicine. The Legacy Plan affirmed that the Cherokee people wanted to maintain ecological integrity for the preservation of cultural identity. Specifically, strong interests were expressed in conserving clean water, fish and wildlife habitats, natural viewsheds and recreational opportunities that help citizens maintain a connection to the ecosystem and boost the economy through tourism. The Legacy Plan outlined how biodiversity is integral to supporting valuable services for the Cherokee people, and acts as a living guide for future management decisions. In 2013, the EBCI tribal council recognized the Legacy Plan as an important document for protecting resources for future generations. It is now vital to use the knowledge gained by the Legacy Plan in an efficient way to protect natural resources while maintaining a productive economy.

For community development and conservation management schemes to coexist, a dynamic plan for integration may provide an optimal model. In the following sections, we outline just such a dynamic plan that includes a model of how to interweave human systems with natural systems. Some conservation groups are now proposing a social-ecological framework where people are members of the system, rather than passive contributors to system change (Grove et al. 2013, Huber et al. 2013). We believe a social-ecological model would work well for the Cherokee because of the close ties to culture, government, and natural resources. In this social-ecological framework, we can add people to the process with the goal of leveraging a unique adaptive management strategy to benefit fish, wildlife, and people alike.

CONSERVATION PLANNING FRAMEWORK

MODEL DESCRIPTION AND BROAD OVERVIEW

To develop a successful conservation plan that benefits people and wildlife alike, managers must somehow efficiently implement and prioritize a variety of disparate activities in a way that minimizes unnecessary efforts or provides decision-makers the ability to track the success and failures of these efforts. A well-designed conceptual framework that includes both environmental and social priorities can help to organize an optimal strategy to complete conservation and development needs while visualizing any missing components.
Coupling research for human and natural systems, under a conceptual framework, has yielded new understandings in conservation, including reciprocal feedbacks, time lags in response to one another, and a better understanding of resilience (Liu et al. 2007). Conceptual frameworks that combine social and ecological perspectives have helped to tease apart several intricate details needed to analyze the feedback between ecosystem services and human well-being (Yang et al. 2015). The perspective of human caused press-pulse changes to the environment has been proposed as a conceptual model for managers to measure social-ecological dynamics (Collins et al. 2011, Hansen 2014). Few examples exist where social-ecological frameworks have been applied, and even fewer add a cultural component. One such example of adding culture comes from South Africa where socioecological theory was used to analyze the influence of urbanization behaviors on the environment (McHale et al. 2013). For a successful and practical framework to function, our model includes people as part of the system, rather than passive contributors to change. With millennia of experiences in the environment around them and structured governments in place to manage resources, native people are uniquely poised to implement a social-ecological framework that can work for the whole ecosystem-including people.

To convey how our program manages conservation efforts in the presence of human interests, it was important to develop a conceptual framework that combines social and ecological needs specific to the Eastern Band of the Cherokee Indians. A socio-ecological conceptual framework shows how we manage natural resources, inform the tribe, and adapt to changes

that the tribe must encounter. To promote the most optimal social-ecological balance for the modern Cherokee community, our EBCI Wildlife Action Plan organizes efforts and clarifies our intentions under an adaptive management perspective. An adaptive management scheme leverages an iterative process with decision-making capabilities built in where changes can be made at different rounds over time. Therefore, an adaptive management model is robust to outside disturbances, like the natural changes in the environment or changes in human decision-making. Following our assessment of the current biological conditions, we can determine how biological systems contribute, as a service, to the tribe (Millenium Ecosystem Assessment 2005).

Our social-ecological conceptual model (Fig. 1) includes components of management actions and existing environments. The existing environments are represented by biological conditions and contributed services, as well as social and cultural decision-making, both of which are influenced by our work (management actions) but function independently. Arrows in this model indicate influences between components rather than a temporal process. The model could be used for focusing on projects or efforts that our program considers important. Our program's primary work occurs within the pink shaded area represented by management actions (see Fig. 1), which includes Information Transfer and Processing, and Conservation Strategies. After we accumulate knowledge about the current biological conditions and what services our environment can provide to the tribe, we transfer and process this information to social and cultural decision-makers. Decision-makers (external stakeholders) can include tribal government, community, and partners (e.g. U.S. Fish & Wildlife Service). Based either on our recommendations or social and cultural needs, decision-makers provide choices to support positive or negative pressures and conservation efforts, which cycles back to our management actions or functions independent of our efforts (see External Anthropogenic Threats & Benefits). If social and cultural decision-makers deemed them necessary, based on any anthropogenic threats or contributed services, our conservation actions might influence biological conditions. Therefore, within the information transfer and processing action at the second iteration (cycle two), there would be an assessment of what transpired from the first cycle. If decision-makers wish to support more management actions to develop conservation strategies, then we can alter our plans accordingly. Decisions made by leaders, influenced by existing Tribal and federal laws – lead to prioritization of conservation targets. The EBCI Fisheries and Wildlife Management office focuses the implementation of conservation

strategies to affect biological conditions that have been deemed a management priority by the Eastern Band of Cherokee Indians. Biological targets receiving management attention consist of species, and assemblages based upon a variety of cultural, economic, legal, and ecological factors as outlined in the EBCI Legacy Plan (EBCI 2013).

Because we tie the adaptive management system to social input and biological conditions, our framework is responsive to environmental changes, human decisions and even our own actions (see section- A Framework for Adaptive Management). Conserving EBCI fish and wildlife populations and overall ecosystem health will require well-informed adaptive management strategies based on sound scientific information and support from social and cultural decision-makers.

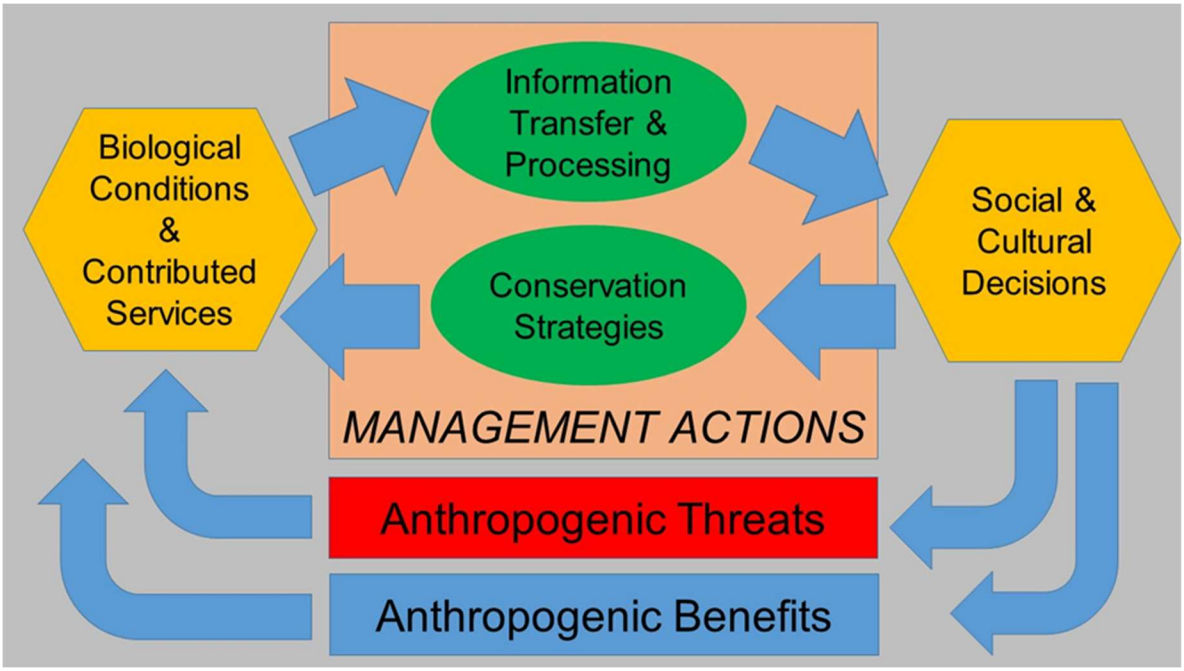

Figure 1- A social-ecological framework that represents our Cherokee Wildlife Action Plan. This is an iterative process where our activities primarily focus on management actions that are influenced by external factors of biological conditions/contributed services and social and cultural decisions. Our work as an agency is centered in the "Management Actions" area where we can re-assess changes from previous iterations, allowing us to adaptively manage (whether strategies or information we convey).

Defining Conservation Targets

Determining where to focus limited resources in the face of accelerating threats to ecological integrity is a challenging task. The EBCI works to identify and prioritize conservation targets through the integration of both cultural values and modern scientific perspectives. In turn, EBCI Natural Resources focuses its conservation strategies on biological conditions that will affect prioritized conservation targets. Specific biological conditions receiving management attention consist of species, assemblages, and habitat specific conservation targets based upon a variety of cultural, economic, legal, and ecological factors. The following social and cultural decisions guide the establishment of conservation targets:

- EBCI government approved natural resource management planning documents (i.e. "Legacy Plan")
- EBCI natural resource codes and laws
- Federal laws, regulations, and statutes that have been demonstrated to be applicable to Native American Trust lands (i.e. Endangered Species Act of 1973)
- Community guidance (i.e. elders advisory boards, hunters, Cherokee language)

The following criteria are assessed in this management document to develop conservation target priorities and direct management actions. All species that meet one or more of the following criteria are considered Cherokee Species of Concern (CSC) and are further sub-categorized based upon primary and secondary cultural or ecological values (Appendix 1. Cherokee Species of Concern).

Culturally Significant Species

We prioritize species for this classification based upon an expression of community value as documented through the EBCI Legacy Plan, contemporary and historic public input, and historic documentation verified by the EBCI Tribal Historic Preservation Office. Animals also often possess multiple cultural values and uses. These include species that:

- Are difficult to assess, yet are hunted, fished, and trapped for consumptive or recreational purposes (Cultural-Subsistence)
- Support material needs including artisan and traditional cultural practices (Cultural/Practice)
- Support spiritual values and other non-consumptive uses (Cultural-Aesthetic)

Ecologically Significant Species

Species meeting this classification have been prioritized based upon legal and regulatory factors, range-wide and EBCI conservation status, as well as relative importance to ecosystem processes

- Species that are federally protected under the Endangered Species Act of 1973 (Ecological-ESA)
- Species classified as Federal Species of Concern, species being assessed for listing under the ESA, or species known to be rare and/or declining on EBCI Trust lands (Ecological-Rare)
- Native or non-native species that threaten to cause net harm to economic or cultural values either directly or indirectly through changes to the environment or impacts to native species (Ecological-Invasive)
- Species that perform critical ecosystem functions and without their presence cause decline in other community members (Ecological-Keystone)
- Whose status is either rare or unknown as defined by EBCI Natural Resources

Biodiversity

It is the responsibility of the EBCI Natural Resources to improve our ecosystems by maintaining a great diversity of species to fill all essential roles in the environment. Preserving a higher biodiversity of species is critical to maintaining ecosystem services that include but are not limited to waste pollutant decomposition, maintenance of water quality and forest health, nutrient cycling and soil formation, pest/disease control, and crop pollination. Conservation targets prioritized within this category include species assemblages that perform critical ecosystem functions, and whose status is either rare or unknown as defined by EBCI Natural Resources (Appendix 2).

Maintenance of biodiversity at multiple scales including the species diversity, within species genetic diversity, and habitat diversity is also necessary to provide (sustainably) material and cultural services to the Cherokee community. All native organisms found within Cherokee's aboriginal homelands are tied to Cherokee identity and culture. The simple act of seeing the diversity of life within streams and a forest can provide a spiritual connection and is provides an economic value as a view-scape (EBCI 2013).

To protect this diversity, we wish to understand the conservation status of all species native to Cherokee lands and waters and implement strategies to mitigate threats to their persistence. In the initial phases of our work, we perform much inventory and monitoring that can help us understand the biological diversity of a variety of organismal groups that exist on Cherokee

lands (Appendix 2). Species assemblages facing existing and impending threats also receive prioritized management attention (Appendix 1&3). Much of our work centers on the discovery of the Cherokee biodiversity, which is still largely unexplored, especially when considering changes in diversity over temporal or spatial scales (e.g. Beta Diversity).

External Anthropogenic Threats & Benefits

Many people, whether community members, tribal leaders, conservation groups, or federal agencies, make decisions that do not pass through our EBCI natural resource program to conserve and protect wildlife (Fig. 1). These external, or anthropogenic decisions, can either help or harm vulnerable species, or the environments they occupy. People make decisions based on economic or social needs that can either follow or work in opposition of EBCI Natural Resources' conservation goals. For example, run-off into streams occurs on EBCI lands because of construction activities for creating businesses, houses, or roads. After some assessment, we might determine that these anthropogenic activities are harmful to the environment. We may determine through sampling or experimentation that ecosystems are degraded (e.g. via siltation, increased temperature), and active remediation may include stocking filter-feeding mollusks or planting trees to control erosion and temperature. Despite our efforts as an agency to remediate damage caused by human actions, it would be up to these external anthropogenic decision-makers to curtail much of the damage through changes in future activities (such as reduced construction around stream banks).

We are, however, fortunate that people work to benefit Cherokee ecosystems, independent of our management involvement. Private citizens work to protect their natural resources, especially those that are important for harvesting. For example, white-tailed deer (*Odocoileus virginianus*) densities are less than fifteen animals per square mile the southern Appalachians (North Carolina Wildlife Resources Commission 2015), yet deer are a culturally significant species to the Cherokee (Mooney 1900). In a recent deer restoration effort (2013-Present), we determined that deer poaching is low on tribal lands and many citizens were willing to help to manage land and report deer sightings for our research and management. Private citizens are more than happy to plant trees, provide habitat and food sources for all wildlife.

MANAGEMENT ACTIONS

We group our management actions into 1) conservation strategies, which work to enhance contributed ecosystem services through altering biological conditions and 2) information transfer and processing, which functions to condense information that we collect about the fate of natural resources for informing decision-makers and the public. For example, after each conservation target (see Appendix 3) is identified, we must assess its biological condition, what information is transferred, strategies of conservation we implement, and whom the decision-makers will be. The manner that we perform these activities may be different for each conservation target. The following section broadly summarizes how our work as a fisheries and wildlife program fit into thematic areas for adaptive management.

Conservation Strategies

Conservation strategies focus on altering biological conditions and subsequently enhance contributed ecosystem services. Our strategies to conserve and protect natural resources fall into two main areas: 1) Inventory and Monitoring, and 2) Management and Research.

Initially, we inventory our populations, communities, and ecosystems to determine what resources may act as services to the tribe (arrows moving into and out of Biological Conditions & Contributed Services- Fig. 1). Even though we continue inventory activities throughout every cycle of the process, our next step is to focus on species, populations, communities, and ecosystems that are given priority by social and cultural decisions. Social and cultural inputs that have led to the prioritization of these conservation targets include the development of the EBCI IRMP, Traditional Ecological Knowledge (TEK) provided through elder advisory board meetings and language groups, ongoing outreach with Cherokee leadership and community members, as well as tribal and federal regulations pertaining to fish and wildlife resources. These priority biological conditions become part of our monitoring efforts. To conserve these priority biological conditions, we develop adaptive plans that include active management and research. Research can inform what management strategies will be best suited to conserve a biological condition. Research generally comes in the form of experimentation or associating changes of the priority condition's status with changes to the environment. Therefore, research results can inform management decisions and methods.

The following outline provides our specific goals and objectives related to the present CWAP conservation strategies and supportive processes (Inventory and Monitoring):

Inventory & Monitoring

Goal: Evaluate the composition, distribution and trends of organisms and their habitats

Objectives:

1. Develop a comprehensive understanding of species, communities and ecosystems on EBCI lands
    a. Conduct field studies to determine the occurrence and location of all vertebrate species, vascular plant species, and selected invertebrate species.
    b. Collect abiotic information through field and remote sensing methods pertaining to aquatic and terrestrial ecosystems

2. Understand the status and trends of priority biological conditions
    a. Conduct population level surveys focused on growth, life history and behavior
    b. Conduct community level surveys focused on species composition, biomass, trophic structure and complexity
    c. Conduct ecosystem level surveys focused on primary and secondary productivity, nutrient dynamics, physical habitat conditions, and biotic interactions

Management & Research

Goal: Implement natural resource conservation strategies to enhance the integrity of biological conditions

Objectives:

1. Sustainably manage game populations utilizing scientifically defensible data to meet EBCI community subsistence needs
    a. Collect hunter harvest data
    b. Collect population growth and demographic information
    c. Implement management decisions related to harvest regulation, habitat enhancement, and population augmentation strategies
2. Establish desired biological conditions through the implementation of species, community and ecological restoration projects
    a. Determine compositional restoration targets
    b. Conduct native species introductions and associated research projects
    c. Conduct habitat augmentation and associated research projects
3. Understand and mitigate the impact from nuisance and non-native invasive species
    a. Conduct research projects to understand the direct and in-direct impacts of nuisance and non-native invasive species
    b. Conduct removal efforts on prioritized species
4. Contribute to landscape scale rare species conservation efforts and satisfy Endangered Species Act Section 7 requirements related to the implementation of EBCI projects
    a. Complete presence - absence surveys for species listed under the ESA to both meet EBCI regulatory requirements and contribute to recovery efforts

b. Conduct field studies focused on understanding the abundance, distribution, and life history requirements of U.S. Fish and Wildlife designated Candidate species (C) on EBCI lands

Information Transfer & Processing

Our conservation strategies would not be possible without supportive processes, like outreach activities and science-based dissemination. After we learn what organisms exist in the environment and how they may be of benefit to the tribe and the rest of the ecosystem, our program is tasked with organizing and disseminating this information. We develop a variety of reports for private, state, federal and tribal collaborators and funding agencies. To develop these reports, we collect, store and summarize our inventory and monitoring data. We interpret these data and provide management recommendations. If there are areas we do not possess expertise, we contract other biological staff and work closely with state and federal biologists to develop reports and recommendations. We identify our audience and our methods of processing and transferring information for every conservation target plan (Appendix 3).

Outreach

Goal: Lead in educating the Cherokee community about natural resource conservation issues

Objectives:

1. Generate print and digital media to inform the Cherokee community about ongoing conservation initiatives
2. Implement citizen science initiatives to improve EBCI Natural Resources data collection capacity and facilitate community stewardship
3. Engage the Cherokee community to better understand and incorporate modern and traditional sources of ecological knowledge into the EBCI Natural Resources planning process
4. Provide information to Tribal leadership pertaining to trends in biological conditions and their relationships with contributed services to the Cherokee community
5. Create opportunities for student intern and graduate student training

Science-based Dissemination

Goal: Facilitate the organization and transfer of scientific information between EBCI Natural Resources and external stakeholders

Objectives:

1. Effectively manage and manipulate both quantitative and spatial data to inform conservation initiatives
2. Sustain cooperative relationships with external natural resource management entities to enhance the Tribe's capacity to implement large-scale fish and wildlife conservation projects
3. Share and utilize the best available scientific information to inform conservation decisions

4. Review and improve the implementation of federal and tribal regulations pertaining to fish and wildlife conservation
5. Compile and integrate results from inventory, monitoring, management, and restoration strategies into existing conservation plans mechanisms

A FRAMEWORK FOR ADAPTIVE MANAGEMENT

When biologists need to coordinate and organize complex scenarios for a goal-oriented strategy to conserve a variety of species and their environments, they consider applying adaptive management perspectives (Lancia et al. 1996). Adaptive management follows a process that builds upon itself iteratively so managers are constantly learning from experience or experimentation; where assessment and re-assessment helps adjust to any perturbations to the focal system (Lancia et al. 1996). These strategies were first helpful in situations where there was uncertainty in the environment or changes could occur (Riley et al. 2002). Because environments and human-interests change so quickly, the application of adaptive management has proven difficult and often only used as a theoretical perspective for fisheries and wildlife management (Lee 1999). The most complex scenarios include coupled human and natural systems where society changes (i.e. policy and culture) and so does the natural world. Therefore, few examples exist of a social-ecological perspective with real-world application for adaptive management.

With a rich culture tied to their environment, a fully functional sovereign government, and a contiguous land base in one of the most biodiversity rich areas on the continent, the Eastern Band of the Cherokee Indians possess the perfect situation to develop an adaptive management framework around social-ecological perspectives. Although our management actions function independently of external changes from humans (social changes such as harvest strategies, economic growth) and the natural world (floods, climate change, invasive species), we are adaptive to these changes in our management strategies. In our model, a change might occur independent of our management actions. When a change occurs in either of these external areas, we, as a management agency, must alter our methods to fit the change to meet a goal of conserving natural resources. We can use this model to track our progress, acting as a guidebook for assessment and re-assessment during periods when we must adjust our methods to external changes.

Our model (Fig. 1), when implemented for our conservation strategies to effect biological conditions and the subsequent information transfer activities provides the foundation for applying adaptive management in a cyclical nature. Through this framework, annual action plans are implemented involving inventory, monitoring, research, and restoration strategies. Although it is not outlined directly in this document, we are developing models for every conservation target (Appendix 3) so we can track the success and progress of our efforts and how we adjust to various external changes. We then conduct assessments to support the transfer of relevant information to social-cultural decision makers. In a practical sense, this most often involves communication with Tribal leadership, federal regulatory agencies, and funding entities- but we also perform outreach to tribal community members and schools. Social-cultural decision making then shapes our conservation priorities and strategies based upon ongoing impacts to Cherokee cultural and ecosystem services. Conservation strategies for specific targets can be maintained (i.e. continued monitoring of biodiversity indices), expanded (i.e. monitoring transitioning to research) or reduced (i.e. species no longer specifically monitored due to successful recovery efforts). From these decisions EBCI Natural Resources develops revised status updates of Cherokee Species of Concern as appropriate and develops updated annual conservation work plans based upon available budgets and operational capacities.

Currently, most of our efforts fit into baseline inventory and monitoring where we simply determine population presence and stability. Future efforts will have more research and active management areas that respond to various external activities or changes (i.e. natural biological or social and cultural decisions). These potential changes and our active management is summarized in Appendix 3. Appendix 3 provides a baseline for future revisions of our work- that are functionally iterative and adaptive in nature. We are planning periodic assessments where we learn from previous work with a goal to remove at risk species and develop best management practice for others.

Over the years, our management has shifted due to both changes in society and our biological conditions or the services they provide. To paint the picture of how we adaptively manage following changes, we provide examples here.

Example of Changes in Social & Cultural Decision-making

Our program is subject to any federal listing changes to species under the Endangered Species Act, despite their status on tribal lands. For example, Indiana bats (*Myotis sodalis*) were first added to the Endangered Species list in 1967, despite their potential for great abundance in the southern Appalachians. Therefore, this change in priority and management was due to external decision-making rather than local assessments of biological condition. This listing lead to federal protection on tribal lands, which meant that a moratorium for cutting potential summertime roost trees was in place. Many tribal members must contact our program or the Forestry Department for the Bureau of Indian Affairs prior to cutting any tree down on their property. We survey for trees that fit the defined tree roost specifications for bats and must coordinate a survey to verify that bats are not exiting a tree before tree removal is allowed. It is important to note that this does not occur on neighboring state lands where private citizens often remove old trees, which happen to be ideal for roosting bats. To adaptively manage, we are now preparing an experimental use of acoustic detectors in hope to streamline the process for clearing roost trees.

Changes in attitudes toward species can also influence our management. Within the southern Appalachians, the EBCI consider invasive species one of the greatest threats to cultural and economic stability (EBCI 2013). Some non-native species, however, have taken the beneficial place of native organisms as cultural and economic resources. With our definition of a net harm to EBCI resources, some situations will require evaluation. We do not consider a non-native or exotic designation as equivalent to invasive. Our program believes that invasive species are most appropriately defined as a species that causes net harm to Cherokee economic, cultural, or natural resources. There are many examples of non-native species used for horticultural and agricultural purposes becoming naturalized and leaving a net positive benefit to people, ecosystems or communities (Brown and Sax 2004, Colautti and MacIsaac 2004). For example, Japanese honeysuckle (*Lonicera japonica*) is deemed an invasive species by many federal and state agencies because it can crowd out or outcompete native species (Munger 2002, Schierenbeck 2004), but many Cherokee tribal members have adopted this East Asia native as culturally important for making baskets. Honeysuckle baskets are easier on elder hands than traditional rivercane and white-oak, and preferred by some basket makers. Our program has not verified any case that Japanese honeysuckle caused negative impacts outside of already disturbed areas, so the net harm is likely negligible. Although this honeysuckle

species was initially designated as invasive, we now consider it a culturally significant organism.

Example of Changes to Biological Conditions & Contributed Services

There are many biological and environmental changes that are not within the control of our management but influence what we do to protect organisms or the resources they provide to people. These may include, but not limited to invasive species, droughts, tornadoes, disease, and climate change. Flooding, for example, can have dramatic consequences to our ecosystem as a source of change from the biological conditions and contributed services box of the model (Fig. 1). Flooding of our road culverts is a result of external and natural processes that occurs independent of our management that threatens Brook Trout (*Salvelinus fontinalis*) populations (Poplar-Jeffers et al. 2009). To respond, our program develops information summaries about habitat degradation and trout population assessments that is transferred to tribal council for funding requests to mitigate the issue (social and cultural decisions). If funded, we work with EBCI engineering and Department of Transportation to 1) develop bank stabilization and riparian restoration, 2) install bottomless culverts for fish (of all age classes) to pass under low flow conditions, and 3) continue staff funding to monitor Brook Trout.

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APPENDICES

Wildlife species have been identified as conservation targets based upon factors that directly impact the Cherokee people's livelihood and well-being. The following criteria are assessed in this management document to develop conservation target priorities and direct management actions. All species that meet one or more of the following criteria are considered Cherokee Species of Concern (CSC) and are further sub-categorized based upon primary and secondary cultural or ecological values (Table 1.).

We organize our current priority targets (conservation targets) and any projects associated with each target according to the services they provide for the tribe, or the ecosystem. Each year, we adjust our methods and strategies based on results and data collected in previous years as well as any new social or cultural information or needs that arise during the year. Social changes occur when, for example, tribal citizens or leaders decide to add a new value (usually economic or cultural) to a target. Changes also occur when species become federally listed under section 7 of the Endangered Species Act. We might also gain more knowledge about the cultural importance of a species. Another portion of the adaptive process comes when we alter our conservation work. For example, we might have been surveying a species for a number of years and decide to monitor for any changes in their population. This adaptation from inventory to monitoring allows us to determine how well a species is doing. If we determine that a species, we are monitoring has declined or no longer occurs in a location, this could lead to questions. These questions form the basis of research. Within the tables below, we walk through our adaptive management process, first stating our management goal, the history of the target as well as any previous projects involving that target and how the project has evolved over the years. Next, we detail our current project methodology, any results we may have for the year and finally any adjustments we plan to incorporate into our methods in the following year. In addition, we have listed what kind of service these conservation targets provide, which gives some insight into our reasoning behind prioritizing the species or community of animals. The table below explains each contributed service that may be listed below each target.

Table 1.

Contributed Service	Definition
Cultural	A non-material benefit that contributes to the development and cultural advancement of people (ex. spiritual, recreational, sense of place).
Provisioning	Any type of benefit to people that can be extracted from nature (ex. Food, Water, Fiber, Fuel).
Regulating	Benefit(s) provided by ecosystem processes that moderate natural phenomena (ex. climate, wastes, pest & disease control).
Supporting	Services that help the ecosystem supply other services (ex. nutrient cycles, soil creation, pollination, flood control).
Biodiversity	Contributes to the variety of life in the world or a particular habitat or ecosystem.
Economic	Provides monetary value (direct or indirect) to the tribe.

The conservation targets and associated projects listed below are not all encompassing of what the Office of Fisheries & Wildlife Management works on each year. In addition to these projects, we work and collaborate on several "non-target" projects which might include outreach events, such as the Island Discovery event that takes place each year, research projects that are cross-jurisdictional but provide the tribe benefits, and any other large-scale projects, such as climate change, that work beyond fish and wildlife specifically but definitely impact these resources. These projects may not be listed in the paragraphs below but at the end, we list the current projects that work beyond our core conservation targets.

<table>
<tr><td colspan="3">Conservation Target: Black Bear (Ursus americanus)</td></tr>
<tr><td colspan="3">Management Goal: Conserve a hunt-able black bear population while minimizing human-bear conflict.</td></tr>
<tr><td>Biological Conditions
Unknown population characteristics related to hunter harvest, stable habitat</td><td>Contributed Service
Provisioning, Cultural, Supporting</td><td>Conservation Strategies
Monitoring, Research, Management</td></tr>
<tr><td colspan="3">History and Adaptive Process: The American black bear once ranged throughout North America, including most of North Carolina. Currently, they are only found throughout the Piedmont, Coast, and Mountains of the state and not in more central and eastern portions. Over-harvesting and habitat degradation pushed them into more remote mountain areas including the Great Smoky Mountains National Park and EBCI Tribal Reserve. There are many stories and teachings about bears within Cherokee culture where they are called Yo-Na (ꮕᎾ). A few years ago, the dog training season was extended into the Spring, due to hunter interest in keeping dogs ready for the Fall hunting season. Conflicts arise when dogs venture into the park after bears and dogs are collected. Since 2007, we have gathered samples from voluntary hunter harvest. The average number of participants is 2.5 a year with the peak being 15. According to several hunting groups, these participant numbers are far below that harvested annually. Low participation, despite a monetary incentive, has led us to seek alternative assessments of bear populations. In 2008, we initiated bear bait stations with NCWRC to determine presence. After assessment, we determined that there were methodological deficiencies in transect positions, so the bait stations were discontinued in 2019. Looking for better methods to understand bear populations, we chose to implement a bear hair snare study, beginning in 2020, supplemented with camera trapping. The hair provides a DNA sample to determine individual identification for a re-capture dataset resulting in a quantitative-driven density estimation. Camera trapping helps confirm DNA results and can provide demographic and behavioral information- like sow-cub ratios. Even though we have fewer human/bear conflicts than our neighbors, we continue to manage conflicts as needed. Working closely with NRE staff, we have developed methods to mitigate human/bear conflicts. We have also obtained funding for forensic evaluation and management of conflicts.</td></tr>
<tr><td colspan="3">MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Monitoring:
• Continue to collect hunter harvest and demographic data from teeth (age, reproductive frequency) and tissue (DNA banking).
• Assist in any wildlife/nuisance calls regarding black bears.
Research:</td></tr>
</table>

- Implement bear hair snare study coupled with camera traps across a randomized block design to gain more information about bear populations.

Management:

- Perform outreach with hunters and the public to foster a stronger tagging and reporting system.
- Install preventative measures, such as fencing, for nuisance bear issues when warranted.

Results and Discussion for Information Transfer and Processing

Research:

- Hair collected from bear hair study across two years resulted in demographic data from 26 individuals and 3 family groups.
- 25 bear teeth collected from 2015-2022 were sent for aging analysis.
- Perform analyses on bear hair study data to work towards peer reviewed publication.

Management, Social & Cultural:

- Volunteer participation in hunter harvest tooth collection was very low (n = 2).
- Human-wildlife conflicts occur mostly near trashcans.
- Worked with over 14 landowners regarding nuisance bear issues and property access for bear hair study.
- We leverage private land-owner access to maintain hair snares and camera traps. We inform these citizens across almost 20 sites about the presence of bears and other species, providing them images and data.

Adaptive Decision for 2023

Management or Methodological Changes:

- Expand bear hair snare study to include 20 randomized sites.
- Continue to explore photo and hair data to determine the effect of human presence/development on bear activity, number of bears per season, and bear movement.
- Use hair snare study and camera trapping to help evaluate human-wildlife conflicts.
- Work more with NRE to get more samples from nuisance bears.
- Evaluate effectiveness of preventative measures & explore alternatives.
- Increase hunter participation in harvest reporting.
- Work with sanitation to inquire about bear-proof trashcans.

Social & Cultural Changes:

- Determine if increase in prize money will increase hunter participation.
- Communicate with the public about bear safety, reduced feeding opportunities, & hunter participation.
- Propose changes to the Tribal Code regarding tagging and reporting harvest of black bears.

Partners: EBCI Natural Resource Enforcement (NRE), North Carolina Wildlife Resources Commission (NCWRC), Western Carolina University (WCU), Matson's Laboratory

Conservation Target: Bats - some federally listed species

Management Goal: Conserve the diversity and abundance of native bats.

Biological Conditions	Contributed Service	Conservation Strategies
Impacts from disease, habitat priority	Biodiversity, Supporting, Regulating, Cultural	Inventory, Research, Management

History and Adaptive Process: Cherokee stories hold bats (Tsa-Me-Ha GOlo*v*) in high regard as a species that represents diversity and inclusion for the game stickball. Bats are the primary consumers of nocturnal insects, consuming thousands of potential agricultural and forest pests daily. They are incredibly important to the ecosystem yet often misunderstood as a nuisance animal. Previous mist-netting surveys of bats between 2004-2015 on the Qualla boundary have resulted in captures of the federally listed Northern-long eared bat and Indiana bat on EBCI lands. National/local populations of bats have been impacted by White-nose syndrome (WNS) and habitat degradation. Mist-netting for bats has occurred on EBCI lands since 2005 for both regulatory and research purposes. Long-term netting surveys have been supplemented with mobile and stationary acoustic surveys since 2011. The unknown effects of COVID-19 on bats and the loss of federal permitting caused us to initially switch exclusively to monitoring bats non-invasively using acoustics. Upon re-evaluating our methods in the adaptive process, we found that low recapture rates were enough reason to reduce stress and switch exclusively to acoustic sampling. Protections on bats have also impacted Tribal development and forestry practices on the boundary. Surveying of trees before and after removal and performing acoustic studies and mist-netting was previously a requirement of USFWS which often resulted in delays in housing and development projects on the boundary. However, in 2021 an agreement with USFWS (Programmatic) was put in place to allow development projects to continue with fewer restrictions regarding bat habitat.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Conducting passive acoustic surveys via a stationary bat detector across the boundary.
- Conducting mobile acoustic surveys across the boundary.

Research:

- Performing analyses on acoustic data, working towards peer reviewed publication.

Management:

- Continued efforts working with BIA Forestry to maintain accurate records of all timber removal per Programmatic reporting requirements.
- Performing pre- and post- tree removal surveys as needed.
- Working through data management techniques for large number of acoustic files.

Results and Discussion for Information Transfer and Processing

Ecological:

- Acoustic evidence suggests that EBCI lands continue to support, up to 11, different species of bats.

Management:

- Large amounts of data produced are difficult to manage.

Social & Cultural:

- Reduced restriction on tree-cutting has allowed for quicker processing but reporting requirements are difficult to maintain without cooperation from partners.
- Worked with 4 landowners regarding nuisance bat issues.
- Participate in National Environmental Policy Act (NEPA) training provided by the BIA.

Adaptive Decision for 2023

Management or Methodological Changes:

- Work towards obtaining Endangered Species Permit to start mist-netting listed or rare bat species in areas that they are acoustically detected.

Social & Cultural Changes:

- Continue working with the public to educate about the importance of bats.

Partners: Natural Resources Enforcement (NRE)**,** BIA Forestry, U.S. Fish & Wildlife Service (USFWS)

Conservation Target: Carolina Northern Flying Squirrel (*Glaucomys sabrinus)* - Federally Endangered

Management Goal: Conserve Carolina Northern Flying Squirrel populations

Biological Conditions	**Contributed Service**	**Conservation Strategies**
Strong population fluctuations, habitat priority	Biodiversity, Supporting, Cultural	Inventory, Monitoring, Research

History and Adaptive Process: Like bats, flying squirrels (De-Wa- SG), are revered in Cherokee moral stories in relation to their role in the game of stickball. The Carolina Northern Flying Squirrel (CNFS) is found only in the high mountaintops in western North Carolina, southwest Virginia, and eastern Tennessee. It was listed as Endangered in 1985, likely due to the loss of mature trees suitable for nesting. The CNFS is only known to occur on EBCI lands within the Tribal Reserve**.** Initial nest-box surveys for CNFS were conducted in 2006, however the first detection of the species was not found until 2008. Continued nest-box surveys from 2009-2019 yielded only 4 recaptures (>4% recapture rate) but nearly 90 CNFS and 50 southern flying squirrels (SFS) total captures. Due to the limited resulting data and potential stress on the animals, we stopped monitoring nest boxes and developed a plan to monitor flying squirrels using acoustics. This monitoring method took some development but can be used for both SFS and CNFS. Pilot- studies for squirrel acoustics began in 2019, with official surveys starting in 2021. Official surveys for the first year identified both species of flying squirrels. High elevation spruce-fir forests are listed as a restoration priority under the revised EBCI Forest Management Plan. We have participated in the spruce-fir working group for our region- where restoration is a priority.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory & Monitoring:

- Conduct acoustic surveys using passive acoustic detectors to determine flying squirrel distribution across the boundary.

Research:

- Process recordings to determine flying squirrel distribution during different winter/spring time periods (November through May).
- Work towards modeling occupancy of flying squirrels across the boundary and preparing data and methods for peer review.

Management:

- Create training material for interns and staff to be able to process squirrel recordings.
- Aid tribal citizens with flying squirrel issues as they arise. Usually helping to remove animals from attics.

Results and Discussion for Information Transfer and Processing

Ecological:

- Both species of flying squirrels are still found within high elevations of Tribal Reserve.
- Flying squirrel trills are the easiest to identify within our recordings and potentially the most abundant of the squirrel call types.
- There are areas with ideal habitat that have never had CNFS captures.

Management:

- Implement acoustic detectors during winter, avoiding early spring, to maximize number of squirrel recordings over other mammal sounds.

Social & Cultural:

- The habitat that CNFS occupy is at risk for future developments.

Adaptive Decision for 2023

Management or Methodological Changes:

- Work towards creating an automated process for finding flying squirrels within recordings to streamline the process.
- Gain management experience from the spruce-fir working group and add restoration plans to our land management plan.
- Obtain an updated ESA permit.

Social & Cultural Changes:

- Maintain ESA compliance and advise on projects that occur at high elevations in vital CNFS habitat.

Partners: North Carolina Wildlife Resources Commission (NCWRC), U.S. Fish & Wildlife Service (USFWS)

Conservation Target: Bird/Anuran Communities

Management Goal: Conserve the diversity and abundance of native birds.

Biological Conditions	**Contributed Service**	**Conservation Strategies**
Variable populations, forest habitat impacts	Biodiversity, Provisioning	Inventory, Research

History and Adaptive Process: The state of North Carolina has more than 450 avian species including migratory and resident species. Currently we have catalogued 40% of the potential 161 species that could occur in and around tribal lands and waters. EBCI lands contain a variety of avian habitats which offer a potential for increased bird diversity**.** The EBCI has previously contracted a bird biologist to conduct annual Breeding Bird Survey routes and Monitoring Avian Productivity and Survivorship (MAPS) studies on EBCI lands since 2011. This has also included nest-box surveys for Saw-Whet Owls. This has given us baseline inventory data for which we can continue to monitor bird populations. The need for more specific data, less-invasive methods, and fewer man-hours has pushed us to add a non-invasive monitoring approach, deploying passive acoustic detectors. The addition of these methods has also allowed us to add anuran communities to our inventory and establish baseline data. However, we still contract Blue Ridge Bird Observatory to conduct regular bird surveys and point-count surveys.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Establish baseline data for non-game birds and anurans using passive acoustic detectors.
- Work with NRE when injured raptor and other bird issues arise.

Research:

- Evaluate differences in point-count surveys versus the use of passive acoustic detectors.
- Participate in research with SARRs that takes place on EBCI lands.

Results and Discussion for Information Transfer and Processing

Ecological:

- Passive acoustic surveys are missing more common species.
- Point-count surveys yielded similar results to passive acoustic sampling.

Management:

- A large amount of data is produced using acoustic sampling.
- There is a need for additional training and the creation of an automated classifier due to limited staff and time for this project.

Adaptive Decision for 2023

Management or Methodological Changes:

- Expand survey to include the habitat types that are missing and sample opportunistically.
- Work to reduce amount of data produced by acoustic surveys.
- Continue to assist NRE on injured raptor calls.

Social & Cultural Changes:

- Work more closely with the language immersion programs and netting efforts to pass on knowledge.

Partners: Southern Appalachian Raptor Research (SARR) - Big Bald Banding Station, U.S. Geological Survey (USGS), North Carolina Wildlife Resources Commission (NCWRC)

Conservation Target: Wild turkey & Ruffed grouse (Phasianidae Family)

Management Goal: Promote hunt-able populations of forest game birds.

Biological Conditions	Contributed Service	Conservation Strategies
Unknown density/harvest rate/health, stable habitat	Provisioning, Cultural	Monitoring, Management

History and Adaptive Process: Wild turkeys and grouse are two game birds that can be found in western North Carolina and on EBCI lands. Wild turkey (*Meleagris gallopavo,* ᎬᎾ) and ruffed grouse (*Bonasa umbellus,* ᏫᎵᏍᏗ) are significant game animals for the Cherokee tribe. Our office works to understand their populations and distribution across tribal lands. Both species can be legally harvested under certain restrictions (see tribal muni-code section 113). Grouse/Gobbler surveys were conducted from 2012 to 2020 during the months of March and April. During these surveys, a vehicle would stop every half mile for a visual/auditory survey on Tribal Reserve roads. Due to the nature of Tribal Reserve roads, which contain switchbacks and turns, we found that we were often surveying within the same unit multiple times therefore any observation of grouse or turkey could have been double counted- a.k.a. pseudoreplicated. This was evaluated as a methodological flaw that would bias any conclusions. In addition, wild turkey poult populations were surveyed haphazardly throughout the month of August from 2008 to 2017- but citizen contributions from newspaper and social media was too minimal to contribute to our over-all population evaluation. We also accepted hunter/harvest records during some of these years. These surveys were discontinued due to lack of hunter participation and limited staff availability. To help account for the lack of staff capacity and hunter participation, we switched to non-invasive monitoring techniques, such as passive acoustic detectors and camera trapping.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Monitoring:

- Deploying passive acoustic detectors in Tribal Reserve and across the boundary during spring/summer months.
- Developing acoustic and camera-trap methods to identify game birds for occupancy and breeding phenology (peak breeding).

Management:

- Using data collected to find the best times to record information on game birds.
- Continued management of wildlife openings for the benefit of game birds and other harvestable wildlife.

Results and Discussion for Information Transfer and Processing

Ecological:

- Passive acoustic surveys were missing more common species including Wild Turkey, and Ruffed Grouse.

Management:

- A large amount of data is produced because of acoustic sampling.
- There is a need for additional training and the creation of an automated classifier due to limited staff and time for this project.

Social & Cultural:

- Minimal hunter participation or citizen science.
- We leverage private land-owner access to deploy acoustic detectors and camera traps. We inform these citizens across almost 20 sites, about the presence of these species.

Adaptive Decision for 2023

Management or Methodological Changes:

- Expand acoustic survey to include the habitat types that are missing.
- Work to reduce amount of data produced by acoustic surveys- so the recordings sample more efficiently.
- Analyze camera-trap data for occupancy- and determine if it might be sufficient sample to use for harvest recommendations.
- We are starting to work with the Wild Turkey Federation to promote youth hunting and help fund land management projects.

Social & Cultural Changes:

- Without hunter participation, we will not have full knowledge of population health. Staff capacity is also too low to attend check stations. Perhaps we can ask for code modification for electronic submissions.
- Include hunter education and youth hunting opportunities in our openings. Explore interest from the community.

Partners: North Carolina Wildlife Resources Commission (NCWRC), Wild Turkey Federation

Conservation Target: Bald and Golden Eagles (*Hailaeetus lucocephalus and Aquila chrysaetos* respectively)

Management Goal: To monitor eagle distributions and occurrences. Promote ethical use and procurement of feathers.

Biological Conditions	**Contributed Services**	**Conservation Strategies**
Unknown population (range edge), stable habitat	Biodiversity, Cultural	Inventory, Monitoring

History and Adaptive Process: Eagles (A-Wo-Ha-Li/ DᏭᏍᏉ) are important in Cherokee culture, as evident in our stories, ceremonies and even the eagle dance (DᏭᏍᏉ DᏢᎾᎯᎾᏗ) portrayed at the Cherokee Outdoor Drama Theater. In 1940, Congress passed the Bald Eagle Protection Act, later amended to include golden eagles (DᏭᏍᏉ DᏭSᏫ ᏧᎩᏓ), which prevented the selling, killing, or possession of any part of the birds. However, their decline continued due to threats of chemical contamination and habitat loss. In 1978, bald eagles were federally listed as an endangered species. Since their listing, populations have rebounded greatly. In 2007, they were removed from the threatened and endangered species list and bald eagles have been abundant in western North Carolina. We have met with groups that monitor golden eagles, but because we are at the southern end of their range, we may not see as many individuals, and they may only stay a short time. Anecdotally, there has been an increase in interest in having feathers for graduating high school students. The demand has increased with growth of state tribes and culture clubs, that have also found ways to source feathers. The USFWS has a backlog of eagle feather applications with citizens of EBCI waiting years. Therefore, many tribes are finding other ways to source feathers. Our office will support citizen interests in the use of eagles.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Intake of citizen sightings and haphazard sampling to determine locations, temporal occurrence for both bald and golden eagles.

Monitoring:

- Using trail cameras and opportunistic sightings. Leverage roadkill to bait camera traps for high elevation sampling of golden eagles.

Results and Discussion for Information Transfer and Processing

Ecological:

- Both golden and bald eagles have been found on tribal lands. Bald eagle sightings have increased over the last decade. Golden eagle presence seems to be isolated to the Fall and are undetected in some years.
- Sightings of bald eagles taking fish- assumed to be trout.
- Captured camera footage of bald and golden eagles competing over a deer carcass in previous years.

Management:

- Continued maintenance of riparian buffer for hunting purposes.
- Deer carcasses are difficult to source- we need to know if other carcasses will work to attract golden eagles to camera traps.

Social & Cultural:

- Compiling background materials on eagles.
- Made federal (USFWS) eagle feather applications available to community members.

Adaptive Decision for 2023

Management or Methodological Changes:

- Develop standard sampling project using camera trapping, citizen science and nest monitoring.
- Engage the USFWS on permitting and sampling.
- Obtain hands-on raptor handling experience with Carolina Raptor Center.
- Work more closely with the AMJV to capture and monitor eagles.
- Procure more carcasses- assess the golden eagle preference because deer carcasses are more difficult to source in our area.

Social & Cultural Changes:

- Become more active in eagle working groups.
- Engage the USFWS use of feathers and feather procurement and distribution for citizens.
- Issue standard processing statement for USFWS when illegal feather possession by individuals from state tribes and culture clubs have been identified.
- Work more closely with Tribal Historic Preservation Office and cultural experts on disseminating cultural and historical use of eagles to outside groups and tribal citizens.
- Educate about the impacts of lead ammo and good alternatives that can be sourced locally.

Partners: Eastern Golden Eagle Working Group, Appalachian Mountains Joint Venture (AMJV), North Carolina Wildlife Resources Commission (NCWRC), U.S. Fish & Wildlife Service (USFWS)

Conservation Target: Stream Fish Assemblages

Management Goal: To determine and conserve native fish species assemblages in EBCI drainages.

Biological Conditions	Contributed Service	Conservation Strategies
Non-Native Invasive Species, water quality threats, Man-Made barriers, variable populations.	Biodiversity, Provisioning, Economic, Public Safety & Health	Inventory, Monitoring

History and Adaptive Process: Modern-day EBCI trust lands are found within the Little Tennessee River and Hiwassee River watersheds and support a diversity of fishes and other aquatic organisms. Historical surveys have identified approximately 40 fish species from 9 families. Although diverse, the riverine ecosystems on EBCI lands face several threats including point and non-point source pollution, physical habitat manipulation and fragmentation, non-native species, acid deposition, and global climate change. In addition, housing and commercial developments and physical barriers, such as Ela Dam, threaten the stream fish assemblages in this area. Therefore, we continue to inventory and monitor fish species across EBCI lands, observing any negative impacts, especially to more sensitive species. We conducted Index of Biotic Integrity (IBI) surveys via electroshocking methods at six sites across EBCI waters since 2013. Due to our team's Adaptive Management procedure, we have been utilizing new developments in technology (environmental Deoxyribose Nucleic Acid- eDNA) since 2021 to determine if Non-Invasive methods are a viable option to conduct species assemblage surveys.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Conducted electroshocking & eDNA sampling to assemble fish species list.

Monitoring:

- Conducted fish bio-monitoring surveys through IBI & eDNA methods (6 sites).

Results and Discussion for Information Transfer and Processing

Ecological:

- We obtained fish population dynamics and diversity indices to calculate overall stream health.

Management:

- Adaptive management recommendations for ongoing habitat restoration efforts and other identified threats.

Social & Cultural:

- Participated in outreach efforts & programs with the public, most of which are youth oriented.
- Assessed health of highly used and culturally important resource (river system).
- Biological technician received training at the Highlands Biological Station for “Fish of the Southern Appalachians”.

Adaptive Decision for 2023

Management or Methodological Changes:

• Continue to assess effectiveness of eDNA (non-invasive) vs electroshocking (invasive) methods for species assemblage surveys. **Social & Cultural Changes:** • Continue to educate the public about the high diversity of fish species present within EBCI waters.
Partners: North Carolina Wildlife Resources Commission **(**NCWRC), Tangled Bank Conservation, LLC (TBC), Conservation Fisheries, Inc. (CFI)

Conservation Target: Hellbender (*Cryptobranchus alleganiensis*)

Management Goal: To understand Hellbender population dynamics and develop management procedures.

Biological Conditions	Contributed Service	Conservation Strategies
Non-Native Invasive Species, water quality threats, Man-Made barriers, variable populations.	Biodiversity, Regulating	Inventory, Monitoring, Research

History and Adaptive Process: The eastern hellbender (*dG*) is one of three salamander species in the world designated under the giant salamander family. In North Carolina, these animals are found in fast-flowing mountain streams. The hellbender is classified as a species of concern for North Carolina, as populations are variable. Hellbenders are associated with well-oxygenated, clear, and overall clean waters. On EBCI lands, adult hellbenders are found by anglers, locals, visitors, and biologists alike, however their true distribution on the boundary is unknown. Official **s**urveys for hellbenders began in 2018 with citizen sightings being recorded and haphazard surveys being performed and catalogued by outside groups in years prior. Surveys are carried out with two different methodologies (active & passive) via snorkeling across 11 sites in Tribal waters. Environmental DNA, or eDNA, has been used since 2021 as an additional tool for detecting hellbenders in sites where presence is unsure or cannot be effectively manually surveyed.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Conduct snorkeling surveys via active methods (snorkeling and rock-flipping) at alternating (odd, even) sites each year.

Monitoring:

- Conduct snorkeling surveys via passive methods (snorkeling without disturbing rocks) at all 11 sites each year during breeding season (August – September).
- Collect water samples for eDNA to determine hellbender presence.

Research:

- After noting that some sites along tribal waters lacked suitable hellbender habitat, we began to build concrete slabs in 2018 to be used as den rocks.

Results and Discussion for Information Transfer and Processing

Ecological:

- Since 2021, 10 hellbenders have been captured and PIT tagged. While present, compared to surrounding waterways with similar habitat, EBCI waterways appear to have relatively low-density populations.

Social & Cultural:

- Conducted outreach and snorkel event communicating the importance of this species.

Adaptive Decision for 2023

Management or Methodological Changes:

- Procure funding to conduct a No-Rise study so that concrete slabs can be placed into the river.
- Potentially accept and raise 30 Hellbenders from Dallas-Fort-worth Zoo.

- Continue to compare the effectiveness of active vs. passive surveys as part of our move towards non-invasive methods.

Social & Cultural Changes:

- Continue to work with the community to develop an understanding of the importance of these animals and dispel any misinformation about them.
- Distribute informational posters communicating the importance of not disrupting stream habitat (stacking rocks).
- Develop legal protections for hellbenders- against moving rocks and killing them.

Partners: North Carolina Wildlife Resources Commission (NCWRC), Tangled Bank Conservation, LLC (TBC), Conservation Fisheries, Inc. (CFI)

Conservation Target: Herpetofauna (reptiles and amphibians)

Management Goal: Maintain amphibian and reptile diversity across EBCI lands.

Biological Conditions	Contributed Service	Conservation Strategies
Variable populations, Stable habitat	Biodiversity, Supporting, Cultural	Inventory

History and Adaptive Process: The presence of amphibians, particularly salamanders (S&9S), provides traditional knowledge that water is clean. There are over 60 species of amphibians and reptiles in the western part of North Carolina and the Southern Appalachians represent the greatest diversity of salamanders in the world. Amphibians are the most important vertebrate for ecosystem function in the woodland environment by annually turning over tons of biomass in their consumption of insects. A total of 19 salamander species are recorded to occur on EBCI lands. However, many more are likely undocumented. In previous years, mostly haphazard surveys were conducted but we also deployed pitfall arrays, coverboards, and performed road cruising. In 2015, we hosted a bio-blitz focused on herpetofauna. This included 5 groups of 4-6 biologists from all over the southeast- including students and experts in each taxonomic category. In less than two days, the bio-blitz documented over 40 species. We expanded surveys to include environmental DNA (eDNA) and citizen science. eDNA typically involves the collection of water samples that are filtered and run through several established DNA primers for species identification. We are also using passive acoustic detectors to survey species of frogs on EBCI lands. The major threats to amphibians and reptiles are habitat destruction, persecution, invasive species, and introduced diseases.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Deployed passive acoustic detectors to record frog calls during the spring and summer months.
- Collected water samples at wetland sites across the boundary.
- Worked with external partners (TBC, NCWRC) to develop primers for herpetofauna, including bog turtles and Junaluska salamanders.
- Contracted external partners (TBC) to perform DNA analysis (quantitative PCR) on collected water samples.
- Conduct haphazard surveys for herpetofauna.

Results and Discussion for Information Transfer and Processing

Ecological:

- We have inventoried 45 of a possible 62 amphibian and reptile species so far. Broken into taxon groups (with percent of total potential): salamanders (76%), anurans (67%), turtles (50%), and lizards (67%).
- Common Mudpuppy (*Necturus maculosus*) was found on EBCI lands using eDNA methods.
- Several samples (7) were collected at wetland sites to survey Bog Turtles yet yielded no positive results.
- Acoustic survey recordings were missing several frog species that should have been identified within recordings (I.e. American Toad *(Anaxyrus americanus*)).

Social & Cultural:

- We worked between researchers and the consortium of fluent Cherokee language speakers to provide names for three new salamander species to science. These include *Desmognathus adatsihi, Desmognathus gvnigeusgwotli,* and *Necturus dunisdatlvi*.

Adaptive Decision for 2023

Management or Methodological Changes:

- Use mapping software to identify potential wetland areas across the boundary.
- Expand eDNA surveys for herpetofauna to include identified wetlands.
- Re-connect with external partners to identify problems with eDNA use and identify a path forward.
- Expand acoustic surveying to more sites across the boundary and include more wetland areas.
- Add road-cruising as a method for future herpetofauna surveying.
- Create training for interns and staff for processing acoustic recordings.
- Alter methods for acoustic sampling to minimize data collected and maximize species captured within recordings.

Partners: Tangled Bank Conservation, LLC (TBC), North Carolina Wildlife Resources Commission (NCWRC)

Conservation Target: Mussels

Management Goal: To restore native freshwater mussel species back to EBCI watersheds.

Biological Conditions: Non-native Invasive Species, Water quality threats, Man-Made barriers, Variable populations, Stable habitat	**Contributed Service** Cultural, Biodiversity, Regulating, Provisioning (historically), Public Health	**Conservation Strategies** Monitoring, Restoration

History and Adaptive Process: Despite having an important cultural and subsistence role in Cherokee history, freshwater mussels (ᎤᏣᏂᏕᏏ) have been extirpated from much of their historical range in tribal waters. This has been due to several factors, with the biggest of those being the Ela Dam. Due to their spawning methods which rely on various fish species to carry their larvae upstream, low density upstream populations have been unable to be replenished for nearly a century. Mussels have also played important cultural and ecological roles as food and material sources, as well as acting as natural water filters, removing chemical, bacterial, and fungal pollutants in tribal waters. Beginning in 2020 our team began restoration efforts at 3 sites (approx. 32,300 sq. Ft.) across the Oconaluftee River with three species, (*Lampsilis fasciola, Villosa iris, & Elliptio dilatata*). We stocked approximately 350 individually tagged mature mussels and have been monitoring their populations since then. In the spring of 2023, we partnered with NCWRC & Marion State Fish Hatchery to stock over 1,200 *Lampsilis fasciola* in tribal waters. Alongside our work, researchers from Western Carolina University have also come to study freshwater mussels and have successfully completed three master's degrees with the help of our team. Today, Cherokee artisans carve shells and must source their muscle shells off of tribal waters.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Monitoring:

- Passive surveys methods are conducted once a month from July-September to determine continued presence/quantity of mussels along 3 sites.

Results and Discussion for Information Transfer and Processing

Ecological:

- Since the stocking of the 350 tagged mussels, the totals of tags detected have decreased.

Adaptive Decision for 2023

Management or Methodological Changes:

- Continue to monitor stocked sites. Due to the decrease in detected tags, investigate reassessing stocking locations and understand what factors may be leading to mortality at sites.
- Partner with Marion Hatchery to purse the theory that Sicklefin Redhorse (*Moxostoma spp.*) may be suitable host for larvae.

Social & Cultural Changes:

- Pursue potentially partnering with other tribes for raising mussels due to their historical cultural importance.

Conservation Target: Eastern Box Turtles (*Terrapene carolina*)

Management Goal: To determine the presence/ density of the culturally significant species, the Eastern Box Turtle

Biological Conditions	**Contributed Service**	**Conservation Strategies**
Non-Native Invasive species, Stable habitat, Poaching/Pet trade, Variable population/slow reproduction.	Biodiversity, Cultural	Inventory

History and Adaptive Process: The Eastern Box Turtle is one of four subspecies of box turtles east of the Mississippi. Daksi (ᏔᎦᏏ) permeates the Cherokee culture through art, stories and ceremony. As a culturally significant, and admittedly charismatic species, our office has been haphazardly monitoring box turtles on EBCI lands since 2016. Our office has been collecting biological data from each individual and marking them with a unique identifier. Mark-recapture techniques have yet to yield a recapture since 2016. However, in 2021, we increased our efforts by accepting turtles from EBCI citizens more readily and created a standard procedure for our box turtle project.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Capture, mark, and release box turtles as they are found or brought to our office by EBCI citizens.

Results and Discussion for Information Transfer and Processing

Ecological:

- Since 2016, we have documented, marked, and released 27 box turtles, with no recaptures.
- One injured turtle was successfully rehabilitated and released on EBCI lands.

Social & Cultural:

- Work alongside members of the community to investigate reports of box turtles.

Adaptive Decision for 2023

Management or Methodological Changes:

- Expand inventory process to achieve recaptures.
- Explore the benefits of partnering with the North Carolina box turtle project.

Social & Cultural Changes:

- Increase public involvement through social media and other methods.
- Develop methods for better intake from public and public reporting.

Partners: North Carolina Wildlife Resources Commission (NCWRC)

Conservation Target: Timber Rattlesnake (*Crotalus horridus*)

Management Goal: Conserve Timber Rattlesnake population while minimizing human-snake conflict.

Biological Conditions	Contributed Service	Conservation Strategies
non-native invasive species, stable habitat, variable population/ slow reproduction, human persecution	Biodiversity, Public Health, Cultural	Inventory

History and Adaptive Process: Timber Rattlesnakes (also known as Canebrake Rattlesnakes and ᎤᏂᏅᏗ) have a storied history in Cherokee culture and on EBCI lands. Revered and feared, they have been at best avoided and at worst actively persecuted. Stories, like rattlesnakes' revenge, historically taught Cherokee children to walk away from these potentially dangerous animals, which is exactly what modern biologists recommend today. However, a settler-colonial perspective of natural resource subjugation has been adopted by many tribal citizens as well. Timber rattlesnakes have been almost entirely extirpated from the middle part of North Carolina. Noticing these trends, our team decided to expand upon our more generalized herpetofauna inventorying project to focus efforts on Timber Rattlesnakes. We plan to begin implementing road-cruising methods during the times that these animals are most likely to be observed. Haphazard and opportunistic survey methods will also be used. Morphological and habitat data will be collected on each individual and then they will be PIT tagged in the event of capture to potentially transition this project into a monitoring program.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Opportunistically capture and uniquely mark (with a PIT tag) Timber Rattlesnakes when found.

Results and Discussion for Information Transfer and Processing

- This project is still in development and will be discussed at future adaptive management meeting.

Adaptive Decision for 2023

Management or Methodological Changes:

- Develop and implement road-cruising & haphazard sampling methods.
- Move from only inventorying opportunistically to monitoring with more captures, effort-based sampling procedures and by implementing radio telemetry methods to further understand range, habitat use and for locating more individuals through den discoveries.
- Work with academic and state partners to expand our venomous snake capture training.

Social & Cultural Changes:

- Develop methods and outreach material for education of the public of the cultural and ecological importance of this species.
- Use the help of citizen scientists to locate and respond to calls about venomous snakes.

Partners: North Carolina Wildlife Resources Commission (NCWRC)

Conservation Target: Feral Swine (*Sus scrofa*)

Management Goal: Reduce threats of wild hogs to private land and culturally significant natural resources.

Biological Conditions	Contributed Service	Conservation Strategies
unknown density, disease vector, human-wildlife conflict, invasive threat	Provisioning (threat)	Management, Research

History and Adaptive Process: Feral hogs are widespread in western North Carolina and in the neighboring Great Smoky Mountains National Park. These animals are adaptable and highly prolific. Hogs are ravenous, eating almost anything they can fit into their mouth. They cause problems in ecosystems as they compete for resources with native wildlife, decrease water quality, increase soil erosion, spread diseases, and can eradicate native plant populations and communities. Pigs (Si-Gwa- ᏏᏆ), provide a food source through hunting, but the damage they can do far outweighs the benefits. Therefore, we have participated in collaring studies with the park to track hog movement, removed hogs from areas as necessary, and looked at hog damage to land-owner property and delicate headwater ecosystems.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Research:

- Use trail cameras to improve density estimates.
- Collecting opportunistic biological/health data from wild hogs.
- Survey headwater sites for hog damage.

Management:

- Develop strategies to reduce human-wildlife conflicts and damage management on EBCI lands.
- Assist in the development of tribal codes to mitigate wild hog disease threats to agricultural resources.
- Trap and assist USDA partners to reduce wild hog populations as necessary.

Results and Discussion for Information Transfer and Processing

Ecological:

- No hog damage was found at 11 headwater sites- but a baseline of plant communities was established prior to their invasion.

Management:

- New equipment purchased for trapping wild hogs.

Adaptive Decision for 2023

Management or Methodological Changes:

- Develop methods and test equipment for wild hog trapping.
- Continue monitoring headwaters for damage.
- Purchase equipment for NRE to continue management.

Partners: U.S. Department of Agriculture- Asheville Office (USDA), Great Smoky Mountain National Park (GSMNP), Virginia Tech, EBCI Natural Resources Enforcement (NRE)

Conservation Target: Sicklefin Redhorse (*Moxostoma ugidatli*)

Management Goal: Restore sicklefin redhorse to tribal waters.

Biological Conditions	Contributed Service	Conservation Strategies
Not detected after introduced. Do not appear to be a stable population in tribal waters, likely due to Ela dam.	Future Provisioning, Biodiversity	Monitoring, Restoration, Research, Lobbying, Outreach

History and Adaptive Process:
Recognized as a unique species now, this was known by the Cherokee people for centuries (u-gi-da-tli- ᎤᏪᏓᏅ). Along the creeks and rivers of Western North Carolina, the Cherokee once used fish weirs to capture and harvest sicklefin redhorse. The fish only became known to the scientific community in 1992. Because of their limited distribution and small densities, they were considered a species of conservation concern by the biological community. As a proactive consolation to the Endangered Species Act listing process, the sicklefin redhorse was placed under a Candidate Conservation Agreement (CCA) in 2015 between the United States Fish and Wildlife Service, North Carolina Wildlife Resources Commission, Duke Energy Carolinas (LLC), Tennessee Valley Authority, Eastern Band of Cherokee Indians, and Georgia Department of Natural Resources. Sicklefin redhorse fry stocking above Ela Dam was initiated in 2007. Regular adult redhorse boat electro-fishing surveys, including an intensive study with Western Carolina University from 2017-2018, have not resulted in any captures of adult sicklefin redhorse originating from stocking efforts. We continued to stock fry (larval) and young of the year age classes through 2021 whereupon we initiated a genetic study (sampling water) to evaluate the success of our efforts. Multiple efforts were also made to stock and radio-track adult sicklefin redhorse in the upper Oconaluftee watershed. Genetic study and radio-tracking results indicate that downstream dispersal over Ela Dam is preventing the successful re-establishment of this fish in EBCI managed waters.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Use environmental DNA (eDNA) and standard boat and backpack shocking surveys to identify sicklefin redhorse.

Monitoring:

- Perform telemetry tracking project of tagged adult sicklefin redhorse.

Research:

- Use of eDNA to determine the efficacy of stocking and test methods for detecting sicklefin at different distances.
- Use of telemetry to determine the impacts of Ela dam and general movement behavior.

Results and Discussion for Information Transfer and Processing

Inventory, Research and Monitoring:

- We tested eDNA results from 14 sites from 9/8/21 (pre and post stocking), most were negative for sicklefin presence before stocking. All samples were positive for sicklefin presence immediately following each stocking event. We tested 8 sites from 10/12/22 (pre stocking)- All were negative for sicklefin.

Management:

- In April 2022, 14 fish were implanted with trackers and tracked in the following months. Most implanted fish eventually went over Ela dam.
- 6,156 fish (1903 fry/larval, 149 large/y.o.y. per site) were stocked into the Oconaluftee.
- Evaluation of Ela dam- SFRH are likely not in the waters after passing over the dam, stocking isn't really working for us as a restoration method because animals seem to be moving over the dam and cannot return.

Social & Cultural:

- Speaker consortium agreed upon the name U-Gi-Da-Tli/ ᎤᏃᏓᏣ, translated as "it wears a feather".
- To introduce the importance of redhorse, we worked with the speakers consortium and Cherokee language learners on a fish fry where we captured black and golden redhorse. Myrtle Driver Johnson (beloved woman) led the cleaning and cooking of these fish for Cherokee language group and our staff.
- We are providing information in outreach forms about the damage dams can have to fish passage, for species like sicklefin.

Adaptive Decision for 2023

Management or Methodological Changes:

- Evaluation of eDNA for assessing restoration- look at data to determine how effective eDNA sampling was at detecting sicklefin redhorse. It seems very useful at as much as 2 kilometers.
- Because our results show Ela dam is a significant barrier to all age classes, we determined we should halt any introductions until the Ela dam is removed.

Social & Cultural Changes:

- There are social changes associated with the dam removal that requires a geo-political and financial lobbying effort by EBCI and NCWRC leadership.
- Increase access to redhorse fish as a food source- restoring interest in redhorse as a cultural species.

Partners: United States Fish and Wildlife Service (USFWS), North Carolina Wildlife Resources Commission (NCWRC), Duke Energy Carolinas, LLC, Tangled Bank Conservation, LLC (TBC), Tennessee Valley Authority and Georgia Department of Natural Resources, Western Carolina University (WCU)

Conservation Target: Elk (*Cervus elaphus*)

Management Goal: Minimize human-elk conflicts, manage calving habitat, estimate population size and eventually restore to a population size that can sustain managed hunting.

Biological Conditions	**Contributed Service**	**Conservation Strategies**
unknown density/health, stable habitat	Future Provisioning, Supporting, Economic	Monitoring, Management, Research

History and Adaptive Process: For thousands of years elk (A-whi E-Gwa- DᏫ RᏆ) had co-existed with people and thrived in the southern Appalachians but were wiped out nearly 250 years ago by the fur trade and logging. In 2001 and 2002, the National Park Service reintroduced 52 elk into the Cataloochee area of the Great Smoky Mountain National Park to determine if elk could survive and reproduce in the area. Elk thrived and established ranges outside the park boundary, including on EBCI lands. The Qualla boundary now holds 40-50% of the elk population in North Carolina. This has imposed challenges on EBCI citizens as elk wander and congregate in gardens and near tourists and businesses. Our program manages elk and their habitat by maintaining wildlife openings within the Tribal Reserve, away from downtown, and responds to nuisance calls. To help assist with population estimation, we have participated in population studies with external partners using fecal capture-recapture techniques from 2019-2021.

In 2020- Elk viewing garnered $29 million and 400 jobs to the Jackson and Swain County area. From that amount, Cherokee saw $7 million in financial benefits and ~100 jobs. A sizeable percentage of visitors (43%) had been to Harrah's Cherokee Casino within the past 12 months, with about a third of those visitors saying that having elk in the area influenced their decision to come to Harrah's Casino. In addition to the beneficial economic impacts, the presence of elk is appreciated by EBCI members: the overwhelming majority of members (80%) like having elk around, and 42% of members have engaged (or tried to engage) in wildlife viewing of elk. Problems with visitor viewing were twice that of problems with the elk themselves: in the past 12 months, 13% of members had problems with elk, while 26% had problems with people viewing elk. Examples of problems experienced with elk most commonly included damage to gardens and landscaping, while nearly all problems with visitors and tourists viewing elk involved transportation issues, such as traffic jams and illegal or obstructive parking. Among those who experienced problems, a majority (78%) still like having elk around: after discussing the problems they had experienced, 44% said they like having elk on the Qualla Boundary and 34% like having elk on the Qualla Boundary but worry about the problems they can cause. Only 9% of those who have experienced problems said they regard elk as a nuisance.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Monitoring:

- Deploy radio-collars and track study animals for movement, survival, and successful reproduction.
- Necropsy animals for age, health, and disease (I.e. Chronic Wasting Disease).

Management:

- Meetings with Risk Management and EBCI-D.O.T. about road signage.
- Perform outreach with landowners and public to mitigate conflicts.

Research:

- Participated in elk population study with external partners. We have several years of minimum counts and fecal DNA capture.
- Surveyed for calves in tribal reserve to help in population data collection.

- Deployed cameras for highway corridor study on elk.

Results and Discussion for Information Transfer and Processing

Ecological:

- Few elk identified using overpasses in highway corridor study.
- Collared one calf successfully during 2022 season.
- Responded to elk mortalities and perform necropsy on several occasions.
- Walked 46 transects, 27.5 miles for elk scat population study.

Management:

- Conducted elk traffic control on several occasions with NRE.
- Responded to 11+ elk nuisance calls.
- Manage 17 elk preventative fences.

Social & Cultural:

- Discussed elk issues and helped when warranted for several landowners.

Adaptive Decision for 2023

Management or Methodological Changes:

- Revisit population study for fecal capture-recapture. We are planning to partner again with the NCWRC and GSMNP but without UT with a focus on fields and open areas to sample. This will greatly reduce our efforts.
- Our program has deemed the population growth results inconclusive for making management decisions.
- Compare highway corridor study results to see if animal diversity and elk presence are the same for control and overpass sites.
- Create a map of elk fences and high traffic areas for future discussions with Risk Management.
- Apply methods for an elk behavior study.

Social & Cultural Changes:

- We now know elk are worth a lot of money (>$1million each/ annually). But we are unsure of the efficacy and feasibility of an elk hunt to garner revenue like other areas that have higher densities with more lands. Tourist dollars seem to rival that of draw hunts elsewhere, lending to the need of a professional assessment before we determine how best to use this resource. Tribal leadership or citizens might be driven more by social influence than by data in making decisions. The state of North Carolina may initiate a hunt but the population is a shared resource with the tribe.
- The tribe may want to evaluate the population assessment independently through professional review.

Partners: Blue Ridge Parkway, University of Tennessee Knoxville (UT), NRE, North Carolina Wildlife Resources Commission (NCWRC), Great Smoky Mountains National Park (GSMNP)

Conservation Target: Coyote (*Canis latrans*)

Management Goal: Reduce threats of coyotes to culturally significant natural resources.

Biological Conditions	Contributed Service	Conservation Strategies
unknown density, disease vector, nuisance threat	Provisioning (threat)	Management, Research

History and Adaptive Process: Coyotes are considered one of the hardiest and most adaptable species on the continent, surviving anywhere food is abundant. Coyote populations began expanding into North Carolina in the 1990's. As some states designate this species as an invasive species, coyotes compete for resources with other mammals and are opportunistic scavengers and hunters, eating anything readily available. There is some evidence that coyotes are significant predators on white-tailed deer fawns, a species protected by EBCI for their cultural value. Currently, hunting coyote on EBCI lands is strongly supported as there is an open season, no bag limit, and a $25 bounty per head. Our office implements the coyote bounty system, started around 2009, and collects biological and health data from harvested individuals as they are brough to us.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Management:

- Collect biological/health data from harvested coyotes.
- Implement coyote bounty system.

Research:

- We wish to ask about demographic characteristics of our coyote populations- the average age of hunted coyotes, the size, sex and phenotypic variation.
- We are collecting data on hunter effort per unit.
- We have contributed over 50 stomach contents to a diet study performed by researchers at Virginia Tech. Much of the contents included trash- which was not surprising given the hunting locations.

Results and Discussion for Information Transfer and Processing

Ecological:

- 71 total coyote tooth samples collected from 2015-2022 sent for aging analysis.
- Average age of coyote killed is 1 year old.

Management:

- Low participation in coyote bounty system has led to skewed results- where we believe coyote populations are not impacted by the bounty system.

Social & Cultural:

- There is no longer a wolf in the southern Appalachians. It is still debated whether coyotes serve that role in the ecosystem or culturally. Many call coyote by the same Cherokee name as wolf- ᏀᏍᎾ

Adaptive Decision for 2023

Management, Research or Methodological Changes:

- Look into opportunities to pursue a coyote diet study via DNA.
- How much influence has domestic dog hybridizing contributed to diet and behavior variation?

Social & Cultural Changes: • Evaluate low participation in coyote bounty system. • Determine whether coyotes are truly considered invasive.
Partners: EBCI Natural Resources Enforcement (NRE)

Conservation Target: White-tailed Deer (*Odocoileus virginianus*)

Management Goal: Restore and sustain a huntable deer population while minimizing human-deer conflict.

Biological Conditions	**Contributed Service**	**Conservation Strategies**
Unknown density/health, stable habitat	Future Provisioning, Supporting, Cultural	Monitoring, Management, Research

History and Adaptive Process: White-tailed Deer are tied to the history and culture of the Cherokee people as Deer Clan "A-ni Ka-wi", is one of the seven representative clans. At its height, up to one million deer skin pelts were taken annually from our region, which caused deer to nearly become extinct. Fortunately, the deer-skin trade ended by ~1800. Many restoration attempts followed over the next 150 years. Today, in North America, White-tailed Deer are extremely common throughout their range. Despite continued efforts of restocking, deer abundance within North Carolina is unevenly dispersed, with lower abundance in the mountains. The low densities prevent traditional harvesting of these animals; therefore, it is incredibly important for our office to work to restore and maintain these animals. Over the last hundred years, there have been several efforts to increase densities of deer. From 1900, managers have stocked 60 different efforts in western North Carolina with 3,387 total deer relocated and released. One of these efforts included releasing over 257 individuals on EBCI lands. These efforts involved much effort from our staff as the acclimation, tracking, and survival assessments of these animals occurred over ~6 years, following stocking efforts from 2014-2016. We determined that even habituated deer survival is no different from fearful deer when restocking- which can aid in efforts of relocating animals. Since our restocking efforts, there have been anecdotal assessments that densities have had a slight increase. Currently, we looked to road mortalities and the hunting community in surrounding counties to gather tissue samples to evaluate the success of this project. We believe we can find this population within today's animals as descendants likely continue to contribute to the overall population. We have ascertained through historical and ecological work, that large-scale habitat management is the most important tool for bringing back white-tailed deer to Cherokee citizens. We also believe that our land management efforts need to expand well beyond small food plots and that we will need to work across jurisdictional boundaries and implement large-scale fire programs to open understory areas.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Monitoring:

- Haphazard collection- road mortalities. Necropsy animals for age, health, and disease – collecting samples for genetic population testing.

Management:

- General wildlife plots that contribute to fawning environments and forage.
- Perform outreach with landowners and public to mitigate conflict issues.

Research:

- Work on report of deer-restocking and tracking efforts.
- Does the behavioral condition of stocked deer influence their success?

Results and Discussion for Information Transfer and Processing

Ecological:

- Minimal habitat for deer forage and breeding.

- Habituation does not influence the survival of deer in the southern Appalachian environment

Management:

- Stocking efforts are unlikely the sole method to restore deer in the southern Appalachians.

Social & Cultural:

- Deer are still important to tribal citizens, but they must travel and spend large amounts of personal funds to access this resource.

Adaptive Decision for 2023

Management or Methodological Changes:

- Perform inventory on deer samples collected over previous years.
- Analyze data for influences of historic translocations on deer ecology.
- Develop additional data collection processes through improved coordination with NRE, Animal Control, and the hunting community.
- Re-evaluate cross-jurisdictional land management plants to leverage large-scale opportunities to enhance habitat for deer.
- Work more frequently with BIA to establish burn plans.

Research

- Did our stocking efforts contribute to current deer populations? The use of DNA to investigate restoration success.

Social & Cultural Changes:

- Ask tri-council to pass a resolution to pursue hunting opportunities by leveraging state and federal land access and relief of out licenses within the aboriginal homeland.
- Pursue the international hunter safety course for citizens through the Native American Fish and Wildlife Society.

Partners: EBCI Natural Resources Enforcement (NRE), North Carolina Wildlife Resources Commission (NCWRC), Great Smoky Mountains National Park (GSMNP), Bureau of Indian Affairs (BIA)

Conservation Target: Human/Wildlife Conflicts

Management Goal: To ensure safe and positive transactions between all humans and wildlife.

Biological Conditions	Contributed Service	Conservation Strategies
Nuisance threats, public safety issue	Public Service & Safety, Economic	Management

History and Adaptive Process: Since establishment, our office has responded to landowner requests and calls regarding nuisance wildlife, injured wildlife, and public safety. Depending on the nature of the call, we work with our Tribal partners, such as NRE, and external partners to ensure public and wildlife safety. In 2016, one of our main focuses was mitigating human/wildlife conflicts due to an increase in these instances. Our office differs from Natural Resources Enforcement (NRE) because we focus on conflicts dealing with protected species (out of season, federal status or tribal code regulated).

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Management:

- Provide fencing materials and labor as needed for elk nuisance issues.
- Contact and help provide contacts to landowners for calls and requests outside our scope of work and budget.
- Work closely with NRE to provide efficient and reliable services to the public regarding human/wildlife conflicts.
- Respond to human/wildlife conflict calls as needed.
- Perform trapping and removal of certain wildlife when warranted.
- Direct landowners/Tribal entities to external partners as needed.

Results and Discussion for Information Transfer and Processing

Ecological:

- Responded to calls for the following species – birds, bats, raccoons, bears, coyotes, wasps, bobcats, beavers, hogs, moles, elk, snakes, squirrels, and amphibians.

Management:

- Maintained fences and provided additional fencing materials as needed for elders as budget allowed.
- Served as liaisons between landowners/Tribal entities and external partners when wildlife/conflict was out of our scope of work.
- Performed hazing to prevent human/wildlife conflicts.
- Trapping and removal of certain wildlife species when necessary.
- We worked closely with dispatch to characterize our role for conflict calls- protected species and non-emergency situations.

Social & Cultural:

- Educated the public on the importance of minimizing human/wildlife conflict.
- Educated the public on how to minimize human/wildlife conflict.

Adaptive Decision for 2023

Management or Methodological Changes:

- Create “Standard Operating Protocol” for human-wildlife conflicts and related calls to streamline process and prioritize projects.

• Track yearly incidents more closely to evaluate the productivity of project. **Social & Cultural Changes:** • Explore options for minimizing elk/human conflict (ex. signage, behavioral conditioning, etc.).
Partners: EBCI Natural Resources Enforcement (NRE), U.S. Department of Agriculture APHIS, Cherokee Animal Control

Conservation Target: Wildlife Disease

Management Goal: Identify and mitigate wildlife diseases to ensure the health and safety of wildlife and the public.

Biological Conditions	Contributed Service	Conservation Strategies
Disease vectors, public safety issue	Public Safety, Health, Economic	Inventory

History and Adaptive Process: The maintenance of healthy wildlife populations is important as diseases can affect the wildlife themselves as well as people, pets, and livestock. Therefore, our office is tasked to respond when there is potential wildlife disease exposure and the sampling of wildlife for these diseases.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Work with external partners to assess roadkill and other wildlife for Rabies.
- Work with NRE in cases with wildlife and potential disease exposure.
- Maintain samples and biological data from dead and injured wildlife to assess for potential diseases.

Results and Discussion for Information Transfer and Processing

Management:

- Worked with USDA to transfer several samples from roadkill mammals for Rabies testing.
- Worked with NCWRC to transfer several samples from cervids for Chronic Wasting Disease (CWD) testing.

Social & Cultural:

- When contacted, we educated several consumers of wild game about parasites and diseases contained within wild game and how to mitigate these health concerns.
- Participate in "Biologist Disease Sample Training" provided by the Native American Fish and Wildlife Society.

Adaptive Decision for 2023

Management or Methodological Changes:

- Monitor for CWD, Epizootic Hemorrhagic Disease (EHD), Highly Pathogenic Avian Influenza (HPAI), Brucellosis, Pseudorabies, Rabies, Canine Distemper, COVID, Meningeal Worm, Blue Tongue and other diseases.
- Establish relationship with Laboratory that will give data for samples tested. Communicate with NAFWS to see if they can assist.
- Look to work with a USDA certified wild meat processor.

Social & Cultural Changes:

- Continue to educate the public about potential disease exposure.

Partners: U.S. Department of Agriculture, U.S. Fish & Wildlife Service (USFWS), North Carolina Wildlife Resources Commission (NCWRC), North Carolina Department of Agriculture and Consumer Services, EBCI Natural Resources Enforcement (NRE)

Conservation Target: Wild Trout (*Salvelinus fontinalis*)

Management Goal: Restore populations of wild brook trout.

Biological Conditions	Contributed Service	Conservation Strategies
Unknown density/health	Future Provisioning, Regulating, Economic, Cultural	Inventory

History and Adaptive Process: Brook trout (D𝒹𝒥) are the only native salmonid found within EBCI watersheds. General fisheries inventory efforts were initiated in the 1970s (only summary data available) that identified the presence of brook trout in 16 streams. Today, allopatric populations inhabit a limited number of headwater streams on EBCI lands in Jackson and Swain Counties. Typically, this species inhabits cold-water streams that have excellent water quality and low levels of siltation. This makes them great indicators of water quality. Declines of these fish warrant conservation efforts and restoration initiatives.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Inventory:

- Assess and prioritize population restoration opportunities through the use of existing barriers, construction of artificial barriers, and physical or chemical removal of non-native trout.
- Assess and prioritize habitat restoration opportunities including riparian habitat enhancement, remediating aquatic organisms passage issues, and reducing non-point source pollution threats.

Results and Discussion for Information Transfer and Processing

- No results/discussion currently for this project.

Adaptive Decision for 2023

Management or Methodological Changes:

- Work with external partners to coordinate future trout work.
- Update mapping of trout distribution in shapefiles.

Partners: North Carolina Wildlife Resources Commission (NCWRC)

Conservation Target: Habitat Management

Management Goal: Manage and promote healthy habitat for all organisms on tribal lands and waters.

Biological Conditions	Contributed Service	Conservation Strategies
Variable	Provisioning, Supporting, Cultural	Management, Restoration, Research

History and Adaptive Process: All organisms, even people, require habitat to live. As an ecological management unit, we work to manage and promote healthy habitats for all organisms on tribal lands and in tribal waters. This requires a broader assessment and prescription beyond food plots for wildlife or standard early successional management designs. We might even consider management designs beyond the rudimentary biodiversity maxima perspective. From this largely ecological perspective, our office is central to habitat management that benefits the people and the ecosystem. We currently manage several small plots that total approximately 46.8 acres of wildlife openings across tribal reserve. In the late 2000s, some of the openings were cleared of trees and dense vegetation to create open space and a food source for grazing animals. These openings also provide a safe space away from populated areas- including highways, residents, and businesses. Yearly surveys of hard mast within the forest, evaluated the acorn production of oak species which can be directly related to growth of certain animal populations, were conducted from 2008-2017. These surveys took a considerable amount of staff time and were discontinued in 2017 due to the lack of data needs compared to other regional efforts (surrounding management units collect these data). Concerning low Hellbender density seems associated with the lack of cover rocks and the fact that concrete hellbender huts could not sustain our high-grade rivers, we created concrete slab habitats in 2018. The need for additional assessment on the effects of the hellbender habitat additions on the stream flow and levels (a No Rise permit) has stalled the addition of these rocks to the river. Additionally, we provide input for management of public and private lands as needed and as it might pertain to the promotion of certain species- plant or animal. Many of our hurdles for managing larger wildlife populations are limited by the lack of large-scale uninterrupted landscapes. We will need to work closely with state and federal partners to clear sites and implement management plans in an organized way.

MANAGEMENT ACTIONS

Current Methodology for Conservation Strategies

Management:

- Maintain >50 acres for wildlife and pollinators across Tribal Reserve, powerline and waterline right of ways and Kituwah.
- Several concrete slabs to be used as hellbender habitat in Tribal Waters.

Results and Discussion for Information Transfer and Processing

Ecological:

Management:

- Worked 20 acres of openings including plowing, mowing, and invasive vegetation removal.
- Planted ¼ acre of native pollinator seed.
- Worked with BIA to burn wildlife openings.

Social & Cultural:

- Provide outreach opportunities for Cherokee Choices students regarding native pollinators.

- These wildlife openings provide hunting opportunities for EBCI citizens where turkey and grouse are known to breed.

Adaptive Decision for 2023

Management or Methodological Changes:

- We obtained the America the Beautiful Challenge grant, which will help us in large landscape management objectives. We wish to develop a large-scale planning effort to benefit species impacted by changes to the landscape and to climate.
- Develop a cohesive management strategy for all species within EBCI boundaries.
- Work more with BIA Fire for burn scheduling for wildlife plots and other areas.
- Reengage with forest management planning.
- Get involved with more private landowners to provide land management information.
- Work with landscape modeling across jurisdictions for management applications.
- Plan native pollinator plot plantings and future.
- Riparian management plans- focusing on rivercane restoration.
- Continue efforts to apply prescriptions for spruce-fir restoration.
- Help implement an ecological forest- beyond the horticultural buzz words of permaculture or regenerative practices.
- Determine the role and importance of Rivercane (*Arundinaria gigantea*) to various species, both terrestrial and aquatic, as well as to the larger habitat.
- Model & implement cross-jurisdictional Adaptive Management Plans.
- Pursue implementation of hellbender habitat, concrete slabs, into Tribal waters.
- Pursue implementation of bear-proof trash cans.

Social & Cultural Changes:

- Provide information to landowners about managing habitats for specific purposes or species as desired.

Partners: Bureau of Indian Affairs Fire (BIA Fire), U.S. Fish and Wildlife Service (USFWS), Tribal Construction

Non-Target Projects

- America the Beautiful Initiative grant focused on landscape planning and inter-agency habitat conservation in collaboration with NCSU
- Ela Dam biological monitoring- planning.
- Film production focused on Cherokee relationship to Tuckaseegee/Oconaluftee River/aquatic organisms- planning
- Rivercane restoration, artisan harvest, and biodiversity study- collaborative among other tribes and UGA. Fall 2022 harvest and baseline assessments in Yancey CO.
- Overpass research- Biodiversity across 5 overpasses compared to controls. Working with Brianna (Jumper) Pruitt and Clemson University- 2021 Data collected- Planning.
- Effects of stocked trout on ecological processes- Tribal Hatchery and Wingate University- Otter project planning.
- Ecological access to the aboriginal homeland- UKB, Cherokee Nation and EBCI cultural, ecological and language knowledge holders- Planning initiative started.
- 500 year climate adaptation plan for managing tribal resources. USGS, NCSU and EBCI-CIRB
- Inventory of rare, endangered or culturally important species.
    - Alleghany woodrat
    - Small whorled pogonia
    - Rusty Patch Bumblebee
    - Turtles- softshell, map etc.
    - Mapping seed-bearing plants for horticultural and cultural purposes (georeferenced project)
- Outreach
    - Snowbird Youth Language- Stream Sampling Demonstration. (July 29, 2021).
    - Swain County 4H Group- presentation of a variety of organisms and sampling methods (July 22, 2021).
    - American Legion Cherokee Post- Introduction to Natural Resources Program and Fisheries and Wildlife Collaborative. (June 21, 2021).
    - Hickory Tree Giveaway to Cherokee Citizens- (May 20, 2021).
    - Yellowhill community outreach event- (July 8, 2021).
    - Talking Leaves Trout Derby (Aug 7, 2021).
    - Island Discovery- Video for Cherokee Central Schools. (April 2021).
    - New Kituwah Academy Summery Science School—Salamanders (June 9, 2021).
    - Developing a multi-hazard climate risk index for adaptive land and resource management in complex terrain- Carolina Climate Resilience Conference- (May 10, 2021).
    - Preserving Cherokee Natural Resources through a Socio-Ecological Perspective. Humboldt State University. Online Seminar. (April 24, 2021).
    - Molecules in the Mountains- Panel Discussion on Diversity in Science. April 16, 2021).
    - Wingate University Lecture and Discussion. Online Seminar. March 11, 2021).
    - River Basin Center- Seminar Presentation- UGA- Webinar. (March 17, 2021).
    - Safe Passage Meeting- PLA- Capitalizing on the power of partnership: The Pigeon River Gorge Wildlife Crossing Project- Presentation and Panel Discussion- (Feb 11, 2021).
    - Southeast Partnership of Amphibian and Reptile Conservation Annual Meeting- Keynote Panel- Oct 23, 2020).

- University of Tennessee- Knoxville- Department Seminar for EEB- Managing and Protecting Cherokee Cultural Natural Resources: A socio-ecological Adaptive Management Plan. (November 13, 2020).
- Cherokee Natural Resources- Fish and Wildlife Review. Right Path Alumni- (Cherokee, NC) (Sept 2021).
- Animals and Mammals- Cullowhee Kids Daycare (Cullowhee, NC) (Sept 2021).
- Bear Hunting Group- Presenting and meeting with Cherokee Hunters (Cherokee, NC) (Sept-Oct 2021).
- Elk and Farms- education with farmers at Kituwah (Bryson City, NC).
- Wild and Feral Hogs- Education with landowners (Cherokee, NC).
- Bat exclusions- working with homeowners to understand bat exclusionary devices (Cherokee, NC).

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5.5-1 Threats: Energy Production & Mining
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5.7-1 Threats: Biological Resource Use
5.8-1 Threats: Human Intrusions & Disturbance
5.9-1 Threats: Natural System Modifications
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2024 Climate Strategy Report

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

2024 Climate Strategy Report

North Carolina Wildlife Resources Commission

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Executive Summary

The *2024 NC Wildlife Resources Commission (NCWRC) Climate Strategy Report* is the first iteration of the agency's planning effort to address climate related impacts to our state's fish and wildlife resources. As the largest landholding agency in the state, NCWRC is in a paramount position to support the state's commitment through Executive Orders 80, 246, and 305 to reduce greenhouse gas emissions through the conservation of natural lands. As of 2024, NCWRC currently maintains 2,093,664 acres of game lands, many of which are wetlands - including pocosins, forested floodplains, and upland forests. NCWRC's forested land accounts for an estimated 9,042,368 tons of stored carbon and sequesters an average of 382.89 kg/acre/year.[1] NCWRC is committed to responsibly managing these resources to sustain our natural resources to support our state in becoming climate resilient.

Our approach to this planning effort has considered three goals.

1. How lands under our management support NC's resiliency goals to store and sequester greenhouse gas emissions,

2. Strategies that address shifting ecological regimes and their impact on wildlife distribution, and

3. The impacts that climate change will have on access to state game lands.

The planning effort was led by the Habitat Conservation Division and involved leadership from the Inland Fisheries Division, Wildlife Management Division, Land and Water Access Division, and Habitat Conservation Division. The resulting *2024 NC Wildlife Resources Commission Climate Strategy Report* is a "living document" that will be periodically updated as more divisions are consulted and as needed. This planning effort has helped our agency frame our work in a new perspective and reveals opportunities for our agency to contribute towards larger state (and international) goals. This report is also in support of the climate resilience priorities of the North Carolina Wildlife Action Plan.

These strategies were identified through the planning process and summarized on the following 5 pages.

- Evaluate the impacts of climate change into NCWRC programs and operations, and
- Integrate climate change adaptation practices and resiliency planning into NCWRC policies and operations

[1] This information was obtained from the NC Conservation Benefits Calculator (Duke University & Conservation Trust for North Carolina, 2023).

Evaluate the impacts of climate change into NCWRC programs and operations	
Species assessment	Re-evaluate aquatic species stocking strategies regularly to ensure that animals are provided suitable habitat
	Assess and update survey techniques and data points as necessary to account for changes in species behavior, distribution, and species' population status
	Collect data specific to habitat status and environmental covariates that can be used for modeling to mitigate the impacts of climate change
	Assess vulnerability of wildlife to climate impacts and use results to inform management decisions on NCWRC and privately owned lands
Planning	Review existing guidelines and management plans to develop and integrate climate change adaptation and resiliency strategies within these documents
	Continue to monitor rule making authority (i.e., state, councils, federal government) for fish and wildlife species that may become more or less abundant in NC
	Review existing game land management plans to develop and integrate climate change adaptation and resiliency strategies within these documents
	Develop and implement the State Wildlife Action Plan (WAP) in collaboration with diverse partners
Game lands management	Assess vulnerability of game lands to climate impacts and use results to inform management decisions
	Use remote sensing-based vegetation change analysis to monitor habitat shifts on game lands over time to inform management
	Use available threat assessment tools and modeling in game land management planning to maintain optimal habitats for species conservation
	Identify needs associated with maintaining and increasing the use of prescribed fire
	Prioritize climate change and sea-level rise in coastal habitat restoration planning on coastal game lands
	Review Game Land Management to protect remnants of high elevation forests and rock outcrops through fire suppression in these areas and support prescribed fire in adjacent lower elevation forests

Evaluate the impacts of climate change into NCWRC programs and operations	
Technical Guidance	Develop and use resiliency criteria in major investments (land, facilities constructions and retrofits, staff)
	Continue to keep up with research on Best Management Practices for stormwater and erosion control to provide recommendations that best protect and/or enhance fish and wildlife benefits
	Continue to keep up with research on Best Management Practices dams to provide recommendations that protect and/or enhance fish benefits
	Collaborate with DEQ in determining stormwater standards for larger storm events
	Assess and update, if needed, Engineering Best Management Practices to ensure best practices and share best practices with external partners

Integrate climate change adaptation practices and resiliency planning into NCWRC policies and operations	
	Keep abreast of funding opportunities related to resiliency
Species protection	Identify and prioritize land acquisition projects that support species and habitat conservation, reintroductions, and migration; land conservation provides carbon sequestration and storage benefits
	Continue to invest and identify vulnerable species in need of Propagation, Augmentations, Reintroductions, Translocations, and Introductions (PARTI)
	Work with non-federal private landowners to implement Safe Harbor Agreements and Candidate Conservation Agreement with Assurances (SHA/CCAA)
	Continue to manage species based on changes in recruitment, growth, survival, and reproductive success

Integrate climate change adaptation practices and resiliency planning into NCWRC policies and operations	
Habitat protection	Continue to protect and maintain critical habitats identified in the NC Natural and Working Lands Action Plan and in Executive Order 305 to support climate resiliency goals of the state
	Monitor spread of aquatic nuisance species (ANS) and disease and mitigate for their impacts
	Continue to identify and protect areas of thermal refuge on NCWRC and privately owned lands and work with partners to encourage their protection
	Continue to participate in collaborations concerning submerged aquatic vegetation (SAV) and encourage the adoption of protective measures where SAV exists
	Identify priority habitats and assess conservation, protection, and management needs across the landscape
	Work closely with partners to identify key corridors and connectivity needs; identify and help pursue funding for wildlife passage and provide technical guidance and encouragement
	Continue to work with partners to promote and restore aquatic habitat
	Facilitate salt marsh migration through protection of migration corridors
	Provide technical guidance to other agencies and private landowners on species life history and habitat needs to identify and conserve thermal refuges and mitigate drought
	Continue to investigate strategies that will result in increased implementation of prescribed burning by private landowners to support ecosystem resiliency and viability
	Support private landowners in converting introduced grass stands and low productivity cropland to native grasses and forbs to enhance wildlife habitat, improve drought resistance in forage production, and increase ecosystem services while strengthening carbon sequestration and storage capacity compared to non-native herbaceous species

Integrate climate change adaptation practices and resiliency planning into NCWRC policies and operations	
	Utilize the Wildlife Conservation Lands Program (WCLP) to promote green space and diverse plant communities by deferring private landowners' property tax liability
	Continue to support natural infrastructure restoration projects (i.e., living shorelines, oyster reefs, etc.), where appropriate (and design appropriate) through permit review
	Continue to engage and support local governments in incorporating natural area protection in land use planning and policy to support climate resiliency via the Green Growth Toolbox
	Continue to encourage wide riparian, wetland buffers and floodplain protection through permitting and the Green Growth Toolbox
	Provide technical guidance on oyster reef projects to minimize and avoid impacts on fish habitat
	Provide technical guidance on development review to improve site preparation in support of retaining native tree cover
	Continue to prioritize restoration of native habitats and conservation of species of greatest conservation need through technical guidance
Game lands management	Continue to work with partners (i.e., TNC, land trusts, NHP) to support Natural Heritage dedication of nature preserves, land conservation, and restoration
	Protect forested floodplains on game lands
	Continue to identify areas on game lands in need of habitat and stream restoration and replant buffers, as needed
	Continue to support and initiate research and monitoring activities that increase knowledge and understanding of impacts of environmental stressors of change as well as to support continued forest health and resilience using the best available science
	Support and expand utilization of forest management to restore and maintain native forest types that sequester carbon and are more resilient to climate change, disease, and forest pests

Integrate climate change adaptation practices and resiliency planning into NCWRC policies and operations	
	Continue to support the wood products market
	Collaborate with partners to bank seeds for replanting projects on game lands
	Rewet hydrologically altered peatlands, where appropriate, to provide species and habitat improvements, prevent soil loss and catastrophic fire, and increase carbon sequestration
	Continue to monitor game lands for invasive species
	Improve stream connectivity by restoring aquatic organism passage and developing stream crossings that promote aquatic organism passage
	Design bridges and culverts to allow for increased stream flow, i.e., a 500-year flood event
	Continue to limit the impervious surface of new structures and remove existing impervious surface areas when possible
	Work with adjoining landowners to address issues of fire protection, non-native invasive species, and habitat management that extend across boundaries

Introduction

About North Carolina Wildlife Resources Commission

The N.C. Wildlife Resources Commission (NCWRC) is a state government agency created by the General Assembly in 1947 to conserve and sustain the state's fish and wildlife resources through research, scientific management, wise use, and public input. The NCWRC is the regulatory agency responsible for the enforcement of North Carolina's fishing, hunting, trapping, and boating laws.

The mission of the NCWRC is:

> To conserve North Carolina's wildlife resources and their habitats and provide programs and opportunities that allow hunters, anglers, boaters, and other outdoor enthusiasts to enjoy wildlife-associated recreation.

The sale of hunting and fishing licenses, federal grants and other receipts provides financial support for the agency. The agency has an operational budget of approximately $85 million and employs approximately 650 full-time staff and 100 seasonal temporary staff across the state, including wildlife and fisheries biologists and technicians, wildlife law enforcement officers, wildlife educators, communication specialists, and customer service, information technology, and administrative professionals.

North Carolina Wildlife Resources Commission's Vulnerabilities to Climate Change

North Carolina's fish and wildlife resources are and will continue to be impacted by a changing climate. Biologists monitor species distributions and population dynamics to better understand how changing environmental conditions may impact the resiliency of species. For example, monitoring data demonstrates that streams and rivers are warming, resulting in shifts to aquatic species' distributions and the decline of coldwater species (e.g., Brook Trout). The agency also manages over two million acres of public lands, which are already experiencing ecological shifts, such as the transition from freshwater marsh to estuarine marsh in eastern NC game lands. Infrastructure and access to public lands is also vulnerable to climate change, as increased prevalence of flooding, fire, and extreme storm events reduces our ability to provide access to the public on game lands. Management decisions on these lands aim to provide high quality wildlife habitats while also maintaining public access. The consideration of climate vulnerabilities needs to be a part of our decision-making on many fronts.

North Carolina Wildlife Resources Commission's Approach to Fulfilling the Strategies in the Climate Risk Assessment and Resilience Plan

This is the N.C. Wildlife Resources Commission's first internal resiliency planning effort. Our approach has been threefold to consider:

1. How the lands under our management support NC's resiliency goals to store and sequester greenhouse gas emissions,

2. Strategies that address shifting ecological regimes and their impact on wildlife distribution, and

3. The impacts that climate change will have on access to state game lands.

This planning effort has helped our agency frame our work in a new perspective and reveal opportunities for our agency to contribute towards larger state (and international) goals.

Increase statewide resilience to the impacts of climate change

1 Evaluate the impacts of climate change on major investments in programs and operations in the N.C. Wildlife Resources Commission

1.1.1 Use resiliency criteria in major investments (land, facilities constructions and retrofits, staff)

Status: Ongoing

Expected Completion Date: N/A

For new construction, renovation projects, and land acquisition, NCWRC assesses and plans for addressing hazards related to flooding, sea level rise, saltwater intrusion, and increased storm intensity.

NCWRC will update resources to screen projects into the future.

2 Evaluate the impacts of climate change on Inland Fisheries Division's (IFD) programs and operations

2.1.1 Reevaluate aquatic species stocking strategies regularly to ensure that animals are provided suitable habitat

Status: Ongoing

Expected Completion Date: N/A

The North Carolina Wildlife Action Plan (WAP) is periodically reviewed every 5 – 10 years. We are in the process of completing the 2025 revision to the WAP including updating species and habitat management actions. The Aquatic Wildlife Diversity Program within the Inland Fisheries Division completed one Conservation Plan for the Atlantic Pigtoe. Staff have completed the catfish management plan and are working on plans for black bass, temperate bass, and mountain trout. Plans like the WAP and Species Conservation Plans for state listed species identify strategies such as stocking and habitat protection for priority species. Staff collected genetic material from broodstocks and progeny to investigate genetic diversity of source and stocked populations.

Staff plan to complete four Conservation Plans for aquatic state-listed species and complete revisions for the 2025 WAP in 2024.

2.1.2 Assess and update survey techniques and data points as necessary to account for changes in aquatic species behavior, distribution, and species' population status

Status: Ongoing

Expected Completion Date: N/A

Staff have completed 450 surveys in 2023 on fish, crustaceans, and mollusks to update ongoing data collection to observe any changes in aquatic species distribution and population status. These surveys include general distribution of species, habitat assessments, habitat enhancements and restoration, and overall health of fish populations.

Over the next 12 months, staff will continue to monitor and assess aquatic organism populations including fish, crustaceans, and mollusks. These surveys will help evaluate ongoing population status and inform the WAP assessments for species of greatest conservation need. These assessments will help identify species that need augmentation and restoration efforts due to anthropogenic impacts including climate change.

2.1.3 Collect data specific to habitat status and environmental covariates that can be used for modeling to mitigate the impacts of climate change

Status: Ongoing

Expected Completion Date: N/A

NCWRC has been awarded three Competitive State Wildlife Grants (C-SWG) focusing on collecting data and modeling habitat use for Robust Redhorse, Sandhills Chub, and fishes in shared drainages between South Carolina and North Carolina. Additionally, staff conducted 450 surveys and collected data on habitat and environmental variables. Also, NCWRC supports the maintenance of multiple USGS gauges to collect environmental covariates.

2.1.4 Review existing guidelines and management plans to develop and integrate climate change adaptation and resiliency strategies within these documents, and continue to monitor rule making authority (i.e., state, councils, federal government) to provide guidance on proposed regulatory changes for fish species that may become more or less abundant in NC

Status: Ongoing

Expected Completion Date: N/A

Staff currently are involved with NGOs, federal agencies, and other governmental bodies to assess populations of animals both within North Carolina and throughout the mid-Atlantic and Southeastern U.S. This involvement allows staff to understand the changes in population status (declines and increases) due to changes in NC's climate. Staff review and comment on rules from other state and federal entities for fish and their habitats.

Staff recommend rule changes, when needed, for management of fish in NC to mitigate the effects of climate (i.e., no fishing in July for trout related to thermal changes in habitat). For example, staff reviewed the state listing for the Pink Heelsplitter and updated the protected species list for aquatic organisms.

Staff are currently developing management plans for black bass, temperate basses, and mountain trout. Staff are also developing conservation plans for Orangefin Madtom, Yellow Lampmussel, Cape Fear Shiner, and Appalachian Elktoe. These plans will integrate population assessments including habitat degradation (including increased water temperature) and survival of stocked animals for restoration.

2.2 Integrate climate change adaptation practices and resiliency planning into Inland Fisheries Division's (IFD) policies and operations

2.2.1 Continue to invest and identify vulnerable species in need of Propagation, Augmentations, Reintroductions, Translocations, and Introductions (PARTI)

Status: Ongoing

Expected Completion Date: N/A

Staff meet annually to identify and prioritize species for PARTI actions. In the last year, staff submitted four new reintroduction proposals for Spotfin Chub, Roanoke Logperch, Magnificent Ramshorn, and Freshwater Drum.

Staff will meet annually during the winter with collaborators and partners to review current species stockings and identify additional species for PARTI actions.

2.2.2 Continue to manage species based on changes in recruitment, growth, survival, and reproductive success

Status: Ongoing

Expected Completion Date: N/A

Staff have established long-term monitoring sites for priority aquatic species. Staff target surveys for stocking and reintroduction sites to establish population trends. In 2023, staff conducted over 400 surveys to collect population level metrics and genetic diversity of wild and stocked priority species.

Staff plan to continue surveys at long-term monitoring sites.

2.2.3 Monitor spread of aquatic nuisance species (ANS) and disease and mitigate for their impacts

Status: Ongoing

Expected Completion Date: N/A

Staff continually monitor aquatic animal populations across the state. Currently, staff are documenting the spread of Alabama Bass, river herring, White Perch, invasive crayfish, whirling disease, gill lice, Asian clam, and others. Staff are certifying trout production facilities to ensure

that trout stocked in NC are free of whirling disease and gill lice. The state has launched a campaign for “Clean, Drain, Dry and Never Move” to slow the spread of these organisms. Staff have created signage at public access areas to reiterate the importance of not moving aquatic organisms. The IFD has reduced the regulatory burden on invasive species so that they may be removed by the public to hopefully reduce their impacts.

Staff plan to create new signage that explains the detrimental effects of Alabama Bass on other black bass species. Staff will continue to monitor the movement and distribution of ANS species throughout NC. These species and their detrimental effects are a management priority within the WAP.

2.2.4 Work with non-federal private landowners to implement Safe Harbor Agreements and Candidate Conservation Agreement with Assurances (SHA/CCAA)

Status: Ongoing

Expected Completion Date: November 2072; Winter, 2072

The NCWRC and U.S. Fish and Wildlife Service finalized a SHA/CCAA for the reintroduction of 21 aquatic species in NC. Staff identified three species, Roanoke Logperch, Magnificent Ramshorn, and Spotfin Chub, and four non-federal landowners for inclusion in the SHA/CCAA in 2023.

Aquatic Wildlife Diversity staff plan to work with two additional species, Carolina Madtom and Tar River Spinymussel, for prioritization in 2024.

2.2.5 Continue to work with partners to remove dams and other barriers to support species ability to move and adapt to changing ecosystems

Status: Ongoing

Expected Completion Date: N/A

Staff have worked with partners to create a database that prioritizes dam removal based on ecological importance. Dam removal is important to many aquatic organisms including coastal anadromous species, coldwater stream assemblages, and many species of greatest conservation need listed in the WAP because dams isolate aquatic communities by creating a barrier to movement and alter riverine habitats. Staff have begun to work with cooperators to remove high priority dams throughout NC.

Staff will continue to work with cooperators to assess and remove high priority dams. Staff will continue to monitor aquatic animal populations both pre- and post- dam removal. Obtaining funding for future dam removals through grants will also be a high priority over the next 12 months.

2.2.6 Continue to work with partners to promote and restore aquatic habitat

Status: Ongoing

Expected Completion Date: N/A

Staff have constructed a nursery of native freshwater aquatic plants to establish and augment aquatic habitat in lakes and rivers. Native plants help control erosion and provide habitat for native aquatic species.

2.2.7 Provide technical guidance to other agencies and private landowners on species life history and habitat needs to identify and conserve thermal refuges and mitigate drought

Status: Ongoing

Expected Completion Date: N/A

Staff use expertise to provide guidance on actions to mitigate climate change including coldwater releases below dams, minimum flows, pulses, and recommendations for land conservation.

Staff serve on more than 27 technical committees including universities, land trusts, partnerships, private consultants, USFWS, other state agencies, local governments, NGOs, private companies, lake associations to provide technical guidance on aquatic species.

3 Evaluate the impacts of climate change on Wildlife Management Division's (WMD) programs and operations

3.1.1 Assess vulnerability of wildlife to climate impacts and use results to inform species and habitat management decisions on NCWRC and privately owned lands

Status: Ongoing

Expected Completion Date: N/A

The 2015 NC Wildlife Action Plan has identified species and habitats that are impacted by climate change.

Staff completed species conservation plans for the bog turtle and southern hognose snake in 2023 and are working on species conservation plans for the Virginia big-eared bat, sea turtles, peregrine falcon, black rail, and green salamanders in 2024. We will use existing climate models to inform wildlife species vulnerability and will address this in all upcoming species conservation plans and in the 2025 NC Wildlife Action Plan.

Staff will work with the Land and Water Access Division to update Game Lands Management Plans such that predicted climate change impacts to habitats important to SGCN and game species are accounted for through land management, restoration, enhancement, and acquisition.

3.1.2 Assess and update survey techniques as necessary to account for changes in wildlife species behavior and distribution

Status: Ongoing

Expected Completion Date: N/A

Staff complete surveys on sea turtles, diamond-backed terrapins, colonially-nesting waterbirds, piping plovers, American oystercatchers, gopher frogs and other species of frogs, tiger salamanders and other species of salamanders, rattlesnakes and other snake species, passerines, bald eagles, peregrine falcons, barn owls, bat species, bog turtles, spotted turtles, box turtles, riverine turtles, woodrats, flying squirrels, and small mammals to update ongoing data collection to observe any changes in wildlife species distribution and population status. These surveys include general distribution of species, habitat assessments, habitat enhancements and restoration, and overall health of wildlife populations.

Similar numbers of surveys will continue at pre-determined cycles.

These surveys will help evaluate ongoing population status and will inform the NC Wildlife Action Plan assessments for species of greatest conservation need. These assessments will help identify species that need protection and restoration efforts due to anthropogenic impacts including climate change.

3.1.3 Review existing guidelines and management plans to develop and integrate climate change adaptation and resiliency strategies within these documents and monitor the need to implement regulatory changes for wildlife species that may become more or less abundant in NC

Status: Ongoing

Expected Completion Date: N/A

Staff review the state listing of species annually and update the protected species list for wildlife. Staff currently are involved with NGOs, federal agencies, and other governmental bodies to assess populations of animals both within North Carolina and throughout the mid-Atlantic and Southeastern U.S. This involvement allows staff to understand the changes in population status (declines and increases) due to changes in North Carolina's climate.

Staff will continue to develop conservation plans for at-risk species. These plans already integrate population assessments, including habitat loss and degradation (including changes due to climate change).

3.2 Integrate climate change adaptation practices and resiliency planning into Wildlife Management Division's (WMD) policies and operations

3.2.1 Continue to invest in translocation and propagation of vulnerable species

Status: Ongoing

Expected Completion Date: N/A

The Wildlife Management Division collaborates with other NCWRC divisions, government entities, and private and public landholders to develop techniques and practices consistent with translocation and propagation of at-risk species. Currently, with partners, NCWRC propagates gopher frogs and uses a head-start program to augment existing populations on public land. Additionally, the division is working with Zoo Knoxville, Tennessee to hatch bog turtles and grow to first-year size, then return to their nest site – a head-starting pilot project for bog turtles.

In the coming year, staff will continue this practice to support vulnerable species and to learn more about this management option should it be needed in the future relative to climate change impacts on habitat needs.

3.2.2 Continue to manage species based on changes in recruitment, growth, survival, and population status

Status: Ongoing

Expected Completion Date: N/A

Staff have established long-term monitoring sites for priority wildlife species. In 2023, staff conducted over 400 surveys to collect population level metrics and genetic diversity information for priority species. Additionally, all game species are managed under these parameters. Game species data are collected through hunter harvest, mail, and observation surveys, and trend analyses are conducted. Surveys and monitoring of SGCN are conducted using appropriate methods (counts, cover boards, aural recording units, camera traps, mist nets, etc.) and data are evaluated for long-term trends. These data and influential factors, including climate variables, are collected and analyzed to determine needs for management actions.

Staff plan to continue surveys at long-term monitoring sites and through long-term data collection activities.

3.2.3 Continue to identify and protect areas of thermal refuge on WRC, privately owned lands, and partner agency lands and work with partners to encourage their protection

Status: Ongoing

Expected Completion Date: N/A

Staff identify and protect habitats of thermal refuge, which are under threat from climate change. Winter hibernacula for bats are protected with gates and signage, rock outcrops and

falcon eyries are protected through conservation actions with partners, and spruce-fir habitats are enhanced through plantings. Ephemeral ponds in longleaf pine and native grass habitats are restored, enhanced, and created for important amphibian habitat. Waterbird islands in North Carolina's sounds and the Lower Cape Fear River are enhanced through beneficial use of dredged material and a partnership with the U.S. Army Corps of Engineers.

3.2.4 Identify priority habitats and assess conservation, protection, and management needs across the landscape

Status: Ongoing

Expected Completion Date: N/A

NCWRC uses a variety of tools to identify and work with landholders to focus conservation efforts on undeveloped lands with an effort towards managing for priority habitats listed in the NC Wildlife Action Plan. Habitat surveys are conducted annually by Wildlife Diversity staff to determine use by species of greatest conservation need and need for conservation, protection, and management. Staff within the WMD Operations Program, especially Wildlife Conservation Biologists, work with private landowners to evaluate habitat conditions and priority species' needs as they develop management recommendations to meet the landowner's goals and objectives for their property. These evaluations will continue into the coming year.

3.2.5 Support private landowners in converting introduced grass stands and low productivity cropland to native grasses and forbs to enhance wildlife habitat, improve drought resistance in forage production, and increase ecosystem services while strengthening carbon sequestration and storage capacity compared to non-native herbaceous species

Status: Ongoing

Expected Completion Date: N/A

Staff within the WMD Operations Program and Habitat Conservation Division will continue to promote the establishment of native vegetation to meet both production and habitat-oriented objectives. The Commission maintains specialized seed drills which are required to effectively plant native seeds, as well as sprayers needed for site preparation herbicide treatments. This equipment is available to private landowners who are interested in native vegetation establishment. Efforts are underway to increase machinery available to landowners and increase technical knowledge with on-the-ground trials. Operations Program staff continue to influence financial assistance programs to ensure funds are available to offset costs associated with establishment and management of native herbaceous vegetation.

3.2.6 Continue to investigate strategies that will result in increased implementation of prescribed burning by private landowners to support ecosystem resiliency and viability

Status: Ongoing

Expected Completion Date: N/A

Staff continue to work with other partners to promote and, when possible, facilitate prescribed burning on private lands. This includes taking learnership roles in the Bladen Lakes Area Prescribed Burn Association and being active in other Prescribed Burn Associations to facilitate peer-to-peer learning between landowners. We also loan equipment (e.g., water pumps) to landowners so they can implement burns on their property. Staff also participate in the N.C. Prescribed Fire Council and work cooperatively with the N.C. Forest Service and NGOs to promote fire as a valuable conservation tool.

Our emphasis will be in recommending prescribed burning to enhance species of greatest conservation need in appropriate ecosystems, but we are continuing to explore the ability to conduct or contract burning on private lands. However, liability and personnel demands limit those actions at this time. We will continue exploring options to expand equipment loan opportunities in the future, as well as promote and influence financial assistance options to offset costs associated with conducting prescribed burns on private lands.

3.2.7 Utilize the Wildlife Conservation Lands Program (WCLP) to promote green space and diverse plant communities by deferring private landowners' property tax liability

Status: Ongoing

Expected Completion Date: N/A

Staff will continue to use the WCLP to aid landowners who wish to manage their property for ecological, not economic, goals and objectives. Removing the production-oriented requirements of the Present Use Value Program, WCLP allows landowners to manage for more diverse plant communities that favor a wider range of wildlife species. Diversification of vegetation on WCLP enrolled lands, compared to the monoculture stands often associated with timber or crop production, results in overall ecosystem resiliency. A much wider range of ecological services can be realized from these properties, and retaining open lands by reducing some of the financial incentive of development will likely provide a buffer in greenhouse gas emissions.

4 Evaluate the impacts of climate change on Land and Water Access' (LAWA) programs and operations.

4.1.1 Review existing game land management plans to develop and integrate climate change adaptation and resiliency strategies within these documents

Status: Ongoing

Expected Completion Date: N/A

Over the next year, a reference sheet will be developed to support staff in integrating adaptation and resiliency strategies into management planning as the plans come up for review. Game Land Management Plans will begin to be up for review in 2024/25.

4.1.2 Assess vulnerability of game lands to climate impacts and use results to inform management decisions

Status: Ongoing

Expected Completion Date: N/A

Staff regularly assess vulnerabilities of game lands, i.e., rising sea levels, emerging diseases, impeded access, and adjust management decisions to address new vulnerabilities. Staff will also meet within the next year to assess and discuss needed management actions to address emerging or continuous vulnerabilities.

4.1.3 Use remote sensing-based vegetation change analysis to monitor habitat shifts on game lands over time to inform management

Status: Ongoing

Expected Completion Date: N/A

As of 2024, no remote sensing-based vegetation change analysis tools are used in game land management. Over the next year, staff will identify and assess remote sensing-based vegetation change analysis tools available to assist management decisions on game lands.

4.1.4 Use available threat assessment tools and modeling in game land management planning to maintain optimal habitats for species conservation

Status: Ongoing

Expected Completion Date: N/A

Staff are developing a Forest Optimization Tool in collaboration with N.C. State University. This tool considers forest habitat scenarios until 2050. Additionally, NCWRC staff from the Habitat Conservation Division are collaborating with the Southeast Climate Adaptation Strategy to develop a new threat assessment tool to identify Conservation Opportunity Areas.

Staff will use these tools to assist in management planning and decision-making related to game lands. Staff will investigate and utilize new technologies, resources, and methodologies that may assist in land management practices as appropriate.

4.1.5 Identify needs associated with maintaining and increasing the use of prescribed fire

Status: Ongoing

Expected Completion Date: December 2023

The Forest Optimization Tool (mentioned in 2.5.4) will be used to determine an optimal fire interval using two scenarios that can be 1. achieved with existing manpower and equipment, and 2. achieved with increasing manpower and equipment. This tool will be used in coming years to support decision-making on prescribed fire needs on game lands.

4.1.6 Prioritize climate change and sea-level rise in coastal habitat restoration planning on coastal game lands

Status: Ongoing

Expected Completion Date: December 2024

Game land managers on the coast continually evaluate and use mapping tools to prioritize restoration opportunities based on addressing vulnerabilities; examples include addressing flooding issues at game lands and redirecting long leaf pine reforestation efforts to where soils are most suitable. Over the next year, staff will meet to discuss where sea-level rise is expected to occur on game lands and to identify restoration needs and will use available modeling tools to guide discussions.

4.1.7 Review game land management to protect remnants of high elevation forests and rock outcrops through fire suppression in these areas and support prescribed fire in adjacent lower elevation forests

Status: Ongoing

Expected Completion Date: N/A

Staff do not burn high elevation forests or areas of rock outcrops. Prescribed fire is a regular part of management on lower elevation forests. This supports the protection of higher elevation forests, which are important areas of thermal refuge for cold-adapted species. Land and Water Access staff will continue to manage habitats with fire to support vulnerable species.

4.2 Integrate climate change adaptation practices and resiliency planning into Land and Water Access' (LAWA) policies and operations

4.2.1 Identify and prioritize land acquisition projects that support species and habitat conservation, reintroductions, and migration; land conservation provides carbon sequestration and storage benefits

Status: Ongoing

Expected Completion Date: N/A

Over the last year, land acquisition efforts have supported species and habitat conservation, as well as migration. Land acquisition priorities are guided by the NC Wildlife Action Plan, species conservation plans, and game land management plans. Specifically, last year's acquisitions

benefited the gopher frog, red-cockaded woodpecker, bog turtle, Littlewing Pearlymussel, Spotfin Chub, Appalachian Elktoe, as well as a suite of game species.

Land acquisition efforts will continue to prioritize species and habitat conservation using the most up-to-date science available, including sea level rise models. Internal land team meetings are held by staff, in addition to Land and Property Committee Board meetings, which continue to inform land acquisition strategy and communication between agency staff and leadership within the NCWRC.

4.2.2 Continue to protect and maintain critical habitats identified in the NC Natural and Working Lands Action Plan and in Executive Order 305 to support climate resiliency goals of the state

Status: Ongoing

Expected Completion Date: N/A

NCWRC currently maintains 2,093,664 acres of game lands, many of which are wetlands - including pocosins, forested floodplains, and upland forests. NCWRC's forested land accounts for an estimated 9,042,368 tons of stored carbon and sequesters an average of 382.89 kg/acre/year.[2]

These habitats are priority habitats identified in the NC Wildlife Action Plan and will have potentially higher priority for land acquisition than other habitat types through the agency's internal scoring processes. Over the next year, NCWRC staff will review scoring criteria and identify needs for addressing climate resilience considerations in land acquisition scoring criteria.

4.2.3 Facilitate salt marsh migration through protection of migration corridors

Status: Ongoing

Expected Completion Date: N/A

Land acquisitions in the coastal region continue to protect migration corridors. NCWRC partners with the NC Coastal Land Trust and The Nature Conservancy to identify priority acquisition opportunities. These partnerships are enduring and NCWRC will continue to acquire land for conservation in marsh migration areas.

Over the next year, NCWRC staff will review scoring criteria and identify needs for addressing climate resilience considerations in land acquisition scoring criteria.

[2] This information was obtained from the NC Conservation Benefits Calculator (Duke University & Conservation Trust for North Carolina, 2023).

4.2.4 Continue to support and initiate research and monitoring activities that increase knowledge and understanding of impacts of environmental stressors of change as well as to support continued forest health and resilience using the best available science

Status: Ongoing

Expected Completion Date: N/A

Forest stands managed by staff are monitored to keep track of their growth, health, and management needs. A Forest Optimization Tool is in development in collaboration with N.C. State University; this tool will identify management needs to address optimal forest health. Additionally, NCWRC facilitates research by universities to identify emerging forest health threats; previous research includes projects on wooly adelgid (mountains), oak regeneration (mountains), and a fire needs assessment (statewide).

In the coming year, NCWRC will facilitate research on an upcoming smoke and prescribed fire study, directed by N.C. State University.

4.2.5 Support and expand utilization of forest management to restore and maintain native forest types that sequester carbon and are more resilient to climate change, disease, and forest pests

Status: Ongoing

Expected Completion Date: N/A

In addition to the Forest Optimization Tool referenced in strategies 2.5.4, 2.5.5, and 2.6.4, LAWA also supports forest resiliency through planting and appropriate management of native forest types, including longleaf pine restoration on appropriate soils, oak regeneration, and shortleaf pine restoration. Staff are also working with partners to replant red spruce and Frasier fir at high elevations.

4.2.6 Continue to support the wood products markets

Status: Ongoing

Expected Completion Date: N/A

In 2022, NCWRC completed 33 timber sales for 2022, equaling 4,595 acres. The completion of the Forest Optimization Tool, mentioned in previous strategies, will help determine forests most suitable for harvest.

4.2.7 Continue to identify areas on game lands in need of habitat and stream restoration and replant buffers, as needed

Status: Ongoing

Expected Completion Date: N/A

Over the past few years, NCWRC has been partnering with The Nature Conservancy to identify and implement habitat and stream restoration projects on Angola Bay Game Lands, Holly Shelter Game Lands, and the Upper Roanoke Game Lands.

In the next year and beyond, NCWRC is committed to working with partners to develop, implement, and maintain stream and wetland restoration projects on these and other game lands, as opportunities arise.

4.2.8 Improve stream connectivity by restoring aquatic organism passage and developing stream crossings that promote aquatic organism passage

Status: Ongoing

Expected Completion Date: June 2025

In the past year, staff have completed a culvert inventory on streams with anadromous fish. Additionally, NCWRC staff have from LAWA, Habitat Conservation, and IFD coordinated to identify opportunities on western game lands to address stream restoration and aquatic organism passage needs.

In the coming year, NCWRC is partnering with The Nature Conservancy to replace two culverts and one bridge on the Pollock's Ferry tract of the Upper Roanoke River Game Land to restore fish passage.

4.2.9 Rewet hydrologically altered peatlands, where appropriate, to provide species and habitat improvements, prevent soil loss and catastrophic fire, and increase carbon sequestration

Status: Underway

Expected Completion Date: June 2025

Since 2020, NCWRC has partnered with The Nature Conservancy to rewet drained peatlands on Angola Bay Game Lands. 6,037 acres of peatland will be restored while still maintaining public access. The Nature Conservancy has completed a hydrologic study to determine compatibility to implement similar pocosin on Holly Shelter Game Lands. Funding for further work has been applied for from NFWF America the Beautiful and the NC Land and Water Fund.

Over the next year, staff and partners will continue the implementation phase of Angola Bay work and analyze and review results of Holly Shelter hydrologic study. Staff will continue working with partners to assess and evaluate hydrologically altered peatlands and identify opportunities for restoration.

4.2.10 Continue to work with partners (i.e., TNC, land trusts, NHP) to support Natural Heritage dedication of nature preserves, land conservation, and restoration

Status: Ongoing

Expected Completion Date: N/A

Staff will continue to work with partners to support restoration of conserved lands. This includes enrollment of conserved lands as Natural Heritage dedications, US Forest Service stewardship projects in the mountains, and partnering with The Nature Conservancy to increase our ability to manage with prescribed fire, replant riparian buffers, enhance fish passage, and restore hydrologic functioning of drained peatland soils. These activities and partnerships will continue in the coming year, including projects mentioned in strategies 2.6.7, 2.6.8, and 2.6.9.

4.2.11 Collaborate with partners to bank seeds for replanting projects on game lands

Status: Ongoing

Expected Completion Date: N/A

Staff collect native warm season grasses and tree seeds to enhance nursery stock and support habitat restoration projects, as requested.

4.2.12 Continue to monitor game lands for invasive species

Status: Ongoing

Expected Completion Date: N/A

Staff continuously monitor game lands for non-native invasive species as part of their regular monitoring activities, problem areas are treated as time permits.

4.2.13 Work with adjoining landowners to address issues of fire protection, non-native invasive species, and habitat management that extend across boundaries

Status: Ongoing

Expected Completion Date: N/A

Staff work with adjoining landowners to support species and habitat needs as opportunities arise.

5 Evaluate the impacts of climate change on Habitat Conservation Division technical guidance programs and operations

5.1.1 Develop and implement the State Wildlife Action Plan (WAP) in collaboration with diverse partners

Status: Ongoing

Expected Completion Date: N/A

The NC Wildlife Action Plan (WAP) identifies fish and wildlife species of greatest conservation need (SGCN) and other species for which there are research or management priorities. The

WAP's priority recommendations can be used to specifically target conservation or management options for SGCN and their essential habitats. The goal is to strategically target declining populations and imperiled animals and their required habitats early, thereby reducing the risk of extinction and precluding the need for listing under the Endangered Species Act.

The WAP will continue to reflect statewide conservation concerns by ensuring collaboration with diverse partners that includes federal and state agencies, local governments and communities, conservation organizations, businesses, American Indians, and individuals interested in the Plan's conservation strategies. Habitat Conservation will continue to update and maintain the WAP and work with internal and external groups to implement the Plan's priority conservation actions.

5.1.2 Continue to keep up with research on Best Management Practices for stormwater and erosion control to provide recommendations that best protect and/or enhance fish and wildlife benefits

Status: Ongoing

Expected Completion Date: N/A

Potentially increasing storm intensities and frequencies may require changes to post construction stormwater management designs, particularly in situations that now focus on requirements for outfall protection versus treatment of stormwater quantity. Staff attend trainings and conferences related to stormwater management and water quality to keep up with the latest science and engineering.

In the coming year, staff will informally assess BMP performance on completed projects, coordinate with DEQ staff, and apply those observations with comparable research in future project recommendations. Additionally, staff will update Green Growth Toolbox resources to include the most current BMP design information beneficial for wildlife and aquatic habitats. These updates will provide local governments with additional information to consider for their own stormwater design standards.

5.1.3 Collaborate with DEQ in determining stormwater standards for larger storm events

Status: Proposed

Expected Completion Date: December 2024

Due to changes in Waters of the United States rules, many acres of wetlands will lose protection and there will be reduced capacity on the landscape to treat stormwater. Additionally, larger storm events are impacting the ability of existing stormwater standards to work. In the next year, staff will engage with DEQ to identify how to enhance stormwater standards to address increasing needs. Staff will also recommend the use of higher standards in flood prone areas through technical guidance.

5.1.4 Continue to keep up with research on Best Management Practices for dams to provide recommendations that protect and/or enhance fish benefits

Status: Ongoing

Expected Completion Date: N/A

Climate change heightens the need to provide connectivity for aquatic organisms. Staff provide guidance to dam operators to maintain ecological flows, minimize impacts of drought events on the aquatic environment, and work to track and control aquatic nuisance species. To increase habitat connectivity, NCWRC has focused on dam removals to reconnect aquatic habitats. Staff attend trainings to keep up with the latest science on dam operation and removal projects.

5.1.5 Assess and update, if needed, Engineering Best Management Practices to ensure best practices and share best practices with external partners

Status: Ongoing

Expected Completion Date: N/A

Staff provide recommendations on engineering best management practices for reducing environmental impacts to other state agencies and external partners. The Division of Energy, Mineral, and Land Resources' plans for stream stabilization often require riprap which can block aquatic organism passage. Staff provides recommendations on how to design projects to reduce impacts to aquatic ecosystems as well recommendations on best materials to use for reducing environmental impacts. Staff also provide recommendations on culvert designs that allow for non-erosive velocities and increase streambank stability, as well as allow for aquatic organism passage.

Staff will informally assess the environmental performance of culvert designs (aquatic life passage, bedload retention, channel stability) on completed projects and collaborate with DEQ and other agencies on future modifications of hydraulic design criteria (e.g., NCDOT Guidelines for Hydraulic Studies).

5.2 Integrate climate change adaptation practices and resiliency planning into Habitat Conservation Division technical guidance policies and operations

5.2.1 Continue to support natural infrastructure restoration projects (i.e., living shorelines, oyster reefs, etc.), where appropriate (and design appropriate) through permit review

Status: Ongoing

Expected Completion Date: N/A

Staff review projects and provide recommendations to encourage projects that minimize wildlife habitat impacts and encourages designs that are truly 'nature-based,' with minimal hardened structures. Staff also encourage the use of native vegetation wherever plantings are to be

installed, they provide comments to minimize loss of SAV, natural shorelines, and public trust waters.

Technical guidance will continue into the coming year.

5.2.2 Keep abreast of funding opportunities related to resiliency

Status: Proposed

Expected Completion Date: October 2024

NCWRC staff recognize opportunities when they are available and send to appropriate staff within the agency.

In the next 12 months, staff will develop and maintain a list of potential projects and partnerships that could be implemented as funding opportunities become available (e.g., list of locations where installation of new USGS monitoring gauges will be beneficial for aquatic species monitoring and surveys).

5.2.3 Continue to engage and support local governments in incorporating natural area protection in land use planning and policy to support climate resiliency via the Green Growth Toolbox

Status: Ongoing

Completion Date: N/A

The Green Growth Toolbox handbook and associated educational materials were updated in 2023 to provide information and resources on the latest climate science and related community resiliency strategies. These resources are intended to assist local governments in developing plans and ordinances to protect their natural resources.

Over the next year, staff will integrate natural areas-related climate resiliency strategies into their technical guidance work with local governments. They will also continue to partner with organizations that support climate resiliency planning with local and regional governments, such as NCORR and Sea Grant.

5.2.4 Continue to encourage wide riparian, wetland buffers and floodplain protection through permitting and the Green Growth Toolbox

Status: Ongoing

Expected Completion Date: N/A

Staff continue to recommend protection of the widest riparian buffers and the minimum of the 100-year floodplain, as practical, in our recommendations for habitat conservation. In 2022, we reviewed over 1500 environmental documents and permit applications to identify opportunities to enhance these protections.

Water of the United States rule changes will impact our ability to make recommendations regarding wetland protection and stream buffers, especially related to isolated wetlands. Staff may need to identify new strategies to address diminishing protections on isolated wetlands, including those that would also support flood attenuation, water quality/quantity, and wildlife habitat.

5.2.5 Continue to participate in collaborations concerning submerged aquatic vegetation (SAV) and encourage the adoption of protective measures where SAV exists

Status: Ongoing

Expected Completion Date: N/A

NCWRC is a signatory to the Albemarle Pamlico National Estuarine Partnership Memorandum of Understanding; staff continue to support SAV mapping work and provide technical guidance on projects that may impact SAV.

Technical guidance work will continue as opportunities arise.

5.2.6 Provide technical guidance on oyster reef projects to minimize and avoid impacts on fish habitat

Status: Ongoing

Expected Completion Date: N/A

Staff provide recommendations on where oyster reef projects will provide the most benefit and where these projects should be avoided to reduce impacts to fish and wildlife habitats.

Technical guidance work will continue as opportunities arise.

5.2.7 Provide technical guidance on development review to improve site preparation in support of retaining native tree cover

Status: Ongoing

Expected Completion Date: N/A

Staff review projects and provide recommendations to reduce mass grading and clear-cutting; staff encourage retention of native tree canopy, adequate marking of native trees to avoid damage during construction, and offer on-site assistance. Staff meet with developers to discuss the Wildlife Friendly Development Certification, as opportunities arise.

In the coming year, staff will learn more about soil amendment guidance to ensure natural areas are adequately marked so construction activities do not damage native trees and habitats.

5.2.8 Continue to prioritize restoration of native habitats and conservation of species of greatest conservation need through technical guidance

Status: Ongoing

Expected Completion Date: N/A

Staff provide technical guidance to partners on native habitat restoration and conservation to support wildlife, including pollinator and native grass habitat restoration on private lands and on solar farms, aquatic and wildlife passage projects across road projects and through developed landscapes. Native grass restoration supports carbon sequestration and storage, in addition to providing pollinator habitat. In 2019 and 2020, staff worked with a solar farm in Rowan County to plant a 15-species forb and grass mix in the buffer area of the farm, as well as underneath the tall edge of the solar panels. Not only was this a benefit to the insect community – which insect diversity increased quite a bit with the addition of that vegetation – but it allowed the maintenance division of that solar company to make less frequent trips to the farm for mowing. Staff are conducting a long-term, multi-taxa wildlife study at a stream and wetland mitigation site in Guilford County. The data from this study will help guide compensatory mitigation providers in improving terrestrial and aquatic wildlife habitats, including for SGCN species.

Technical guidance work with continue as opportunities arise.

5.2.9 Work closely with partners to identify key corridors and connectivity needs; identify and help pursue funding for wildlife passage and provide technical guidance and encouragement

Status: Ongoing

Expected Completion Date: N/A

Staff helped NC Department of Transportation apply for a grant that would improve culvert capacity and add fencing in an area I-40 near the Tennessee state line to increase habitat connectivity for wildlife, particularly meso-mammals. The location was identified as a key opportunity based on research conducted by non-governmental organizations. Staff also coordinate efforts to bring together conservation and local government partners in the Triangle to identify and prioritize the conservation and restoration of habitat connectivity. These coordination efforts are important in maintaining connectivity in rapidly developing landscapes.

Technical guidance and coordination efforts will continue into the coming year.

5.2.10 Provide recommendations that protect and/or enhance fish benefits on dam projects

Status: Ongoing

Expected Completion Date: N/A

Climate change heightens the need to provide connectivity for aquatic organisms. Staff provide guidance to dam operators to maintain ecological flows, minimize impacts of drought events on the aquatic environment, and work to track and control aquatic nuisance species. To increase habitat connectivity, NCWRC has focused on dam removals to reconnect aquatic habitats. During the year, significant work has been done on proposed dam removals in the Cape Fear,

Little Tennessee, and French Broad drainages. WRC is providing technical guidance to NRCS and private landowners on restoring stream buffers on a dam improvement project in Yadkin County. The stream contains a relic native mussel population, including a state threatened species.

This technical guidance will continue into the coming year.

5.2.11 Provide recommendations that protect and/or enhance aquatic resources on stormwater and erosion control projects

Status: Ongoing

Expected Completion Date: N/A

Staff provide technical guidance on stormwater and erosion control projects, such as native seed mixes for soil stabilization.

This technical guidance will continue into the coming year.

6 Integrate climate change adaptation practices and resiliency planning into Engineering policies and operations

6.1.1 Continue to limit the impervious surface of new structures and remove existing impervious surface areas when possible

Status: Ongoing

Expected Completion Date: N/A

As renovations and new construction require new paving or repaving, we are working to implement the use of pervious paving grid systems where stormwater permitting limits development. These have been installed at multiple access areas already.

6.1.2 Design bridges and culverts to allow for increased stream flow, i.e., a 500-year flood event

Status: Ongoing

Expected Completion Date: N/A

As bridges and culverts require replacement, inundation mapping is done to evaluate the proper sizing for adequate flood events. Floodplain/way requirements also continue to evolve and become more stringent.

Table 6-1 Objectives and example strategies and priority actions for conservation of species.

Goal 1. Improve our understanding of the species diversity of North Carolina and enhance our ability to make conservation management decisions for all species.	
Objective 1.A - Expand information base for priority species (through surveys, research)	
Strategy example	**Collect statewide distribution information for species**
Priority Action example	• Conduct field surveys to collect distribution information
Priority Action example	• Coordinate with state-wide *survey* efforts and incorporate regional and national survey methodologies (as appropriate)
Strategy example	**Determine relative abundance or occupancy of species**
Priority Action example	• Conduct studies to collect relative abundance data or occupancy
Priority Action example	• Coordinate with state-wide *monitoring* efforts and incorporate regional and national monitoring methodologies (as appropriate)
Strategy example	**Resolve taxonomic problems**
Priority Action example	• Pursue formal descriptions for known or putative undescribed species
Priority Action example	• Improve ability to identify cryptic or narrowly differentiated taxa
Objective 1.B - Expand information on long-term trends across species groups, habitats, and management actions (through monitoring)	
Strategy example	**Identify the most critical factors in understanding limits on populations**
Priority Action example	• Improve understanding of community associations
Strategy example	**Determine and evaluate population trends**
Priority Action example	• Establish monitoring protocol, schedule, and sites to determine population trends
Priority Action example	• Monitor the implementation of specific conservation actions
Objective 1.C - Increase knowledge about impacts and develop responses to threats to species	
Strategy example	**Identify critical scientific and management needs**
Priority Action example	• Evaluate climate variability impacts
Priority Action example	• Investigate potentially injurious non-native species

Table 6-1 Objectives and example strategies and priority actions for conservation of species.

Goal 1. Improve our understanding of the species diversity of North Carolina and enhance our ability to make conservation management decisions for all species.	
Strategy example	**Integrate best-available science and adaptive management strategies**
Priority Action example	• Identify opportunities to integrate climate adaptation and mitigation efforts
Priority Action example	• Reduce non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate
Objective 1.D - Foster partnerships and cooperative efforts	
Strategy example	**Support partnerships to achieve common goals, improve efficiency and prevent duplication of efforts**
Priority Action example	• Improve data collection, management, and dissemination within and among agencies, organizations, academia, local governments and private industry
Priority Action example	• Identify public perceptions towards wildlife resources (human dimensions surveys)
Priority Action example	• Promote and expand public participation in agency programs (education, outreach)
Strategy example	**Engage the public**
Priority Action example	• Improve awareness of and appreciation for our wildlife resources
Priority Action example	• Support educational opportunities and citizen science programs
Objective 1.E - Support and improve existing non-regulatory and regulatory programs aimed at conserving species and their habitats	
Strategy example	**Increase efficiency and effectiveness of guidance and review processes aimed at minimizing negative impacts on species (technical guidance, permit review)**
Priority Action example	• Work cooperatively with and provide technical guidance to local governments and communities to implement the Green Growth Toolbox
Priority Action example	• Review and provide comments on Federal Energy Regulatory Commission (FERC) licensing and relicensing projects and implement provisions of FERC settlement agreements

Table 6-1 Objectives and example strategies and priority actions for conservation of species.

Goal 1. Improve our understanding of the species diversity of North Carolina and enhance our ability to make conservation management decisions for all species.	
Strategy example	**Disseminate information to selected audiences through appropriate media**
Priority Action example	• Provide updates and share information for all topics through the internet and other electronic sharing portals
Strategy example	**Increase efficiency and effectiveness of statutes, rules, regulations and review processes affecting priority species (rules and regulations)**
Strategy example	**Improve coordination with local and regional land-use planning efforts and regulatory agencies (coordination, technical guidance)**

Table 6.2 Objectives and example strategies and priority actions for conservation of habitats.

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Objective 2.A - Conserve habitats to support healthy fish, wildlife and plant populations and ecosystem functions	
Strategy example	**Promote and support habitat protection efforts**
Priority Action example	• Periodically update identification of priority areas for habitat conservation
Priority Action example	• Use acquisition and easements to conserve habitats
Objective 2.B - Manage habitats for ecological complexity at all scales	
Strategy example	**Maintain ecological functions of terrestrial and aquatic habitats**
Priority Action example	• Use prescribed fire where appropriate and to maintain communities adapted to fire.
Priority Action example	• Work with private landowners to encourage and facilitate burning on their properties in fire-dependent ecosystems
Strategy example	**Support ecologically effective population densities**
Priority Action example	• Establish means and protocol for captive breeding program for SGCN priority species.
Strategy example	**Manage populations to maintain sustainable communities of species**
Priority Action example	• Improve long-term sustainability of imperiled species by reducing vulnerability to isolated catastrophic events or genetic problems.
Objective 2.C -Recover and restore species and habitats	
Strategy example	**Utilize propagation techniques for reintroduction of native species and populations**
Priority Action example	• Collect gravid mussels from the wild in order to propagate juvenile mussels at fish hatchery facilities.
Priority Action example	• Re-establish fish and mollusk populations within species' historic range.
Strategy example	**Utilize in-stream habitat restoration techniques, including barrier removal (e.g., dams, culverts, pipes), bank stabilization, installing BMPs, and natural channel design**
Priority Action example	• Improve data collection, management, and dissemination within and among agencies, organizations, academia, and private industry
Strategy example	**Promote or restore natural or improved flow regimes**

Table 6.2 Objectives and example strategies and priority actions for conservation of habitats.

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Objective 2.D - Foster partnerships and cooperative efforts	
Strategy example	**Support partnerships to achieve common goals, improve efficiency and prevent duplication of efforts**
Priority Action example	• Improve data collection, management, and dissemination within and among agencies, organizations, academia, and private industry
Priority Action example	• Identify public perceptions towards wildlife resources (human dimensions surveys)
Priority Action example	• Increase communication, cooperation and collaboration among conservation partners at the state, regional, and nation scales via partnerships and working groups.
Priority Action example	• Develop new partnerships to coordinate conservation efforts and address conservation needs in the Yadkin – Pee Dee corridor, Uwharrie Mountain region, and in the northern tier counties of the Piedmont.
Strategy example	**Engage the public**
Priority Action example	• Promote and expand public participation in agency programs (education, outreach)
Priority Action example	• Identify public perceptions towards wildlife resources (human dimensions surveys)
Priority Action example	• Improve awareness of and appreciation for our wildlife resources
Priority Action example	• Promote and expand public participation in agency programs
Priority Action example	• Support educational opportunities and citizen science programs
Objective 2.E - Support and improve existing regulations and programs aimed at conserving species and their habitats	
Strategy example	**Increase efficiency and effectiveness of guidance and review processes aimed at minimizing negative impacts on fish, wildlife, and habitats (technical guidance, permit review)**
Priority Action example	• Provide accessible information on distribution, biology, status, threats, etc. for priority species groups
Strategy example	**Disseminate information to selected audiences through appropriate media**
Priority Action example	• Build education and outreach components into project implementation and disseminate print and electronic media to facilitate information exchange and education.

Table 6.2 Objectives and example strategies and priority actions for conservation of habitats.

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Strategy example	**Increase efficiency and effectiveness of statutes, rules, regulations and review processes affecting habitats (rules and regulations)**
Priority Action example	• Standardize the species listing process under the state Endangered Species statutes.
Priority Action example	• Investigate, implement, and support (as appropriate) programs that are directed at listed species recovery (e.g., Habitat Conservation Planning, Landowner Incentive Program, Safe Harbor)
Priority Action example	• Support incentive and information programs that help reduce sedimentation and erosion (e.g., fencing livestock from streams, improve tilling practices), minimize pesticide and herbicide use, and modernize wastewater treatment facilities..
Strategy example	**Improve coordination with local and regional land-use planning efforts and regulatory agencies (coordination, technical guidance)**
Priority Action example	• Support establishment of riparian buffers along streams, implementation of low impact development, and better stormwater management (e.g., secondary and cumulative impacts) through program coordination, cooperative projects, and technical guidance
Priority Action example	• Encourage the adoption of growth management plans by county/ municipal governments
Priority Action example	• Work with zoning and planning boards to steer development away from priority areas and habitats.

Table 7.1 Species-Specific Monitoring Efforts

Species Common Name (see Appendix G for Scientific Names)	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
AMPHIBIANS		
Green Salamander	NCWRC, NCDPR, USFS, USFWS, Universities, Land Trusts, Volunteers	Periodic
Carolina Gopher Frog	NCWRC, NCMNS, NCDPR, NCNHP, USFWS, DOD (USMC), USFS, SCDNR, SREL, TNC	
Neuse River Waterdog	NCWRC, NCMNS, NCDPR, USFWS, Nash Community College	
Pine Barrens Treefrog	NCWRC, NCMNS, USFS, DOD Installations	
BIRDS		
American Oystercatcher (Breeding)	NCWRC, NCDPR, NPS, USFWS, DOD (USMC), NERR, Audubon NC	Every 2-3 years
Bachman's sparrow	NCWRC	Annual on Sandhills GL, 5-10 years rangewide (NC)
Bald Eagle	NCWRC, NCDPR, NCNHP, USFWS, USACE, DOD (USMC), Timber Companies	
Northern Bobwhite (or Bobwhite Quail)	NCWRC	Fall, Spring
Cerulean Warbler	NCWRC, USFWS, Volunteers	
Golden-Winged Warbler	Audubon NC, NCWRC	
Ruffed Grouse (drumming counts)	NCWRC, USFS	
Loggerhead Shrike	NCWRC, volunteers	
Mourning Doves	NCWRC, USFWS	
Peregrine Falcon	NCWRC, NCDPR, USFS, Volunteers	
Piping Plover (Breeding)	NCWRC, NCDPR, NPS, USFWS, DOD (USMC), NERR, Audubon NC	
Red-Cockaded Woodpecker	NCWRC, NCFS, NCDPR, USFS, USFWS, DOD (Army, USMC), Sandhills Ecological Institute, TNC, Private Consultants	
Tundra Swans	NCWRC	
Wild Turkey (summer observation survey)	NCWRC, NCFS, USFS, USFWS, Volunteers	
Wilson's Plover (Breeding)	NCWRC, NCDPR, NPS, USFWS, DOD (USMC), NERR, Audubon NC	Every 2-3 years
Wood Duck	NCWRC, USFWS	

Table 7.1 Species-Specific Monitoring Efforts

Species Common Name (see Appendix G for Scientific Names)	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
Yellow-Bellied Sapsuckers (Mountain ecoregion breeding population)	NCWRC, NCMNS, NPS, USFS, USFWS, Mars Hill University, Multi-state work groups	
FRESHWATER FISH		
Largemouth Bass	NCWRC, Duke Power, NC State University	
Roanoke Bass	NCWRC	Periodic
Robust Redhorse	Robust Redhorse Conservation Committee (NC, GA, SC)	
Smallmouth Bass	NCWRC, Universities	
Spotted Bass	NCWRC, Universities	
MAMMALS		
Black Bear	NCWRC, USFS, USFWS, DOD (Army, USMC), Timber Companies	
Carolina Northern Flying Squirrel	NCWRC, NPS, USFS, Eastern Band of Cherokee Indians, Universities	
White-Tailed Deer	NCWRC, DOD (Army, USMC)	
REPTILES		
Bog Turtle	NCWRC, NPS, USFS, USFWS, Project Bog Turtle, TNC, Volunteers	Periodic (triennial)
Chicken Turtle	NCWRC, NCMNS, USFS, DOD	
Diamondback Terrapin	NCWRC, NERR, Volunteers	
Eastern Box Turtle	NCWRC, Davidson College Herpetology Lab, UNC-Greensboro	
Eastern Coachwhip	NCWRC, NCMNS	
Eastern Diamondback Rattlesnake	NCWRC, NCMNS, USFS, DOD	
Northern Pine Snake	NCWRC, NCMNS	
Pigmy Rattlesnake	NCWRC, NCMNS, USFS, USFWS, DOD	
Southern Hognose Snake	NCWRC, NCMNS, NCNHP, NC Herpetological Society	

Table 7.2 Guild and Species Assemblage Monitoring

Guilds	Collaborators	Frequency (Annual unless otherwise noted)
AMPHIBIANS		
Anurans	NCWRC, NCMNS, USFS, USGS, DOD, NCPARC, NC Herpetological Society, Universities, Volunteers	
Salamanders	NCWRC, NCMNS, NCDPR, NPS, USFS, Land Trusts, Universities, Volunteers	Periodic
AQUATIC SPECIES		
Anadromous Fishes (Alewife, American Shad, Blueback Herring, Hickory Shad, Striped Bass)	NCWRC, NCDMF, NMFS, USFWS, ASMFC	
Game Fishes (Black, Striped, and Bodie Bass; Black and White Crappie; Walleye; Muskellunge)	NCWRC, USFS, Duke Power, N.C. State University	Periodic (stock dependent)
Nongame Fishes	NCWRC, NCMNS, NCDWR,USFWS	
Marine Fishes (Fishery Management Plan [FMP] species)	NCDMF, NOAA-Fisheries, NCWRC	
Marine Species (Non- FMP species: shrimp, blue crab, bay scallop, oysters, hard clams)	NCDMF, NOAA-Fisheries	
Brook, Brown, and Rainbow Trout	NCWRC, NPS, USFS	
Crayfishes	NCWRC, NCDWR, NCMNS, NPS	Periodic
Mussels	NCWRC, NCMNS, USFWS, Universities	
BIRDS		
Breeding Birds	NCWRC, USGS, Land Trusts, volunteers	
Colonial Waterbirds (estuarine surveys)	NCWRC, NCDPR, NPS, USACE, USFWS, DOD (USMC), NERR, Audubon NC	Every 2 – 3 years
Game Land Bird Surveys (All-Bird)	NCWRC	Annual
Grassland Songbirds	Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, Volunteers	
Heronry Surveys	NCWRC	Every 5-7 years

Table 7.2 Guild and Species Assemblage Monitoring

Guilds	Collaborators	Frequency (Annual unless otherwise noted)
Migratory Birds	NCWRC, Partners in Flight, Volunteers	Spring, Fall
Neotropical Songbirds	NCWRC, USFS, USGS, Audubon NC, Southern Appalachian Raptor Research (SARR), Weyerhaueser Company-Cool Springs Environmental Education Center	
Nightjars	The Center for Conservation Biology (William & Mary College), NCWRC, Volunteers	
Pelagic (International) Shorebirds	USFWS, NPS, NCWRC	
Raptors (nesting)	NCWRC, SARR, Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, Volunteers	
Riparian Breeding Bird Surveys	NCWRC & Volunteers	Periodic
Shorebirds (Nonbreeding)	NCWRC, NPS, USFWS, DOD (USMC)	
Songbirds (Breeding, Winter)	NCWRC, USFS, Audubon NC	
Waterfowl	NCWRC, USFWS, NCDPR, Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, Volunteers	
MAMMALS		
Bats	NCWRC, NCMNS, USFS, USFWS, UNC-Greensboro, Indiana State University, National Speleological Society, Volunteers	Some species periodic
Furbearer Species (nongame, foxes)	NCWRC, Licensed trappers	Every 5 years
Rabbits (Mountain ecoregion)	NCWRC	
Small Mammals (Statewide)	NCWRC, NCMNS, NCDPR, USFS, NPS	
State Listed Small Mammals (Mountain ecoregion)	NCWRC, NCMNS, USFS, NPS, Universities, Volunteers	Periodic
REPTILES		
Turtles (semi-aquatic species)	Davidson College Herpetology Lab, NCWRC	
Upland Snake Surveys	NCWRC, NCMNS, USFS, DOD	

Table 7.2 Guild and Species Assemblage Monitoring

Guilds	Collaborators	Frequency (Annual unless otherwise noted)
CLASS: INSECTA		
Butterflies and Moths (summer counts)	NCNHP, Volunteers	
OTHER		
Federal (Candidate, FSC) and State Listed Species	NCWRC, NCDWR, NCNHP, NCDOT, USFS, USFWS, TVA, NC State University, LTWA	Periodic (species, location specific)
Herpetofauna Surveys	NCWRC, Weyerhaueser Company-Cool Springs Environmental Education Center	

Table 7.3 Activity and Project Specific Monitoring

Initiative/Program	Collaborators	Frequency (Annual unless otherwise noted)
AMPHIBIANS & REPTILES (HERPS)		
Calling Amphibian Survey Program (CASP)	NCWRC, NCPARC, volunteers	
Carolina Herp Atlas	Davidson College Herpetology Lab, NCWRC, NCPARC, volunteers	
Catawba River Corridor Coverboard Program	Davidson College Herpetology Lab, Annie Springs Close Greenway, CCARI, NCWF, SCWF, Catawba Lands Conservancy, Catawba Valley Land Trust, Duke Power, The Home Depot, Iredell & Mecklenburg counties Parks and Recreation, SCDNR, SCDPRT	
Davidson College Ecological Preserve Monitoring	Davidson College Herpetology Lab	
Sea Turtle Nesting Beach Monitoring Program	NCWRC, NCDPR, NPS, DOD (USMC),, NERR, BHIC, NC Audubon Society, Volunteers	
Sea Turtle Stranding And Salvage Network	NCWRC, NCDPR, NPS, NCDMF, NERR, NOAA Fisheries, USACE, NC Aquariums, DOD Installations, BHIC, NC Audubon Society, Duke University, NCSU Vet School, Volunteers	
Urban Amphibian Monitoring	Davidson College Herpetology Lab	
AQUATIC SPECIES		
Benthic Macroinvertebrate Index of Biotic Integrity (IBI) Monitoring	NCDWR, NCWRC, TVA, Duke Energy, Progress Energy	Variable (every 5-years per river basin, every 2-years for fixed stations)
Fish Index of Biotic Integrity (IBI) Monitoring	NCWRC, NCDWR, TVA, Duke Energy, Progress Energy	Periodic (2 – 3 years)
Fish Kill Investigations	NCDWR, NCWRC	Periodic (each occurrence)
Index of Biotic Integrity (IBI)	USFS	

Table 7.3 Activity and Project Specific Monitoring

Initiative/Program	Collaborators	Frequency (Annual unless otherwise noted)
Nongame Aquatic Species Relocation, Augmentation, and Restoration Projects	NCWRC, NCDWR, NCDOT, USFS, USFWS, TNDEC, TVA, APGI, BRPP, University of TN-Knoxville, Western Carolina University	Periodic (project specific)
Stream Water Quality And Aquatic Invertebrate Monitoring	Weyerhaueser Company-Cool Springs Environmental Education Center	
BIRDS		
Avid Quail and Grouse Hunter Surveys	NCWRC, Volunteers	
Bird Nest Box and Productivity Surveys	NCWRC, NCDPR, USACE Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, WildSouth, Southern Appalachian Raptor Research, Mountain Wild, Audubon NC, Deltec Homes, Volunteers	
Breeding Bird Surveys (BBS)	NCWRC, NCMNS, NCDPR, USGS, USFS, USFWS, Audubon NC, volunteers	
Christmas Bird Count	Audubon NC, Cornell Lab of Ornithology, Volunteers	
Important Bird Area Monitoring	Audubon NC, NCWRC, Volunteers	
Monitoring Avian Productivity and Survivorship (MAPS) and Migration Banding Stations	NPS, NCWRC, NCMNS, NCDPR, Mecklenburg County Parks & Recreation, Howell Woods Environmental Learning Center, Weymouth Woods State Nature Preserve, Cornell Lab of Ornithology, Institute of Bird Population Studies, Southern Appalachian Raptor Research, Volunteers	
Project Feederwatch	Mecklenburg County Parks & Recreation Cornell Lab of Ornithology, Howell Woods Environmental Learning Center, Volunteers	
MAMMALS		
Avid Rabbit Hunter Survey	NCWRC	
Chronic Wasting Disease (CWD) Surveillance	NCWRC, volunteers	Every 5 years
White-nose Syndrome (WNS) Bat Monitoring	NCWRC, USFS, USFWS, UNC-Greensboro, Indiana State University	

Table 7.3 Activity and Project Specific Monitoring

Initiative/Program	Collaborators	Frequency (Annual unless otherwise noted)
OTHER		
Blue Ridge Parkway Survey Plots	NPS, Mars Hill University	
INRMP Plan Monitoring (multiple species)	DOD Installations, Volunteers	
Management Indicator Species	USFS	
NHP G1/G2 Ranked Species Surveys	NCNHP, NCWRC, International Paper, Weyerhaueser Company, Coastal Land Trust, TNC	
Trapper Harvest Surveys	NCWRC, licensed trappers	Every 5 years

Table 5.3-1
Residential Commercial Development

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.3-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.3 Residential & commercial development			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.01a	Metric 9.01b	Ranking Score	
AMPHIBIANS										
X, N	X	X	Mabee's Salamander	*Ambystoma mabeei*		T	a - b	b - c	8	High
X, N	X	X	Mole Salamander	*Ambystoma talpoideum*		SC	a - b	b - c	8	High
X, N		X	Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*		T	a - b	b	9	High
X, N		X	Green Salamander	*Aneides aeneus*		E	b	b	8	High
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*		SC	b	b	8	High
X	X	X	Barking Treefrog	*Hyla gratiosa*			b	a	9	High
X	X	X	Blue Ridge Gray-cheeked Salamander	*Plethodon amplus*			b	b	8	High
X	X		South Mountain Gray-cheeked Salamander	*Plethodon meridianus*			b	b	8	High
X	X		Southern Ravine Salamander	*Plethodon richmondi*			a	b	9	High
X, N	X	X	Southern Zigzag Salamander	*Plethodon ventralis*		SC	b	b	8	High
X, N	X	X	Wehrle's Salamander	*Plethodon wehrlei*		T	a	b	9	High
X		X	Gopher Frog	*Rana capito*	At-Risk		b	b	8	High
BIRDS										
X			Northern Saw-whet Owl	*Aegolius acadicus*		T	b	b	8	High
			Red-winged Blackbird	*Agelaius phoeniceus*			b	b	8	High
X			Henslow's Sparrow	*Ammodramus henslowii*		E	b	b	8	High
X			Grasshopper Sparrow	*Ammodramus savannarum*			b - c	a - b	8	High
X			Whip-poor-will, Eastern Whip-poor-will	*Antrostomus vociferus*			b	b	8	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
		X	Ruddy Turnstone	*Arenaria interpres*			a	c	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
X		X	Red Knot	*Calidris canutus*	T	T	a	c	8	High
			Semipalmated Sandpiper	*Calidris pusilla*			a	c	8	High
X		X	Wilson's Plover	*Charadrius wilsonia*		SC	b	b	8	High
	X		Rusty Blackbird	*Euphagus carolinus*		T	b	b	8	High
			American Kestrel	*Falco sparverius*			b	b - c	8	High
X		X	American Oystercatcher	*Haematopus palliatus*		SC	b	b	8	High
X	X	X	Black-necked Stilt	*Himantopus mexicanus*			b	b	8	High
X		X	Caspian Tern	*Hydroprogne caspia*		T	b	b	8	High
X	X	X	Marbled Godwit	*Limosa fedoa*			a	c	8	High
	X		Red-headed Woodpecker	*Melanerpes erythrocephalus*			b	b	8	High
		X	Wild Turkey	*Meleagris gallopavo*			b	b	8	High
X		X	Whimbrel	*Numenius phaeopus*			a	b	9	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
	X		Hairy woodpecker	*Picoides villosus*			b	b	8	High
			Scarlet Tanager	*Piranga olivacea*			b - c	b	8	High
X,N			Prothonotary Warbler	*Protonotaria citrea*			a - c	b - c	8	High
			Ovenbird	*Seiurus aurocapillus*			b - c	b	8	High
X	X		Wayne's Black-throated Green Warbler	*Setophaga virens waynei*		E	b	b	8	High
	X		Northern Parula	*Setophaga americana*			a - b	a - b	9	High
			Eastern Meadowlark	*Sturnella magna*			b - d	a - b	8	High
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	At-Risk	SC	b	a	9	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.3-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.3 Residential & commercial development			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.01a	Metric 9.01b	Ranking Score	
CRAYFISHES										
X	X	X	Greensboro Burrowing Crayfish	*Cambarus catagius*		SC	b	b	8	High
	X	X	Carolina Ladle Crayfish	*Cambarus davidi*			b	b	8	High
FRESHWATER FISHES										
X			Least Killifish	*Heterandria formosa*		SC	a	a	10	Very High
X	X		Mountain Madtom	*Noturus eleutherus*		SC	a	a	10	Very High
X	X	X	Stonecat Madtom	*Noturus flavus*		E	a	a	10	Very High
X		X	Carolina Madtom	*Noturus furiosus*	E	E	a	a	10	Very High
X		X	Roanoke Bass	*Ambloplites cavifrons*			a - c	b - d	8	High
		X	Rock Bass	*Ambloplites rupestris*			a - c	c	8	High
X	X		Carolina Quillback	*Carpiodes sp.*			b	b	8	High
X	X		Blotched Chub	*Erimystax insignis*		T	b	b	8	High
X		X	Waccamaw Darter	*Etheostoma perlongum*		T	a - c	b - c	8	High
X			Speckled Killifish	*Fundulus rathbuni*			b	b - c	8	High
X		X	Waccamaw Killifish	*Fundulus waccamensis*			a - b	b - c	8	High
X			American Brook Lamprey [M]	*Lethenteron appendix*		SC	a	a - c	9	High
X			American Brook Lamprey [P]	*Lethenteron appendix*		SC	a	a - c	9	High
X		X	Waccamaw Silverside	*Menidia extensa*	T	T	a - b	b - c	8	High
X		X	Cape Fear Shiner	*Miniellus mekistocholas*	E	E	a - b	b - c	8	High
X	X		Sharpnose Darter	*Percina oxyrhynchus*		E	b	b	8	High
X	X		Roanoke Logperch	*Percina rex*	E	E	b	b	8	High
X		X	Brook Trout (Native)	*Salvelinus fontinalis*			b	b	8	High
FRESHWATER MUSSELS										
X		X	Littlewing Pearlymussel	*Pegias fabula*	E	E	a	a	10	Very High
X		X	Dwarf Wedgemussel	*Alasmidonta heterodon*	E	E	a - c	a - c	8	High
X		X	Appalachian Elktoe	*Alasmidonta raveneliana*	E	E	b	b	8	High
X	X		Uwharrie Elktoe	*Alasmidonta uwharriensis*			b	b	8	High
X	X	X	Brook Floater	*Alasmidonta varicosa*		E	a - b	a - c	9	High
X		X	Slippershell Mussel	*Alasmidonta viridis*		E	b	b	8	High
X	X	X	Barrel Floater	*Anodonta couperiana*		E	a - b	b - c	8	High
X			Tidewater Mucket	*Atlanticoncha ochracea*		T	a	b	9	High
X		X	Rainbow	*Cambarunio iris*		T	b	b	8	High
X			Spike	*Eurynia dilatata*		SC	b	b	8	High
X		X	Wavyrayed Lampmussel	*Lampsilis fasciola*		SC	b	b	8	High
X		X	Carolina Heelsplitter	*Lasmigona decorata*	E	E	a - b	a - c	9	High
X	X	X	Green Floater	*Lasmigona subviridis*	PT	E	a - c	a - c	8	High
X	X		James Spinymussel	*Parvaspina collina*	E	E	a - d	a - c	8	High
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	E	E	a - b	a - b	9	High
X			Tennessee Clubshell	*Pleurobema oviforme*	PE	E	b	b	8	High
X			Tennessee Pigtoe	*Pleuronaia barnesiana*	PE	E	b	b	8	High
X		X	Carolina Creekshell	*Sagittunio vaughanianus*		E	a - b	a - c	9	High
X	X	X	Savannah Lilliput	*Toxolasma pullus*		E	a - b	a - c	9	High
X	X		Notched Rainbow	*Venustaconcha constricta*		T	a - c	a - c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.3-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.3 Residential & commercial development			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.01a	Metric 9.01b	Ranking Score	
X	X	X	Eastern Creekshell	*Villosa delumbis*			a - b	a - c	9	High
X	X		Southern Rainbow	*Villosa vibex*			a - b	b	9	High
MAMMALS										
			Northern Short-tailed Shrew	*Blarina brevicauda*			a - b	a - b	9	High
			Southern Short-tailed Shrew	*Blarina carolinensis*			a - b	a - b	9	High
X	X		Star-nosed Mole	*Condylura cristata (incl C.c. parva)*		SC	a - b	a - b	9	High
X	X		Star-nosed Mole	*Condylura cristata pop. 1*			a - b	a - b	9	High
X		X	Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	E	E	a - b	b - c	8	High
			Least Shrew	*Cryptotis parva*			a - b	a - b	9	High
	X	X	Eastern Red Bat	*Lasiurus borealis*			a - b	b - d	8	High
X		X	Hoary Bat	*Lasiurus cinereus*	At-Risk		a - b	b - d	8	High
X	X	X	Northern Yellow Bat (incl Florida Yellow Bat)	*Lasiurus intermedius (incl L.i. floridanus)*		SC	a - b	a - b	9	High
		X	Seminole Bat	*Lasiurus seminolus*			a - b	b - d	8	High
X		X	Northern Long-eared Bat	*Myotis septentrionalis*	E	E	a - c	b - c	8	High
X	X		Allegheny Woodrat	*Neotoma magister*		SC	b - c	b	8	High
			Common Muskrat	*Ondatra zibethicus*			b	b	8	High
			Eastern Mole	*Scalopus aquaticus*			b	b	8	High
			Masked Shrew	*Sorex cinereus*			a - b	a - b	9	High
X	X		Rock Shrew	*Sorex dispar*			a - b	a - b	9	High
			Smoky Shrew	*Sorex fumeus*			a - b	a - b	9	High
X	X		Southern Pygmy Shrew	*Sorex hoyi winnemana*			a - b	a - b	9	High
			Dismal Swamp Southeastern Shrew	*Sorex longirostris fisheri*			a - b	a - b	9	High
			Southeastern Shrew	*Sorex longirostris longirostris*			a - b	a - b	9	High
X	X		Dismal Swamp Southern Bog Lemming	*Synaptomys cooperi helaletes*			a - b	a - b	9	High
X			Southern Bog Lemming	*Synaptomys cooperi stonei*			a - b	a - b	9	High
REPTILES										
X		X	Bog Turtle	*Glyptemys muhlenbergii*	T(S/A)	T	a - c	b - c	8	High
X, N	X		Northern Map Turtle	*Graptemys geographica*		SC	a - c	b - c	8	High
SNAILS										
X	X	X	Greenfield Ramshorn	*Helisoma eucosmium*		E	a	a	10	Very High
X	X	X	Magnificent Ramshorn	*Planorbella magnifica*	E	E	a	a	10	Very High
			Appalachian Thorn	*Carychium clappi*			a	c	8	High
X			Obese Thorn	*Carychium exiguum*			a	c	8	High
			Ice Thorn	*Carychium exile*			a	c	8	High
			File Thorn	*Carychium nannodes*			a	c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.4-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.4 Agriculture & Aquaculture			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.02a	Metric 9.02b	Ranking Score	
AMPHIBIANS										
X, N		X	Green Salamander	*Aneides aeneus*		E	b	b	8	High
X	X		Seepage Salamander	*Desmognathus aeneus*			b	b	8	High
X, N	X	X	Dwarf Salamander	*Eurycea quadridigitata*		SC	b	b	8	High
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*		SC	b	b	8	High
X	X		Southern Ravine Salamander	*Plethodon richmondi*			b	b	8	High
X, N	X	X	Southern Zigzag Salamander	*Plethodon ventralis*		SC	b	b	8	High
X, N	X	X	Wehrle's Salamander	*Plethodon wehrlei*		T	b	b	8	High
X	X		Atlantic Coast Leopard Frog	*Rana Kauffeldi*			a	c	8	High
X	X	X	Wood Frog - Coastal Plain Pop.	*Rana sylvaticus pop.3*			a	b	9	High
BIRDS										
X		X	Ruffed Grouse	*Bonasa umbellus*			a	a	10	Very High
X			Henslow's Sparrow	*Ammodramus henslowii*		E	b	b	8	High
X			Grasshopper Sparrow	*Ammodramus savannarum*			a - b	b - c	8	High
			Great Egret	*Ardea alba*			b	b	8	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
	X		Short-eared Owl	*Asio flammeus*			b	b - c	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
			Northern Flicker	*Colaptes auratus*			b	b - c	8	High
X		X	Northern Bobwhite	*Colinus virginianus*			a - b	b - c	8	High
		X	Tundra Swan	*Cygnus columbianus*			a - b	b - c	8	High
			Pileated Woodpecker	*Dryocopus pileatus*			b	b	8	High
	X		Rusty Blackbird	*Euphagus carolinus*		T	b	b	8	High
			Yellow-breasted Chat	*Icteria virens*			b	b - c	8	High
			Orchard Oriole	*Icterus spurius*			a	c	8	High
X			Loggerhead Shrike	*Lanius ludovicianus*		SC	a - b	b - c	8	High
			Red-bellied Woodpecker	*Melanerpes carolinus*			b	b	8	High
	X		Red-headed Woodpecker	*Melanerpes erythrocephalus*			b	b	8	High
		X	Wild Turkey	*Meleagris gallopavo*			b	b	8	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
X			Savannah Sparrow	*Passerculus sandwichensis*			a - c	b - c	8	High
			Fox Sparrow	*Passerella iliaca*			a	b	9	High
			Indigo Bunting	*Passerina cyanea*			a	c	8	High
X		X	Red-cockaded Woodpecker	*Picoides borealis*	T	T	a - b	b - c	8	High
	X		Hairy woodpecker	*Picoides villosus*			b	b	8	High
			Scarlet Tanager	*Piranga olivacea*			b	b	8	High
X	X		Vesper Sparrow	*Pooecetes gramineus*		SC	a	b	9	High
X,N			Prothonotary Warbler	*Protonotaria citrea*			b - c	b	8	High
			Ovenbird	*Seiurus aurocapillus*			b	b	8	High
	X		Magnolia Warbler	*Setophaga magnolia*			b	b	8	High
X			Yellow Warbler	*Setophaga petechia*			b	b - c	8	High
			Pine Warbler	*Setophaga pinus*			b	b - c	8	High
X	X		Wayne's Black-throated Green Warbler	*Setophaga virens waynei*		E	b	b	8	High
X,N			Brown-headed Nuthatch	*Sitta pusilla*			a - c	b	8	High
X	X		Dickcissel	*Spiza americana*			a - c	c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.4-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.4 Agriculture & Aquaculture			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.02a	Metric 9.02b	Ranking Score	
			Eastern Meadowlark	*Sturnella magna*			a - c	b - c	8	High
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	At-Risk	SC	b	b	8	High
		X	Warbling Vireo	*Vireo gilvus*			b	b	8	High
			Red-eyed Vireo	*Vireo olivaceus*			b	b	8	High
			Blue-headed Vireo	*Vireo solitarius*			b	b	8	High
			White-throated Sparrow	*Zonotrichia albicollis*			a	c	8	High
CRAYFISHES										
X	X	X	Cedar Creek Crayfish [= Waccamaw Crayfish]	*Procambarus chacei [= P. braswelli]*		E	a - c	c	8	High
FRESHWATER FISHES										
X	X		Mountain Madtom	*Noturus eleutherus*		SC	a	a	10	Very High
X	X	X	Stonecat Madtom	*Noturus flavus*		E	a	a	10	Very High
X		X	Orangefin Madtom	*Noturus gilberti*	At-Risk	E	a	a	10	Very High
X	X		Ironcolor Shiner	*Alburnops chalybaeus*		T	b	b	8	High
X		X	Hickory Shad	*Alosa mediocris*			a - c	c	8	High
			Atlantic Highfin Carpsucker	*Carpiodes sp.*		SC	b	b - c	8	High
X	X		Carolina Quillback	*Carpiodes sp.*			b	b	8	High
X		X	Siouan Thinlip Chub	*Cyprinella leptocheilus*		SC	b	b	8	High
			Redfin Pickerel	*Esox americanus*			b	b	8	High
			Chain Pickerel	*Esox niger*			b	b	8	High
	X		Southern Tessellated Darter	*Etheostoma maculaticeps*			b	b	8	High
X	X		Cutlip Minnow	*Exoglossum maxillingua*		SC	b	b	8	High
			Lined Topminnow	*Fundulus lineolatus*			b	b - c	8	High
X			Lake Phelps Killifish	*Fundulus sp.*			a - b	b	9	High
			Northern Hog Sucker	*Hypentelium nigricans*			b	b	8	High
X			Roanoke Hog Sucker	*Hypentelium roanokense*			b	b	8	High
X			Spotted Sunfish	*Lepomis punctatus*			b	b - c	8	High
X		X	Cape Fear Shiner	*Miniellus mekistocholas*	E	E	b	b - c	8	High
X	X		Bridle Shiner	*Notropis bifrenatus*		E	b	b	8	High
X		X	Carolina Madtom	*Noturus furiosus*	E	E	a - b	a - b	9	High
X		X	Tadpole Madtom	*Noturus gyrinus*			b	b	8	High
X	X		Sharpnose Darter	*Percina oxyrhynchus*		E	b	b	8	High
FRESHWATER MUSSELS										
X	X		Uwharrie Elktoe	*Alasmidonta uwharriensis*			b	b - c	8	High
X		X	Longsolid	*Fusconaia subrotunda*	T	T	a	c	8	High
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	E	E	a - b	b - c	8	High
X		X	Littlewing Pearlymussel	*Pegias fabula*	E	E	a	c	8	High
MAMMALS										
X	X		Star-nosed Mole	*Condylura cristata (incl C.c. parva)*		SC	b	b	8	High
X	X		Star-nosed Mole	*Condylura cristata pop. 1*			b	b	8	High
X		X	Rafinesque's Big-eared Bat - CP Pop	*Corynorhinus rafinesquii macrotis*		SC	a - c	b - c	8	High
	X	X	Silver-haired Bat	*Lasionycteris noctivagans*			a - c	b - c	8	High
	X	X	Eastern Red Bat	*Lasiurus borealis*			a - c	b - c	8	High
X	X	X	Northern Yellow Bat (incl Florida Yellow Bat)	*Lasiurus intermedius (incl L.i. floridanus)*		SC	a - b	a - b	9	High
X		X	Southeastern Bat	*Myotis austroriparius*		SC	a - c	b - c	8	High
X		X	Northern Long-eared Bat	*Myotis septentrionalis*	E	E	a - c	b - c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.4-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.4 Agriculture & Aquaculture			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.02a	Metric 9.02b	Ranking Score	
REPTILES										
X, N	X		Mimic Glass Lizard	*Ophisaurus mimicus*		E	b	a - b	9	High
SNAILS										
X	X	X	Magnificent Ramshorn	*Planorbella magnifica*	E	E	c	a	8	High
			Appalachian Thorn	*Carychium clappi*			a	c	8	High
X			Obese Thorn	*Carychium exiguum*			a	c	8	High
			Ice Thorn	*Carychium exile*			a	c	8	High
			File Thorn	*Carychium nannodes*			a	c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.5-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.5 Energy Production & Mining			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.03a	Metric 9.03b	Ranking Score	
AMPHIBIANS										
X	X	X	Neuse River Waterdog	*Necturus lewisi*	T		b	b	8	High
X, N	X	X	Wehrle's Salamander	*Plethodon wehrlei*		T	b	b	8	High
X		X	Gopher Frog	*Rana capito*	At-Risk		b	b	8	High
FRESHWATER FISHES										
X	X		Carolina Quillback	*Carpiodes sp.*			a	a	10	Very High
X		X	Striped Bass (native)	*Morone saxatilis*			a	a	10	Very High
X	X		Banded Sculpin	*Cottus carolinae*		SC	b	b	8	High
			Whitetail Shiner	*Cyprinella galactura*			b	b	8	High
X			Spotfin Chub	*Erimonax monachus*	T	T	b	b	8	High
X			Turquoise Darter	*Etheostoma inscriptum*		T	b	b	8	High
X			Sooty-banded [Westfall's] Darter	*Percina nigrofasciata*		SC	b	b	8	High
MAMMALS										
X		X	Hoary Bat	*Lasiurus cinereus*	At-Risk		a - c	a - b	9	High
	X	X	Silver-haired Bat	*Lasionycteris noctivagans*			a - b	b - d	8	High
	X	X	Eastern Red Bat	*Lasiurus borealis*			a - c	b - c	8	High
		X	Seminole Bat	*Lasiurus seminolus*			a - c	b - c	8	High
SNAILS										
			Appalachian Thorn	*Carychium clappi*			a	c	8	High
X			Obese Thorn	*Carychium exiguum*			a	c	8	High
			Ice Thorn	*Carychium exile*			a	c	8	High
			File Thorn	*Carychium nannodes*			a	c	8	High

Appendix 5
Table 5.6-1 THREATS

2025 WAP Revision
Taxa Team Evaluations

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority			Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.6 Transportation & Service Corridors			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.04a	Metric 9.04b	Ranking Score	
AMPHIBIANS										
X, N	X	X	Mabee's Salamander	*Ambystoma mabeei*		T	a - c	a - c	8	High
X, N	X	X	Mole Salamander	*Ambystoma talpoideum*		SC	a - c	b - c	8	High
X, N		X	Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*		T	a - b	a - b	9	High
X, N		X	Green Salamander	*Aneides aeneus*		E	b	b	8	High
X	X	X	Imitator Salamander - Waterrock Knob pop.	*Desmognathus imitator pop.1*			a	c	8	High
X, N	X		Junaluska Salamander	*Eurycea junaluska*		T	a	b	9	High
X	X	X	Barking Treefrog	*Hyla gratiosa*			b	b - c	8	High
X		X	Gopher Frog	*Rana capito*	At-Risk		b	b	8	High
X	X	X	Wood Frog - Coastal Plain Pop.	*Rana sylvaticus pop.3*			b	b	8	High
BIRDS										
	X		Rose-breasted Grosbeak	*Pheucticus ludovicianus*			a	a	10	Very High
MAMMALS										
X		X	Red Wolf	*Canis rufus*	E (Expn)	T	a - b	a - b	9	High
X	X		Star-nosed Mole	*Condylura cristata (incl C.c. parva)*		SC	b	b	8	High
X	X		Star-nosed Mole	*Condylura cristata pop. 1*			b	b	8	High
X		X	Gray Bat	*Myotis grisescens*	E	E	a - c	a - c	8	High
			Masked Shrew	*Sorex cinereus*			b	b	8	High
X	X		Rock Shrew	*Sorex dispar*			b	b	8	High
			Dismal Swamp Southeastern Shrew	*Sorex longirostris fisheri*			a - b	a - b	9	High
X	X		Dismal Swamp Southern Bog Lemming	*Synaptomys cooperi helaletes*			a - b	a - b	9	High
REPTILES										
X, N	X	X	Eastern Diamondback Rattlesnake	*Crotalus adamanteus*	At-Risk	E	a - c	b - c	8	High
X, N	X	X	Timber Rattlesnake	*Crotalus horridus*		SC	a - c	a - c	8	High
X	X	X	Eastern Kingsnake	*Lampropeltis getula*			a	c	8	High
X, N	X		Diamondback Terrapin	*Malaclemys terrapin*		SC	a	b - c	9	High
X	X		Coal Skink	*Plestiodon anthracinus*			a - b	b - d	8	High
X	X		Queen Snake	*Regina septemvittata*			a - c	d	8	High
X	X		Pine Woods Snake	*Rhadinaea flavilata*			a - c	d	8	High
X, N	X	X	Carolina Pygmy Rattlesnake	*Sistrurus miliarius miliarius*		SC	a - c	a - c	8	High
SNAILS										
X	X	X	Greenfield Ramshorn	*Helisoma eucosmium*		E	a	a	10	Very High
			Appalachian Thorn	*Carychium clappi*			a	c	8	High
X			Obese Thorn	*Carychium exiguum*			a	c	8	High
			Ice Thorn	*Carychium exile*			a	c	8	High
			File Thorn	*Carychium nannodes*			a	c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.7-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.7 Biological Resource Use			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.05a	Metric 9.05b	Ranking Score	
AMPHIBIANS										
X	X	X	Barking Treefrog	*Hyla gratiosa*			b	b - c	8	High
X	X	X	Wood Frog - Coastal Plain Pop.	*Rana sylvaticus pop.3*			a	b	9	High
BIRDS										
		X	Wood Duck	*Aix sponsa*			a	e - f	10	Very High
		X	Wild Turkey	*Meleagris gallopavo*			a	a	10	Very High
		X	Mourning Dove	*Zenaida macroura*			a	a	10	Very High
			Red-winged Blackbird	*Agelaius phoeniceus*			b	b	8	High
X			Henslow's Sparrow	*Ammodramus henslowii*		E	b	b	8	High
X		X	American Black Duck	*Anas rubripes*			a - c	e	8	High
			Great Egret	*Ardea alba*			b	b	8	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
	X		Rusty Blackbird	*Euphagus carolinus*		T	b	b	8	High
	X		Red-headed Woodpecker	*Melanerpes erythrocephalus*			b	b	8	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
	X		Hairy woodpecker	*Picoides villosus*			b	b	8	High
X,N	X		Yellow-throated Warbler	*Setophaga dominica*			b	b	8	High
	X		Magnolia Warbler	*Setophaga magnolia*			b	b	8	High
X	X		Wayne's Black-throated Green Warbler	*Setophaga virens waynei*		E	b	b	8	High
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	At-Risk	SC	b	a	9	High
FRESHWATER FISHES										
X		X	Striped Bass (native)	*Morone saxatilis*			a	a	10	Very High
X		X	Shortnose Sturgeon	*Acipenser brevirostrum*	E	E	b	b - c	8	High
X		X	Lake Sturgeon	*Acipenser fulvescens*		SC	b	b	8	High
X		X	Atlantic Sturgeon	*Acipenser oxyrinchus*	E	E	a - b	b - c	8	High
X		X	Hickory Shad	*Alosa mediocris*			a	a - d	9	High
MAMMALS										
X		X	Northern Long-eared Bat	*Myotis septentrionalis*	E	E	a - c	b - c	8	High
REPTILES										
X		X	Loggerhead Sea Turtle	*Caretta caretta*	T	T	b	b	8	High
X		X	Green Sea Turtle	*Chelonia mydas*	T	T	b	b	8	High
X, N	X	X	Timber Rattlesnake	*Crotalus horridus*		SC	a - d	a - c	8	High
X		X	Leatherback Sea Turtle	*Dermochelys coriacea*	E	E	b	b	8	High
X	X		Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata imbricata*	E	E	b	b	8	High
X, N	X		Diamondback Terrapin	*Malaclemys terrapin*		SC	a	b	9	High
X, N	X		Carolina (Black) Swamp Snake	*Seminatrix pygaea paludis*		SC	b	b	8	High
SNAILS										
			Appalachian Thorn	*Carychium clappi*			a	c	8	High
X			Obese Thorn	*Carychium exiguum*			a	c	8	High
			Ice Thorn	*Carychium exile*			a	c	8	High
			File Thorn	*Carychium nannodes*			a	c	8	High

Appendix 5
Table 5.8-1 THREATS

2025 WAP Revision
Taxa Team Evaluations

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Common Name	*Scientific Name*	Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.8 Human Intrusions & Disturbance			Anticipated Level of Impact
2025	2025	2025					Metric 9.06a	Metric 9.06b	Ranking Score	
AMPHIBIANS										
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*		SC	b	b	8	High
BIRDS										
X		X	Wilson's Plover	*Charadrius wilsonia*		SC	a	a	10	Very High
X		X	American Oystercatcher	*Haematopus palliatus*		SC	a	a	10	Very High
X		X	Peregrine Falcon, American Peregrine Falcon	*Falco peregrinus*		E	a	b	9	High
X		X	Gull-billed Tern	*Gelochelidon nilotica*		T	a	b	9	High
X	X	X	Black-necked Stilt	*Himantopus mexicanus*			b	a	9	High
X		X	Caspian Tern	*Hydroprogne caspia*		T	a	b	9	High
X		X	Black Skimmer	*Rynchops niger*		SC	a	b	9	High
X		X	Least Tern	*Sterna antillarum*		SC	a	b	9	High
	X		Spotted Sandpiper	*Actitis macularia*			a	c	8	High
	X	X	Common Loon	*Gavia immer*			b	b	8	High
X		X	Royal Tern	*Thalasseus maximus*			a	c	8	High
X		X	Sandwich Tern	*Thalasseus sandvicensis*			a	c	8	High
FRESHWATER FISHES										
X			Least Killifish	*Heterandria formosa*		SC	a	a	10	Very High
MAMMALS										
	X		Least Weasel	*Mustela nivalis*			a	c - e	10	Very High
X			Eastern Spotted Skunk	*Spilogale putorius*			a	c - e	10	Very High
X		X	Red Wolf	*Canis rufus*	E (Expn)	T	b	b	8	High
X		X	Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	E	E	a - c	a - c	8	High
X	X	X	Northern Yellow Bat (incl Florida Yellow Bat)	*Lasiurus intermedius (incl L.i. floridanus)*		SC	a - b	a - c	9	High
X		X	Gray Bat	*Myotis grisescens*	E	E	a - c	a - c	8	High
	X		Long-tailed Weasel	*Neogale frenata*			a	c	8	High
			American Mink	*Neovison vison*			a	c	8	High
			Common Muskrat	*Ondatra zibethicus*			a	c	8	High
X		X	Tricolored Bat	*Perimyotis subflavus*	PE	E	a - b	a - c	9	High
		X	Red Fox	*Vulpes vulpes*			a	c	8	High
SNAILS										
			Appalachian Thorn	*Carychium clappi*			a	c	8	High
X			Obese Thorn	*Carychium exiguum*			a	c	8	High
			Ice Thorn	*Carychium exile*			a	c	8	High
			File Thorn	*Carychium nannodes*			a	c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.9-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.9 Natural System Modifications			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.07a	Metric 9.07b	Ranking Score	
AMPHIBIANS										
X		X	Gopher Frog	*Rana capito*	At-Risk		a	a	10	Very High
X	X	X	Wood Frog - Coastal Plain Pop.	*Rana sylvaticus pop.3*			a	a - b	10	Very High
X	X		Chamberlain's Dwarf Salamander	*Eurycea chamberlaini*	At-Risk		b	b	8	High
X, N	X	X	Dwarf Salamander	*Eurycea quadridigitata*		SC	b	b	8	High
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*		SC	b	b	8	High
	X	X	Brimley's Chorus Frog	*Pseudacris brimleyi*			b	b	8	High
X	X	X	Southern Chorus Frog	*Pseudacris nigrita*			b	b	8	High
X, N	X		Ornate Chorus Frog	*Pseudacris ornata*		E	b	b	8	High
	X	X	Eastern Mud Salamander	*Pseudotriton montanus montanus*			b	b	8	High
	X	X	Red Salamander	*Pseudotriton ruber*			b	b	8	High
BIRDS										
X		X	Wilson's Plover	*Charadrius wilsonia*		SC	a	a	**10**	Very High
X		X	American Oystercatcher	*Haematopus palliatus*		SC	a	a	10	Very High
X			Wood Stork	*Mycteria americana*	T	T	a	a	10	Very High
X		X	Red-cockaded Woodpecker	*Picoides borealis*	T	T	a	a	10	Very High
X	X	X	Black-bellied Plover	*Pluvialis squatarola*			a	a	10	Very High
X		X	Piping Plover (Atlantic Coast pop'n)	*Charadrius melodus*	T	T	b - c	a	**9**	High
X		X	Bachman's Sparrow	*Peucaea aestivalis*		SC	b	a	9	High
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	At-Risk	SC	b	a	9	High
	X		Spotted Sandpiper	*Actitis macularia*			a	c	**8**	High
			Red-winged Blackbird	*Agelaius phoeniceus*			b	b	8	High
X	X		Saltmarsh Sparrow	*Ammodramus caudacutus*	At-Risk		b	b	8	High
X			Henslow's Sparrow	*Ammodramus henslowii*		E	b	b	8	High
X	X		Seaside Sparrow	*Ammodramus maritimus*			b	b	8	High
X	X		Nelson's Sparrow	*Ammodramus nelsoni*			b	b	8	High
X			Whip-poor-will, Eastern Whip-poor-will	*Antrostomus vociferus*			b	b	**8**	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
		X	Ruddy Turnstone	*Arenaria interpres*			a	c	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
X		X	Red Knot	*Calidris canutus*	T	T	a	c	8	High
			Semipalmated Sandpiper	*Calidris pusilla*			a	c	8	High
	X		Hermit Thrush	*Catharus guttatus*			a	c	8	High
	X		Semipalmated Plover	*Charadrius semipalmatus*			b	b	**8**	High
	X		Rusty Blackbird	*Euphagus carolinus*		T	b	b	8	High
X		X	Gull-billed Tern	*Gelochelidon nilotica*		T	b	b	8	High
	X	X	Short-billed Dowitcher	*Limnodromus griseus*			a	c	8	High
X	X	X	Marbled Godwit	*Limosa fedoa*			a	c	8	High
		X	Wild Turkey	*Meleagris gallopavo*			b	b	8	High
X		X	Whimbrel	*Numenius phaeopus*			a	c	**8**	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
			Scarlet Tanager	*Piranga olivacea*			b	b - c	8	High
X		X	Black Skimmer	*Rynchops niger*		SC	b	b	8	High
X		X	Least Tern	*Sterna antillarum*		SC	b	b	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.9-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.9 Natural System Modifications			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.07a	Metric 9.07b	Ranking Score	
CRAYFISHES										
X	X	X	Carolina Needlenose Crayfish	*Cambarus aldermanorum*			b	b	8	High
X		X	Broad River Spiny Crayfish	*Cambarus spicatus*	At-Risk	T	b	b	8	High
FRESHWATER FISHES										
X		X	Blueback Herring (native)	*Alosa aestivalis*			a	a - b	10	Very High
X			Lake Phelps Killifish	*Fundulus sp.*			a	a	10	Very High
X			Least Killifish	*Heterandria formosa*		SC	a	a	10	Very High
X		X	Striped Bass (native)	*Morone saxatilis*			a	a	10	Very High
X	X		Mountain Madtom	*Noturus eleutherus*		SC	a	a	10	Very High
X	X	X	Stonecat Madtom	*Noturus flavus*		E	a	a	10	Very High
X		X	Carolina Madtom	*Noturus furiosus*	E	E	a	a	10	Very High
X		X	Orangefin Madtom	*Noturus gilberti*	At-Risk	E	a	a	10	Very High
X		X	Shortnose Sturgeon	*Acipenser brevirostrum*	E	E	a - b	b	9	High
X		X	Hickory Shad	*Alosa mediocris*			a	a - d	9	High
X		X	Cape Fear Shiner	*Miniellus mekistocholas*	E	E	a - b	b	9	High
X		X	Atlantic Sturgeon	*Acipenser oxyrinchus*	E	E	a - b	b - c	8	High
		X	Rock Bass	*Ambloplites rupestris*			a - c	c	8	High
X		X	American Eel	*Anguilla rostrata*			a - b	b - c	8	High
	X		River Carpsucker	*Carpiodes carpio*		SC	b	b	8	High
X		X	Quillback	*Carpiodes cyprinus*			b	b - c	8	High
			Atlantic Highfin Carpsucker	*Carpiodes sp.*		SC	b	b - c	8	High
X	X		Carolina Quillback	*Carpiodes sp.*			b	b	8	High
X			Blue Ridge Sculpin	*Cottus caeruleomentum*		SC	b	b	8	High
X	X		Banded Sculpin	*Cottus carolinae*		SC	b	b	8	High
			Whitetail Shiner	*Cyprinella galactura*			b	b	8	High
X			Spotfin Chub	*Erimonax monachus*	T	T	b	b	8	High
X			Turquoise Darter	*Etheostoma inscriptum*		T	b	b	8	High
X	X		Cutlip Minnow	*Exoglossum maxillingua*		SC	b	b	8	High
		X	Redbreast Sunfish	*Lepomis auritus*			a - c	b - c	8	High
X		X	Waccamaw Silverside	*Menidia extensa*	T	T	b	b - c	8	High
		X	Smallmouth Bass	*Micropterus dolomieu*			a - c	c	8	High
			Silver Redhorse	*Moxostoma anisurum*			b	b	8	High
X			Bigeye Jumprock	*Moxostoma ariommum*		T	b	b	8	High
X	X		Smallmouth Redhorse	*Moxostoma breviceps*			b	b	8	High
X	X		River Redhorse	*Moxostoma carinatum*			b	b	8	High
X	X		Blacktip Jumprock	*Moxostoma cervinum*			b	b	8	High
X		X	Notchlip Redhorse	*Moxostoma collapsum*			b	b - c	8	High
			Black Redhorse	*Moxostoma duquesnei*			b	b	8	High
			Golden Redhorse	*Moxostoma erythrurum*			b	b	8	High
			Shorthead Redhorse	*Moxostoma macrolepidotum*			b	b - c	8	High
X			V-lip Redhorse	*Moxostoma pappillosum*			b	b - c	8	High
X		X	Robust Redhorse	*Moxostoma robustum*	At-Risk	E	b	b - c	8	High
X			Striped Jumprock	*Moxostoma rupiscartes*			b	b	8	High
X		X	Carolina Redhorse	*Moxostoma sp.*		T	b	b - c	8	High
X		X	Sicklefin Redhorse	*Moxostoma sp.*		T	b	b	8	High
X			Wounded Darter	*Nothonotus vulneratus*		SC	b - c	b	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.9-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.9 Natural System Modifications			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.07a	Metric 9.07b	Ranking Score	
X		X	Tadpole Madtom	*Noturus gyrinus*			b	b - c	8	High
X	X		Blotchside Logperch	*Percina burtoni*		E	b	b	8	High
X			Sooty-banded [Westfall's] Darter	*Percina nigrofasciata*		SC	b	b	8	High
X	X		Roanoke Logperch	*Percina rex*	E	E	b	b	8	High
X		X	Sandhills Chub	*Semotilus lumbee*		SC	b	b - c	8	High
X	X	X	Rustyside Sucker	*Thoburnia hamiltoni*		E	b	b	8	High
FRESHWATER MUSSELS										
X		X	Dwarf Wedgemussel	*Alasmidonta heterodon*	E	E	a - b	b	9	High
X	X	X	Barrel Floater	*Anodonta couperiana*		E	a - b	a - c	9	High
X			Tidewater Mucket	*Atlanticoncha ochracea*		T	a	b	9	High
X	X		James Spinymussel	*Parvaspina collina*	E	E	a - b	b	9	High
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	E	E	a - b	a - b	9	High
X		X	Appalachian Elktoe	*Alasmidonta raveneliana*	E	E	a	c	8	High
X	X		Uwharrie Elktoe	*Alasmidonta uwharriensis*			a - c	b - c	8	High
X	X	X	Brook Floater	*Alasmidonta varicosa*		E	a - b	b - c	8	High
X		X	Slippershell Mussel	*Alasmidonta viridis*		E	a	c	8	High
X		X	Rainbow	*Cambarunio iris*		T	a	c	8	High
X	X	X	Purple Wartyback	*Cyclonaias tuberculata*		E	a	c	8	High
X	X	X	Yellow Lance	*Elliptio lanceolata*	T	T	a - c	b - c	8	High
X			Spike	*Eurynia dilatata*		SC	a	c	8	High
X		X	Atlantic Pigtoe	*Fusconaia masoni*	T	T	a - c	b - c	8	High
X		X	Longsolid	*Fusconaia subrotunda*	T	T	a	c	8	High
X	X		Yellow Lampmussel	*Lampsilis cariosa*		E	a - c	b - c	8	High
X		X	Wavyrayed Lampmussel	*Lampsilis fasciola*		SC	a	c	8	High
X	X		Chameleon lampmussel	*Lampsilis sp. 2*			a - c	b - c	8	High
X	X	X	Green Floater	*Lasmigona subviridis*	PT	E	a - c	b - c	8	High
X		X	Littlewing Pearlymussel	*Pegias fabula*	E	E	a	c	8	High
X			Tennessee Clubshell	*Pleurobema oviforme*	PE	E	a	c	8	High
X			Tennessee Pigtoe	*Pleuronaia barnesiana*	PE	E	a	c	8	High
X		X	Pink heelsplitter	*Potamilus alatus*		SC	a	c	8	High
X	X		Eastern Pondmussel	*Sagittunio nasutus*		T	a - c	b - c	8	High
X		X	Carolina Creekshell	*Sagittunio vaughanianus*		E	a - b	b - c	8	High
X	X		Creeper	*Strophitus undulatus*		T	a - c	b - c	8	High
X	X	X	Savannah Lilliput	*Toxolasma pullus*		E	a - b	b - c	8	High
X	X		Alewife Floater	*Utterbackiana implicata*		T	a - c	a - c	8	High
X	X	X	Eastern Creekshell	*Villosa delumbis*			a - b	b - c	8	High
X	X		Southern Rainbow	*Villosa vibex*			a - b	b - c	8	High
MAMMALS										
X	X		Dismal Swamp Southern Bog Lemming	*Synaptomys cooperi helaletes*			a - b	a - b	9	High
REPTILES										
X		X	Loggerhead Sea Turtle	*Caretta caretta*	T	T	a	b	9	High
X		X	Green Sea Turtle	*Chelonia mydas*	T	T	a	b	9	High
X		X	Leatherback Sea Turtle	*Dermochelys coriacea*	E	E	a	b	9	High
X, N	X		Carolina (Black) Swamp Snake	*Seminatrix pygaea paludis*		SC	a	b	9	High
X		X	Bog Turtle	*Glyptemys muhlenbergii*	T(S/A)	T	a - c	b - c	8	High
X, N	X		Northern Map Turtle	*Graptemys geographica*		SC	a - c	b - c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.9-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.9 Natural System Modifications			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.07a	Metric 9.07b	Ranking Score	
X, N	X	X	Northern Pine Snake	*Pituophis melanoleucus melanoleucus*		T	b	b	8	High
SNAILS										
X	X	X	Greenfield Ramshorn	*Helisoma eucosmium*		E	a	a	10	Very High
X	X	X	Magnificent Ramshorn	*Planorbella magnifica*	E	E	a	a	10	Very High
X	X		Engraved Covert	*Fumonelix orestes*		T	a	a	10	Very High
X			Broad River Supercoil	*Paravitrea nunnehi*			b	b	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.10-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.10 Invasive and Other Problematic Species and Genes			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.08a	Metric 9.08b	Ranking Score	
AMPHIBIANS										
X		X	Oak Toad	*Bufo quercicus*			a	c	8	High
X	X	X	Neuse River Waterdog	*Necturus lewisi*	T		b	b	8	High
X	X	X	Southern Chorus Frog	*Pseudacris nigrita*			a	c	8	High
BIRDS										
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	At-Risk	SC	a	a	10	Very High
X		X	Wilson's Plover	*Charadrius wilsonia*		SC	b	a	9	High
X		X	American Oystercatcher	*Haematopus palliatus*		SC	b	a	9	High
X	X		Saltmarsh Sparrow	*Ammodramus caudacutus*	At-Risk		b	b	8	High
X	X		Seaside Sparrow	*Ammodramus maritimus*			b	b	8	High
X	X		Nelson's Sparrow	*Ammodramus nelsoni*			b	b	8	High
			Great Egret	*Ardea alba*			b	b	8	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
	X		Red-headed Woodpecker	*Melanerpes erythrocephalus*			b	b	8	High
		X	Wild Turkey	*Meleagris gallopavo*			b	b	8	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
X	X	X	King Rail	*Rallus elegans*			b - c	b	8	High
CRAYFISHES										
X	X	X	Coastal Plain Crayfish	*Procambarus ancylus*			b	b	8	High
X	X	X	Santee Crayfish	*Procambarus blandingii*			b	b	8	High
X	X	X	Cedar Creek Crayfish [= Waccamaw Crayfish]	*Procambarus chacei [= P. braswelli]*		E	a - b	b - c	8	High
X	X	X	Pamlico Crayfish	*Procambarus medialis*		T	b	b	8	High
X	X	X	Carolina Sandhills Crayfish	*Procambarus pearsei*		T	a - b	b - c	8	High
X	X	X	Croatan Crayfish	*Procambarus plumimanus*			b	b	8	High
FRESHWATER FISHES										
X	X		Carolina Quillback	*Carpiodes sp.*			a	a	10	Very High
X		X	Carolina Madtom	*Noturus furiosus*	E	E	a - b	a	10	Very High
X		X	Waccamaw Silverside	*Menidia extensa*	T	T	b	a - b	9	High
X		X	Broadtail Madtom	*Noturus sp.*		SC	a - b	a - b	9	High
X		X	Hickory Shad	*Alosa mediocris*			b	b - c	8	High
X		X	Snail Bullhead	*Ameiurus brunneus*			b	b	8	High
X		X	Flat Bullhead	*Ameiurus platycephalus*			b	b	8	High
			Blackstripe Pirate Perch	*Aphredoderus ornatus*			b	b	8	High
			Atlantic Highfin Carpsucker	*Carpiodes sp.*		SC	a - c	a - c	8	High
X			Redside Daces (Hiwassee, Smoky Dace)	*Clinostomus sp.*		SC	b	b	8	High
X	X		Kanawha Darter	*Etheostoma kanawhae*			b	b	8	High
X	X		Tonguetied Minnow	*Exoglossum laurae*			b	b	8	High
X	X		Rosyface Chub	*Hybopsis rubrifrons*		T	b	b	8	High
X	X		Yellowfin Shiner	*Hydrophlox lutipinnis*		SC	b	b	8	High
	X		Saffron Shiner	*Hydrophlox rubricroceus*			b	b	8	High
X	X		New River Shiner	*Miniellus scabriceps*			b	b	8	High
		X	White Bass	*Morone chrysops*			b - c	b	8	High
X		X	Striped Bass (native)	*Morone saxatilis*			b	b	8	High
X		X	Robust Redhorse	*Moxostoma robustum*	At-Risk	E	a - c	a - c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.10-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.10 Invasive and Other Problematic Species and Genes			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.08a	Metric 9.08b	Ranking Score	
X		X	Carolina Redhorse	*Moxostoma sp.*		T	a - c	a - c	8	High
	X		Bigmouth Chub	*Nocomis platyrhynchus*			b	b	8	High
X			Wounded Darter	*Nothonotus vulneratus*		SC	b	b	8	High
	X		Kanawha Rosyface Shiner	*Notropis sp.*			b	b	8	High
X		X	Tadpole Madtom	*Noturus gyrinus*			b	b	8	High
		X	Yellow Perch	*Perca flavescens*			b	b	8	High
X	X		Appalachia Darter	*Percina gymnocephala*			b	b	8	High
X	X		Sharpnose Darter	*Percina oxyrhynchus*		E	b	b	8	High
	X		Kanawha Minnow	*Phenacobius teretulus*		SC	b	b	8	High
	X		Bluntnose Minnow	*Pimephales notatus*			b	b	8	High
FRESHWATER MUSSELS										
X			Waccamaw Spike	*Elliptio waccamawensis*			a	b - c	9	High
X		X	Dwarf Wedgemussel	*Alasmidonta heterodon*	E	E	b	a - c	8	High
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	E	E	b	b - c	8	High
MAMMALS										
X		X	Red Wolf	*Canis rufus*	E (Expn)	T	a	a	10	Very High
REPTILES										
X		X	Bog Turtle	*Glyptemys muhlenbergii*	T(S/A)	T	a - c	b - d	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.11-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Status	NC State Protection Status	Chapter 5, Section 5.11 Pollution			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.09a	Metric 9.09b	Ranking Score	
AMPHIBIANS										
X	X	X	Imitator Salamander - Waterrock Knob pop.	*Desmognathus imitator pop.1*			a	b	9	High
X		X	Eastern Hellbender	*Cryptobranchus alleganiensis allaganiensi*	PE		a - c	b - c	8	High
X	X		Southern Dusky Salamander	*Desmognathus auriculatus*			b	b	8	High
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*		SC	b	b	8	High
X	X	X	Neuse River Waterdog	*Necturus lewisi*	T		b	b	8	High
X, N	X	X	Common Mudpuppy	*Necturus maculosus maculosus*		SC	a	c	8	High
	X	X	Eastern Mud Salamander	*Pseudotriton montanus montanus*			b	b	8	High
	X	X	Red Salamander	*Pseudotriton ruber*			b	b	8	High
X	X		Eastern Lesser Siren	*Siren intermedia intermedia*			b	b	8	High
X	X	X	Greater Siren	*Siren lacertina*			b	b	8	High
X	X	X	Many-lined Salamander	*Stereochilus marginatus*			b	b	8	High
BIRDS										
			Veery	*Catharus fuscescens*			a - b	c - e	9	High
			Red-winged Blackbird	*Agelaius phoeniceus*			b	b	8	High
			Great Egret	*Ardea alba*			b	b	8	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
	X		Rusty Blackbird	*Euphagus carolinus*		T	b	b	8	High
	X	X	Common Loon	*Gavia immer*			b	b	8	High
		X	Wild Turkey	*Meleagris gallopavo*			b	b	8	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
		X	Mourning Dove	*Zenaida macroura*			b	b	8	High
FRESHWATER FISHES										
X			Least Killifish	*Heterandria formosa*		SC	a	a	10	Very High
X	X		Mountain Madtom	*Noturus eleutherus*		SC	a	a	10	Very High
X	X	X	Stonecat Madtom	*Noturus flavus*		E	a	a	10	Very High
X		X	Orangefin Madtom	*Noturus gilberti*	At-Risk	E	a	a	10	Very High
X		X	Shortnose Sturgeon	*Acipenser brevirostrum*	E	E	a - b	b	9	High
X		X	Carolina Madtom	*Noturus furiosus*	E	E	a - b	a - b	9	High
X		X	Lake Sturgeon	*Acipenser fulvescens*		SC	b	b	8	High
X		X	Atlantic Sturgeon	*Acipenser oxyrinchus*	E	E	a - b	b - c	8	High
X	X		Ironcolor Shiner	*Alburnops chalybaeus*		T	b	b	8	High
X		X	Hickory Shad	*Alosa mediocris*			a - c	b - c	8	High
X		X	American Shad	*Alosa sapidissima*			a - c	a - d	8	High
			Blackstripe Pirate Perch	*Aphredoderus ornatus*			b	b	8	High
X	X		Freshwater Drum	*Aplodinotus grunniens*		SC	b	b	8	High
			White Sucker	*Catostomus commersonii*			a - c	c - d	8	High
X			Swampfish	*Chologaster cornuta*			b	b - c	8	High
X			Spotfin Chub	*Erimonax monachus*	T	T	b	b	8	High
X	X		Blotched Chub	*Erimystax insignis*		T	b	b	8	High
	X		Southern Tessellated Darter	*Etheostoma maculaticeps*			b	b	8	High
X		X	Waccamaw Darter	*Etheostoma perlongum*		T	b	b - c	8	High
	X		Tessellated Darter	*Etheostoma sp. cf. olmstedi*			b	b	8	High
X	X		Seagreen Darter	*Etheostoma thalassinum*		SC	b	b	8	High
X		X	Waccamaw Killifish	*Fundulus waccamensis*			b	b - c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.11-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.11 Pollution			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.09a	Metric 9.09b	Ranking Score	
X	X		Mooneye	*Hiodon tergisus*		SC	b	b	8	High
	X		Mimic Shiner	*Paranotropis volucellus*		T	b	b	8	High
X	X		Blotchside Logperch	*Percina burtoni*		E	b	b	8	High
X	X		Roanoke Logperch	*Percina rex*	E	E	b	b	8	High
FRESHWATER MUSSELS										
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	E	E	a - b	a	10	Very High
X		X	Dwarf Wedgemussel	*Alasmidonta heterodon*	E	E	a - b	b	9	High
X	X		Triangle Floater	*Alasmidonta undulata*		T	a - b	b	9	High
X	X	X	Barrel Floater	*Anodonta couperiana*		E	a - b	a - b	9	High
X		X	Pod Lance	*Elliptio folliculata*		SC	a	b	9	High
X	X	X	Cape Fear Spike	*Elliptio marsupiobesa*		SC	a	b	9	High
X			Waccamaw Spike	*Elliptio waccamawensis*			a	b	9	High
X		X	Atlantic Pigtoe	*Fusconaia masoni*	T	T	a - b	b	9	High
X			Waccamaw Fatmucket	*Lampsilis fullerkati*			a	b	9	High
X		X	Rayed Pink Fatmucket	*Lampsilis splendida*			a	b	9	High
X		X	Carolina Heelsplitter	*Lasmigona decorata*	E	E	a	b	9	High
X		X	Carolina Creekshell	*Sagittunio vaughanianus*		E	a	b	9	High
X	X	X	Savannah Lilliput	*Toxolasma pullus*		E	a	b	9	High
X	X		Southern Rainbow	*Villosa vibex*			a	b	9	High
X		X	Appalachian Elktoe	*Alasmidonta raveneliana*	E	E	a	c	8	High
X	X		Uwharrie Elktoe	*Alasmidonta uwharriensis*			a - b	b - c	8	High
X		X	Slippershell Mussel	*Alasmidonta viridis*		E	a	c	8	High
X			Tidewater Mucket	*Atlanticoncha ochracea*		T	b	b	8	High
X		X	Rainbow	*Cambarunio iris*		T	a	c	8	High
X	X	X	Purple Wartyback	*Cyclonaias tuberculata*		E	a	c	8	High
X			Spike	*Eurynia dilatata*		SC	a	c	8	High
X		X	Longsolid	*Fusconaia subrotunda*	T	T	a	c	8	High
X	X		Yellow Lampmussel	*Lampsilis cariosa*		E	a - b	b - c	8	High
X		X	Wavyrayed Lampmussel	*Lampsilis fasciola*		SC	a	c	8	High
X	X		Chameleon lampmussel	*Lampsilis sp. 2*			a - b	b - c	8	High
X	X	X	Green Floater	*Lasmigona subviridis*	PT	E	a - b	b - c	8	High
X	X		James Spinymussel	*Parvaspina collina*	E	E	a - c	b - c	8	High
X		X	Littlewing Pearlymussel	*Pegias fabula*	E	E	a	c	8	High
X			Tennessee Clubshell	*Pleurobema oviforme*	PE	E	a	c	8	High
X			Tennessee Pigtoe	*Pleuronaia barnesiana*	PE	E	a	c	8	High
X		X	Pink heelsplitter	*Potamilus alatus*		SC	a	c	8	High
X	X		Eastern Pondmussel	*Sagittunio nasutus*		T	a - b	b - c	8	High
X	X		Creeper	*Strophitus undulatus*		T	a - b	b - c	8	High
MAMMALS										
X	X		Star-nosed Mole	*Condylura cristata (incl C.c. parva)*		SC	b	b	8	High
X	X		Star-nosed Mole	*Condylura cristata pop. 1*			b	b	8	High
REPTILES										
	X		Gulf Coast Spiny Softshell	*Apalone spinifera aspera*			a	c	8	High
X		X	Loggerhead Sea Turtle	*Caretta caretta*	T	T	b	b	8	High
X		X	Green Sea Turtle	*Chelonia mydas*	T	T	b	b	8	High
X		X	Leatherback Sea Turtle	*Dermochelys coriacea*	E	E	b	b	8	High
	X		Mississippi Map Turtle	*Graptemys pseudogeographica kohnii*			a	c	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.11-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.11 Pollution			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.09a	Metric 9.09b	Ranking Score	
X, N	X		Carolina (Black) Swamp Snake	*Seminatrix pygaea paludis*		SC	b	b	8	High
SNAILS										
X	X	X	Greenfield Ramshorn	*Helisoma eucosmium*		E	a	a	10	Very High
X	X		Black Mantleslug	*Pallifera hemphilli*		SC	a	a	10	Very High
X	X	X	Magnificent Ramshorn	*Planorbella magnifica*	E	E	a	a	10	Very High
	X		Gravel Elimia	*Elimia catenaria*			a - b	a - b	9	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.12-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.12 Climate Change			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.10a	Metric 9.10b	Ranking Score	
AMPHIBIANS										
X		X	Gopher Frog	*Rana capito*	At-Risk		a	a	10	Very High
X	X	X	Wood Frog - Coastal Plain Pop.	*Rana sylvaticus pop.3*			a	a - b	10	Very High
X, N		X	Green Salamander	*Aneides aeneus*		E	a	b	9	High
X		X	Eastern Hellbender	*Cryptobranchus alleganiensis allaganiensi*	PE		a	b - c	9	High
X	X	X	Imitator Salamander - Waterrock Knob pop.	*Desmognathus imitator pop.1*			a	b	9	High
X	X	X	Northern Pygmy Salamander	*Desmognathus organi*			a	b - c	9	High
X	X	X	Southern Pygmy Salamander	*Desmognathus wrighti*			a	b - c	9	High
X, N			Eastern Long-tailed Salamander	*Eurycea longicauda longicauda*		T	a	b - c	9	High
X, N	X	X	Four-toed Salamander	*Hemidactylium scutatum*		SC	a	b - c	9	High
X, N	X	X	Common Mudpuppy	*Necturus maculosus maculosus*		SC	a	b	9	High
X	X		Cheoah Bald Salamander	*Plethodon cheoah*			a	b - c	9	High
X	X		Jordan's Salamander	*Plethodon jordani*			a	b - c	9	High
X, N	X	X	Crevice Salamander	*Plethodon longicrus*		SC	a	b - c	9	High
X	X		South Mountain Gray-cheeked Salamander	*Plethodon meridianus*			a	b - c	9	High
X	X		Southern Ravine Salamander	*Plethodon richmondi*			a	b	9	High
X, N	X	X	Weller's Salamander	*Plethodon welleri*		SC	a	b	9	High
X, N	X	X	Mabee's Salamander	*Ambystoma mabeei*		T	a	b - d	8	High
	X	X	Spotted Salamander	*Ambystoma maculatum*			a	c	8	High
	X	X	Marbled Salamander	*Ambystoma opacum*			a	c	8	High
X, N	X	X	Mole Salamander	*Ambystoma talpoideum*		SC	a	c	8	High
X, N		X	Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*		T	a	b - d	8	High
X		X	Oak Toad	*Bufo quercicus*			a	c	8	High
X	X		Seepage Salamander	*Desmognathus aeneus*			a	c	8	High
X	X		Southern Dusky Salamander	*Desmognathus auriculatus*			a	c	8	High
X, N	X		Dwarf Black-bellied Salamander	*Desmognathus folkertsi*		SC	a	c	8	High
X		X	Imitator Salamander	*Desmognathus imitator*			a	c	8	High
X	X	X	Santeetlah Dusky Salamander	*Desmognathus santeetlah*			a	c	8	High
X, N	X		Junaluska Salamander	*Eurycea junaluska*		T	a	c	8	High
X, N	X	X	Pine Barrens Treefrog	*Hyla andersonii*		T	a	c	8	High
X	X	X	Blue Ridge Gray-cheeked Salamander	*Plethodon amplus*			a	c	8	High
X	X		Tellico Salamander	*Plethodon aureolus*			a	c	8	High
X			Red-legged Salamander	*Plethodon shermani*			a	c	8	High
X	X		Southern Appalachian Salamander	*Plethodon teyahalee*			a	c	8	High
X, N	X	X	Southern Zigzag Salamander	*Plethodon ventralis*		SC	a	c	8	High
X, N	X	X	Wehrle's Salamander	*Plethodon wehrlei*		T	b	b	8	High
X	X		Yonahlossee Salamander	*Plethodon yonahlossee*			a	c	8	High
X	X	X	Southern Chorus Frog	*Pseudacris nigrita*			a	c	8	High
		X	Wood Frog	*Rana sylvaticus*			a - b	b - c	8	High
X	X		Eastern Lesser Siren	*Siren intermedia intermedia*			a	c	8	High
X	X	X	Many-lined Salamander	*Stereochilus marginatus*			a	c	8	High
BIRDS										
X	X		Saltmarsh Sparrow	*Ammodramus caudacutus*	At-Risk		a	a	10	Very High
X	X		Seaside Sparrow	*Ammodramus maritimus*			a	a	10	Very High
X	X		Nelson's Sparrow	*Ammodramus nelsoni*			a	a	10	Very High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.12-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.12 Climate Change			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.10a	Metric 9.10b	Ranking Score	
X		X	Gull-billed Tern	*Gelochelidon nilotica*		T	a	a	10	Very High
X	X		Black Rail, Eastern Black Rail	*Laterallus jamaicensis*	T	T	a	a	10	Very High
X	X	X	Black-bellied Plover	*Pluvialis squatarola*			a	a	10	Very High
X		X	Black Skimmer	*Rynchops niger*		SC	a	a	10	Very High
X		X	Least Tern	*Sterna antillarum*		SC	a	a	10	Very High
	X		Le Conte's Sparrow	*Ammodramus leconteii*			a	b	9	High
X		X	American Black Duck	*Anas rubripes*			a - b	b	9	High
		X	Ruddy Turnstone	*Arenaria interpres*			a	b	9	High
X			Sanderling	*Calidris alba*			a	b	9	High
			Dunlin	*Calidris alpina*			a	b	9	High
X		X	Red Knot	*Calidris canutus*	T	T	a	b	9	High
			Western Sandpiper	*Calidris mauri*			a	b	9	High
			Semipalmated Sandpiper	*Calidris pusilla*			a	b	9	High
			Veery	*Catharus fuscescens*			a - b	c - e	9	High
X		X	Wilson's Plover	*Charadrius wilsonia*		SC	a	b	9	High
X		X	American Oystercatcher	*Haematopus palliatus*		SC	a	b	9	High
X	X	X	Black-necked Stilt	*Himantopus mexicanus*			a	b	9	High
X	X		Least Bittern	*Ixobrychus exilis*		SC	a	b	9	High
	X	X	Short-billed Dowitcher	*Limnodromus griseus*			a	b	9	High
	X	X	Long-billed Dowitcher	*Limnodromus scolopaceus*			a	b	9	High
X	X	X	Marbled Godwit	*Limosa fedoa*			a	b	9	High
X		X	Whimbrel	*Numenius phaeopus*			a	b	9	High
X	X		Clapper Rail	*Rallus longirostris*			a	b	9	High
X		X	Willet	*Tringa semipalmata*			a	b	9	High
X		X	Golden-winged Warbler	*Vermivora chrysoptera*	At-Risk	SC	a	b	9	High
			Red-winged Blackbird	*Agelaius phoeniceus*			b	b	8	High
X			Henslow's Sparrow	*Ammodramus henslowii*		E	b	b	8	High
X			Grasshopper Sparrow	*Ammodramus savannarum*			a - c	b - e	8	High
			Great Egret	*Ardea alba*			b	b	8	High
			Great Blue Heron	*Ardea herodias*			b	b	8	High
X		X	Brant	*Branta bernicla*			a	c	8	High
			Great Horned Owl	*Bubo virginianus*			b	b	8	High
			Green Heron	*Butorides virescens*			b	b	8	High
			Least Sandpiper	*Calidris minutilla*			b	b	8	High
	X		Semipalmated Plover	*Charadrius semipalmatus*			b	b	8	High
	X		Marsh Wren	*Cistothorus palustris*			b	b	8	High
	X		Sedge Wren	*Cistothorus platensis*			b	b	8	High
			Pileated Woodpecker	*Dryocopus pileatus*			a - b	b - d	8	High
X		X	Tricolored Heron	*Egretta tricolor*		SC	b	b - e	8	High
	X		Rusty Blackbird	*Euphagus carolinus*		T	b	b	8	High
X		X	Peregrine Falcon, American Peregrine Falcon	*Falco peregrinus*		E	b	b	8	High
X		X	Caspian Tern	*Hydroprogne caspia*		T	b	b	8	High
			Red-bellied Woodpecker	*Melanerpes carolinus*			a - b	b - d	8	High
	X		Red-headed Woodpecker	*Melanerpes erythrocephalus*			b	b	8	High
		X	Wild Turkey	*Meleagris gallopavo*			b	b	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.12-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.12 Climate Change			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.10a	Metric 9.10b	Ranking Score	
			Brown-headed Cowbird	*Molothrus ater*			a - b	b - d	8	High
X			Osprey	*Pandion haliaetus*			b	b	8	High
X			Savannah Sparrow	*Passerculus sandwichensis*			a - c	e	8	High
X		X	Bachman's Sparrow	*Peucaea aestivalis*		SC	a	c	8	High
	X		Hairy woodpecker	*Picoides villosus*			b	b	8	High
			Scarlet Tanager	*Piranga olivacea*			a - b	b - c	8	High
X	X	X	King Rail	*Rallus elegans*			b	b - c	8	High
	X		Magnolia Warbler	*Setophaga magnolia*			b	b	8	High
			Pine Warbler	*Setophaga pinus*			a - b	b - d	8	High
X	X		Wayne's Black-throated Green Warbler	*Setophaga virens waynei*		E	b	b	8	High
			Field Sparrow	*Spizella pusilla*			a - c	c - d	8	High
X		X	Royal Tern	*Thalasseus maximus*			b	b	8	High
X		X	Sandwich Tern	*Thalasseus sandvicensis*			b	b	8	High
		X	Mourning Dove	*Zenaida macroura*			b	b	8	High
FRESHWATER FISHES										
			Threadfin Shad	*Dorosoma petenense*			a	b	9	High
			Mottled Sculpin	*Cottus bairdi*			b	b	8	High
		X	Rainbow Trout	*Oncorhynchus mykiss*			b	b	8	High
		X	Brown Trout (Naturalized)	*Salmo trutta*			b	b	8	High
X		X	Brook Trout (Native)	*Salvelinus fontinalis*			b	b	8	High
FRESHWATER MUSSELS										
X	X		Triangle Floater	*Alasmidonta undulata*		T	a	a	10	Very High
X		X	Slippershell Mussel	*Alasmidonta viridis*		E	a	a	10	Very High
X	X	X	Yellow Lance	*Elliptio lanceolata*	T	T	a	a	10	Very High
X		X	Longsolid	*Fusconaia subrotunda*	T	T	a	a	10	Very High
X	X		James Spinymussel	*Parvaspina collina*	E	E	a	a	10	Very High
X		X	Tar River Spinymussel	*Parvaspina steinstansana*	E	E	a	a	10	Very High
X		X	Appalachian Elktoe	*Alasmidonta raveneliana*	E	E	a	a - e	8	High
X	X	X	Barrel Floater	*Anodonta couperiana*		E	a - c	a - c	8	High
X			Tidewater Mucket	*Atlanticoncha ochracea*		T	b	b	8	High
X		X	Carolina Heelsplitter	*Lasmigona decorata*	E	E	a - c	a - c	8	High
MAMMALS										
X		X	Red Wolf	*Canis rufus*	E (Expn)	T	a	a	10	Very High
X	X		Star-nosed Mole	*Condylura cristata (incl C.c. parva)*		SC	a	a	10	Very High
X	X		Star-nosed Mole	*Condylura cristata pop. 1*			a	a	10	Very High
X	X		an undescribed Shrew	*Sorex sp. 1*			a	a	10	Very High
			Northern Short-tailed Shrew	*Blarina brevicauda*			a - b	a - b	9	High
			Southern Short-tailed Shrew	*Blarina carolinensis*			a - b	a - b	9	High
			Least Shrew	*Cryptotis parva*			a - b	a - b	9	High
X	X	X	Northern Yellow Bat (incl Florida Yellow Bat)	*Lasiurus intermedius (incl L.i. floridanus)*		SC	a - b	a - b	9	High
			Masked Shrew	*Sorex cinereus*			a - b	a - b	9	High
X	X		Rock Shrew	*Sorex dispar*			a - b	a - b	9	High
			Smoky Shrew	*Sorex fumeus*			a - b	a - b	9	High
X	X		Southern Pygmy Shrew	*Sorex hoyi winnemana*			a - b	a - b	9	High
			Dismal Swamp Southeastern Shrew	*Sorex longirostris fisheri*			a - b	a - b	9	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.12-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.12 Climate Change			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.10a	Metric 9.10b	Ranking Score	
			Southeastern Shrew	*Sorex longirostris longirostris*			a - b	a - b	9	High
X	X		Dismal Swamp Southern Bog Lemming	*Synaptomys cooperi helaletes*			a - b	a - b	9	High
X			Southern Bog Lemming	*Synaptomys cooperi stonei*			a - b	a - b	9	High
			Eastern Mole	*Scalopus aquaticus*			b	b	8	High
REPTILES										
X, N	X		Stripe-necked Musk Turtle	*Sternotherus peltifer*		SC	a	a - c	10	Very High
X		X	Loggerhead Sea Turtle	*Caretta caretta*	T	T	a	b	9	High
X		X	Green Sea Turtle	*Chelonia mydas*	T	T	a	b	9	High
X		X	Leatherback Sea Turtle	*Dermochelys coriacea*	E	E	a	b	9	High
X, N	X		Carolina (Black) Swamp Snake	*Seminatrix pygaea paludis*		SC	a	b	9	High
X	X		Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata imbricata*	E	E	a	c	8	High
X		X	Bog Turtle	*Glyptemys muhlenbergii*	T(S/A)	T	a - b	a - e	8	High
X, N	X		Northern Map Turtle	*Graptemys geographica*		SC	a - b	a - e	8	High
	X		Mississippi Map Turtle	*Graptemys pseudogeographica kohnii*			a	c	8	High
X	X		Eastern Hog-nosed Snake	*Heterodon platirhinos*			a	c	8	High
X, N	X		Diamondback Terrapin	*Malaclemys terrapin*		SC	a	b - d	8	High
X, N	X	X	Coachwhip	*Masticophis flagellum flagellum*		SC	a - c	c - e	8	High
X, N	X	X	Northern Pine Snake	*Pituophis melanoleucus melanoleucus*		T	a	c	8	High
X	X		Northern Red-bellied Cooter	*Pseudemys rubriventris*			a	c	8	High
SNAILS										
X	X	X	Greenfield Ramshorn	*Helisoma eucosmium*		E	a	a	10	Very High
X	X	X	Magnificent Ramshorn	*Planorbella magnifica*	E	E	a	a	10	Very High
X	X		Fragile Glyph	*Pilsbryna clingmani*		E	a	a	10	Very High
X	X		Cape Fear Threetooth	*Triodopsis soelneri*		T	a	a	10	Very High
X			Broad River Supercoil	*Paravitrea nunnehi*			b	b	8	High

SGCN Species of Greatest Conservation Need	Knowledge Gap Research Priority	Management Needs/Concerns Priority	Appendix 5 Table 5.13-1 THREATS 2025 WAP Revision Taxa Team Evaluations		Federal ESA Protection Statu	NC State Protection Status	Chapter 5, Section 5.13 Disease & Pathogens			Anticipated Level of Impact
2025	2025	2025	Common Name	*Scientific Name*			Metric 9.11a	Metric 9.11b	Ranking Score	
AMPHIBIANS										
X		X	Gopher Frog	*Rana capito*	At-Risk		b	b	8	High
BIRDS										
		X	Brown Pelican	*Pelecanus occidentalis*			a	b	9	High
X		X	Peregrine Falcon, American Peregrine Falcon	*Falco peregrinus*		E	b	b	8	High
	X	X	Common Loon	*Gavia immer*			b	b	8	High
MAMMALS										
X		X	Indiana Bat	*Myotis sodalis*	E	E	a	a	10	Very High
X		X	Little Brown Bat	*Myotis lucifugus*	At-Risk	E	b	a - b	9	High
X		X	Northern Long-eared Bat	*Myotis septentrionalis*	E	E	b	a - b	9	High
X		X	Tricolored Bat	*Perimyotis subflavus*	PE	E	b	b	8	High
REPTILES										
X	X		Eastern Hog-nosed Snake	*Heterodon platirhinos*			a - b	c - e	9	High

Appendix 6

6

6-1 Objectives and example strategies and priority actions for conservation of species.
6-2 Objectives and example strategies and priority actions for conservation of habitats.

Table 6-1 Objectives and example strategies and priority actions for conservation of species.

Goal 1. Improve our understanding of the species diversity of North Carolina and enhance our ability to make conservation management decisions for all species.	
Objective 1.A - Expand information base for priority species (through surveys, research)	
Strategy example	**Collect statewide distribution information for species**
Priority Action example	• Conduct field surveys to collect distribution information
Priority Action example	• Coordinate with state-wide *survey* efforts and incorporate regional and national survey methodologies (as appropriate)
Strategy example	**Determine relative abundance or occupancy of species**
Priority Action example	• Conduct studies to collect relative abundance data or occupancy
Priority Action example	• Coordinate with state-wide *monitoring* efforts and incorporate regional and national monitoring methodologies (as appropriate)
Strategy example	**Resolve taxonomic problems**
Priority Action example	• Pursue formal descriptions for known or putative undescribed species
Priority Action example	• Improve ability to identify cryptic or narrowly differentiated taxa
Objective 1.B - Expand information on long-term trends across species groups, habitats, and management actions (through monitoring)	
Strategy example	**Identify the most critical factors in understanding limits on populations**
Priority Action example	• Improve understanding of community associations
Strategy example	**Determine and evaluate population trends**
Priority Action example	• Establish monitoring protocol, schedule, and sites to determine population trends
Priority Action example	• Monitor the implementation of specific conservation actions
Objective 1.C - Increase knowledge about impacts and develop responses to threats to species	
Strategy example	**Identify critical scientific and management needs**
Priority Action example	• Evaluate climate variability impacts
Priority Action example	• Investigate potentially injurious non-native species

Table 6-1 Objectives and example strategies and priority actions for conservation of species.

Goal 1. Improve our understanding of the species diversity of North Carolina and enhance our ability to make conservation management decisions for all species.	
Strategy example	**Integrate best-available science and adaptive management strategies**
Priority Action example	• Identify opportunities to integrate climate adaptation and mitigation efforts
Priority Action example	• Reduce non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate
Objective 1.D - Foster partnerships and cooperative efforts	
Strategy example	**Support partnerships to achieve common goals, improve efficiency and prevent duplication of efforts**
Priority Action example	• Improve data collection, management, and dissemination within and among agencies, organizations, academia, local governments and private industry
Priority Action example	• Identify public perceptions towards wildlife resources (human dimensions surveys)
Priority Action example	• Promote and expand public participation in agency programs (education, outreach)
Strategy example	**Engage the public**
Priority Action example	• Improve awareness of and appreciation for our wildlife resources
Priority Action example	• Support educational opportunities and citizen science programs
Objective 1.E - Support and improve existing non-regulatory and regulatory programs aimed at conserving species and their habitats	
Strategy example	**Increase efficiency and effectiveness of guidance and review processes aimed at minimizing negative impacts on species (technical guidance, permit review)**
Priority Action example	• Work cooperatively with and provide technical guidance to local governments and communities to implement the Green Growth Toolbox
Priority Action example	• Review and provide comments on Federal Energy Regulatory Commission (FERC) licensing and relicensing projects and implement provisions of FERC settlement agreements

Table 6-1 Objectives and example strategies and priority actions for conservation of species.

Goal 1. Improve our understanding of the species diversity of North Carolina and enhance our ability to make conservation management decisions for all species.	
Strategy example	**Disseminate information to selected audiences through appropriate media**
Priority Action example	• Provide updates and share information for all topics through the internet and other electronic sharing portals
Strategy example	**Increase efficiency and effectiveness of statutes, rules, regulations and review processes affecting priority species (rules and regulations)**
Strategy example	**Improve coordination with local and regional land-use planning efforts and regulatory agencies (coordination, technical guidance)**

Table 6.2 Objectives and example strategies and priority actions for conservation of habitats.

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Objective 2.A - Conserve habitats to support healthy fish, wildlife and plant populations and ecosystem functions	
Strategy example	**Promote and support habitat protection efforts**
Priority Action example	• Periodically update identification of priority areas for habitat conservation
Priority Action example	• Use acquisition and easements to conserve habitats
Objective 2.B - Manage habitats for ecological complexity at all scales	
Strategy example	**Maintain ecological functions of terrestrial and aquatic habitats**
Priority Action example	• Use prescribed fire where appropriate and to maintain communities adapted to fire.
Priority Action example	• Work with private landowners to encourage and facilitate burning on their properties in fire-dependent ecosystems
Strategy example	**Support ecologically effective population densities**
Priority Action example	• Establish means and protocol for captive breeding program for SGCN priority species.
Strategy example	**Manage populations to maintain sustainable communities of species**
Priority Action example	• Improve long-term sustainability of imperiled species by reducing vulnerability to isolated catastrophic events or genetic problems.
Objective 2.C -Recover and restore species and habitats	
Strategy example	**Utilize propagation techniques for reintroduction of native species and populations**
Priority Action example	• Collect gravid mussels from the wild in order to propagate juvenile mussels at fish hatchery facilities.
Priority Action example	• Re-establish fish and mollusk populations within species' historic range.
Strategy example	**Utilize in-stream habitat restoration techniques, including barrier removal (e.g., dams, culverts, pipes), bank stabilization, installing BMPs, and natural channel design**
Priority Action example	• Improve data collection, management, and dissemination within and among agencies, organizations, academia, and private industry
Strategy example	**Promote or restore natural or improved flow regimes**

Table 6.2 Objectives and example strategies and priority actions for conservation of habitats.

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Objective 2.D - Foster partnerships and cooperative efforts	
Strategy example	**Support partnerships to achieve common goals, improve efficiency and prevent duplication of efforts**
Priority Action example	• Improve data collection, management, and dissemination within and among agencies, organizations, academia, and private industry
Priority Action example	• Identify public perceptions towards wildlife resources (human dimensions surveys)
Priority Action example	• Increase communication, cooperation and collaboration among conservation partners at the state, regional, and nation scales via partnerships and working groups.
Priority Action example	• Develop new partnerships to coordinate conservation efforts and address conservation needs in the Yadkin – Pee Dee corridor, Uwharrie Mountain region, and in the northern tier counties of the Piedmont.
Strategy example	**Engage the public**
Priority Action example	• Promote and expand public participation in agency programs (education, outreach)
Priority Action example	• Identify public perceptions towards wildlife resources (human dimensions surveys)
Priority Action example	• Improve awareness of and appreciation for our wildlife resources
Priority Action example	• Promote and expand public participation in agency programs
Priority Action example	• Support educational opportunities and citizen science programs
Objective 2.E - Support and improve existing regulations and programs aimed at conserving species and their habitats	
Strategy example	**Increase efficiency and effectiveness of guidance and review processes aimed at minimizing negative impacts on fish, wildlife, and habitats (technical guidance, permit review)**
Priority Action example	• Provide accessible information on distribution, biology, status, threats, etc. for priority species groups
Strategy example	**Disseminate information to selected audiences through appropriate media**
Priority Action example	• Build education and outreach components into project implementation and disseminate print and electronic media to facilitate information exchange and education.

Table 6.2 Objectives and example strategies and priority actions for conservation of habitats.

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Strategy example	**Increase efficiency and effectiveness of statutes, rules, regulations and review processes affecting habitats (rules and regulations)**
Priority Action example	• Standardize the species listing process under the state Endangered Species statutes.
Priority Action example	• Investigate, implement, and support (as appropriate) programs that are directed at listed species recovery (e.g., Habitat Conservation Planning, Landowner Incentive Program, Safe Harbor)
Priority Action example	• Support incentive and information programs that help reduce sedimentation and erosion (e.g., fencing livestock from streams, improve tilling practices), minimize pesticide and herbicide use, and modernize wastewater treatment facilities..
Strategy example	**Improve coordination with local and regional land-use planning efforts and regulatory agencies (coordination, technical guidance)**
Priority Action example	• Support establishment of riparian buffers along streams, implementation of low impact development, and better stormwater management (e.g., secondary and cumulative impacts) through program coordination, cooperative projects, and technical guidance
Priority Action example	• Encourage the adoption of growth management plans by county/ municipal governments
Priority Action example	• Work with zoning and planning boards to steer development away from priority areas and habitats.

Appendix 7

7

7-1 Species-specific monitoring efforts
7-2 Guild and species assemblage monitoring
7-3 Activity and project specific monitoring

Table 7.1 Species-Specific Monitoring Efforts

Species Common Name (see Appendix G for Scientific Names)	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
AMPHIBIANS		
Green Salamander	NCWRC, NCDPR, USFS, USFWS, Universities, Land Trusts, Volunteers	Periodic
Carolina Gopher Frog	NCWRC, NCMNS, NCDPR, NCNHP, USFWS, DOD (USMC), USFS, SCDNR, SREL, TNC	
Neuse River Waterdog	NCWRC, NCMNS, NCDPR, USFWS, Nash Community College	
Pine Barrens Treefrog	NCWRC, NCMNS, USFS, DOD Installations	
BIRDS		
American Oystercatcher (Breeding)	NCWRC, NCDPR, NPS, USFWS, DOD (USMC), NERR, Audubon NC	Every 2-3 years
Bachman's sparrow	NCWRC	Annual on Sandhills GL, 5-10 years rangewide (NC)
Bald Eagle	NCWRC, NCDPR, NCNHP, USFWS, USACE, DOD (USMC), Timber Companies	
Northern Bobwhite (or Bobwhite Quail)	NCWRC	Fall, Spring
Cerulean Warbler	NCWRC, USFWS, Volunteers	
Golden-Winged Warbler	Audubon NC, NCWRC	
Ruffed Grouse (drumming counts)	NCWRC, USFS	
Loggerhead Shrike	NCWRC, volunteers	
Mourning Doves	NCWRC, USFWS	
Peregrine Falcon	NCWRC, NCDPR, USFS, Volunteers	
Piping Plover (Breeding)	NCWRC, NCDPR, NPS, USFWS, DOD (USMC), NERR, Audubon NC	
Red-Cockaded Woodpecker	NCWRC, NCFS, NCDPR, USFS, USFWS, DOD (Army, USMC), Sandhills Ecological Institute, TNC, Private Consultants	
Tundra Swans	NCWRC	
Wild Turkey (summer observation survey)	NCWRC, NCFS, USFS, USFWS, Volunteers	
Wilson's Plover (Breeding)	NCWRC, NCDPR, NPS, USFWS, DOD (USMC), NERR, Audubon NC	Every 2-3 years
Wood Duck	NCWRC, USFWS	

Table 7.1 Species-Specific Monitoring Efforts

Species Common Name (see Appendix G for Scientific Names)	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
Yellow-Bellied Sapsuckers (Mountain ecoregion breeding population)	NCWRC, NCMNS, NPS, USFS, USFWS, Mars Hill University, Multi-state work groups	
FRESHWATER FISH		
Largemouth Bass	NCWRC, Duke Power, NC State University	
Roanoke Bass	NCWRC	Periodic
Robust Redhorse	Robust Redhorse Conservation Committee (NC, GA, SC)	
Smallmouth Bass	NCWRC, Universities	
Spotted Bass	NCWRC, Universities	
MAMMALS		
Black Bear	NCWRC, USFS, USFWS, DOD (Army, USMC), Timber Companies	
Carolina Northern Flying Squirrel	NCWRC, NPS, USFS, Eastern Band of Cherokee Indians, Universities	
White-Tailed Deer	NCWRC, DOD (Army, USMC)	
REPTILES		
Bog Turtle	NCWRC, NPS, USFS, USFWS, Project Bog Turtle, TNC, Volunteers	Periodic (triennial)
Chicken Turtle	NCWRC, NCMNS, USFS, DOD	
Diamondback Terrapin	NCWRC, NERR, Volunteers	
Eastern Box Turtle	NCWRC, Davidson College Herpetology Lab, UNC-Greensboro	
Eastern Coachwhip	NCWRC, NCMNS	
Eastern Diamondback Rattlesnake	NCWRC, NCMNS, USFS, DOD	
Northern Pine Snake	NCWRC, NCMNS	
Pigmy Rattlesnake	NCWRC, NCMNS, USFS, USFWS, DOD	
Southern Hognose Snake	NCWRC, NCMNS, NCNHP, NC Herpetological Society	

Table 7.2 Guild and Species Assemblage Monitoring

Guilds	Collaborators	Frequency (Annual unless otherwise noted)
AMPHIBIANS		
Anurans	NCWRC, NCMNS, USFS, USGS, DOD, NCPARC, NC Herpetological Society, Universities, Volunteers	
Salamanders	NCWRC, NCMNS, NCDPR, NPS, USFS, Land Trusts, Universities, Volunteers	Periodic
AQUATIC SPECIES		
Anadromous Fishes (Alewife, American Shad, Blueback Herring, Hickory Shad, Striped Bass)	NCWRC, NCDMF, NMFS, USFWS, ASMFC	
Game Fishes (Black, Striped, and Bodie Bass; Black and White Crappie; Walleye; Muskellunge)	NCWRC, USFS, Duke Power, N.C. State University	Periodic (stock dependent)
Nongame Fishes	NCWRC, NCMNS, NCDWR,USFWS	
Marine Fishes (Fishery Management Plan [FMP] species)	NCDMF, NOAA-Fisheries, NCWRC	
Marine Species (Non- FMP species: shrimp, blue crab, bay scallop, oysters, hard clams)	NCDMF, NOAA-Fisheries	
Brook, Brown, and Rainbow Trout	NCWRC, NPS, USFS	
Crayfishes	NCWRC, NCDWR, NCMNS, NPS	Periodic
Mussels	NCWRC, NCMNS, USFWS, Universities	
BIRDS		
Breeding Birds	NCWRC, USGS, Land Trusts, volunteers	
Colonial Waterbirds (estuarine surveys)	NCWRC, NCDPR, NPS, USACE, USFWS, DOD (USMC), NERR, Audubon NC	Every 2 – 3 years
Game Land Bird Surveys (All-Bird)	NCWRC	Annual
Grassland Songbirds	Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, Volunteers	
Heronry Surveys	NCWRC	Every 5-7 years

Table 7.2 Guild and Species Assemblage Monitoring

Guilds	Collaborators	Frequency (Annual unless otherwise noted)
Migratory Birds	NCWRC, Partners in Flight, Volunteers	Spring, Fall
Neotropical Songbirds	NCWRC, USFS, USGS, Audubon NC, Southern Appalachian Raptor Research (SARR), Weyerhaueser Company-Cool Springs Environmental Education Center	
Nightjars	The Center for Conservation Biology (William & Mary College), NCWRC, Volunteers	
Pelagic (International) Shorebirds	USFWS, NPS, NCWRC	
Raptors (nesting)	NCWRC, SARR, Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, Volunteers	
Riparian Breeding Bird Surveys	NCWRC & Volunteers	Periodic
Shorebirds (Nonbreeding)	NCWRC, NPS, USFWS, DOD (USMC)	
Songbirds (Breeding, Winter)	NCWRC, USFS, Audubon NC	
Waterfowl	NCWRC, USFWS, NCDPR, Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, Volunteers	
MAMMALS		
Bats	NCWRC, NCMNS, USFS, USFWS, UNC-Greensboro, Indiana State University, National Speleological Society, Volunteers	Some species periodic
Furbearer Species (nongame, foxes)	NCWRC, Licensed trappers	Every 5 years
Rabbits (Mountain ecoregion)	NCWRC	
Small Mammals (Statewide)	NCWRC, NCMNS, NCDPR, USFS, NPS	
State Listed Small Mammals (Mountain ecoregion)	NCWRC, NCMNS, USFS, NPS, Universities, Volunteers	Periodic
REPTILES		
Turtles (semi-aquatic species)	Davidson College Herpetology Lab, NCWRC	
Upland Snake Surveys	NCWRC, NCMNS, USFS, DOD	

Table 7.2 Guild and Species Assemblage Monitoring

Guilds	Collaborators	Frequency (Annual unless otherwise noted)
CLASS: INSECTA		
Butterflies and Moths (summer counts)	NCNHP, Volunteers	
OTHER		
Federal (Candidate, FSC) and State Listed Species	NCWRC, NCDWR, NCNHP, NCDOT, USFS, USFWS, TVA, NC State University, LTWA	Periodic (species, location specific)
Herpetofauna Surveys	NCWRC, Weyerhaueser Company-Cool Springs Environmental Education Center	

Table 7.3 Activity and Project Specific Monitoring

Initiative/Program	Collaborators	Frequency (Annual unless otherwise noted)
AMPHIBIANS & REPTILES (HERPS)		
Calling Amphibian Survey Program (CASP)	NCWRC, NCPARC, volunteers	
Carolina Herp Atlas	Davidson College Herpetology Lab, NCWRC, NCPARC, volunteers	
Catawba River Corridor Coverboard Program	Davidson College Herpetology Lab, Annie Springs Close Greenway, CCARI, NCWF, SCWF, Catawba Lands Conservancy, Catawba Valley Land Trust, Duke Power, The Home Depot, Iredell & Mecklenburg counties Parks and Recreation, SCDNR, SCDPRT	
Davidson College Ecological Preserve Monitoring	Davidson College Herpetology Lab	
Sea Turtle Nesting Beach Monitoring Program	NCWRC, NCDPR, NPS, DOD (USMC),, NERR, BHIC, NC Audubon Society, Volunteers	
Sea Turtle Stranding And Salvage Network	NCWRC, NCDPR, NPS, NCDMF, NERR, NOAA Fisheries, USACE, NC Aquariums, DOD Installations, BHIC, NC Audubon Society, Duke University, NCSU Vet School, Volunteers	
Urban Amphibian Monitoring	Davidson College Herpetology Lab	
AQUATIC SPECIES		
Benthic Macroinvertebrate Index of Biotic Integrity (IBI) Monitoring	NCDWR, NCWRC, TVA, Duke Energy, Progress Energy	Variable (every 5-years per river basin, every 2-years for fixed stations)
Fish Index of Biotic Integrity (IBI) Monitoring	NCWRC, NCDWR, TVA, Duke Energy, Progress Energy	Periodic (2 – 3 years)
Fish Kill Investigations	NCDWR, NCWRC	Periodic (each occurrence)
Index of Biotic Integrity (IBI)	USFS	

Table 7.3 Activity and Project Specific Monitoring

Initiative/Program	Collaborators	Frequency (Annual unless otherwise noted)
Nongame Aquatic Species Relocation, Augmentation, and Restoration Projects	NCWRC, NCDWR, NCDOT, USFS, USFWS, TNDEC, TVA, APGI, BRPP, University of TN-Knoxville, Western Carolina University	Periodic (project specific)
Stream Water Quality And Aquatic Invertebrate Monitoring	Weyerhaueser Company-Cool Springs Environmental Education Center	
BIRDS		
Avid Quail and Grouse Hunter Surveys	NCWRC, Volunteers	
Bird Nest Box and Productivity Surveys	NCWRC, NCDPR, USACE Mecklenburg County Parks & Recreation, Cornell Lab of Ornithology, WildSouth, Southern Appalachian Raptor Research, Mountain Wild, Audubon NC, Deltec Homes, Volunteers	
Breeding Bird Surveys (BBS)	NCWRC, NCMNS, NCDPR, USGS, USFS, USFWS, Audubon NC, volunteers	
Christmas Bird Count	Audubon NC, Cornell Lab of Ornithology, Volunteers	
Important Bird Area Monitoring	Audubon NC, NCWRC, Volunteers	
Monitoring Avian Productivity and Survivorship (MAPS) and Migration Banding Stations	NPS, NCWRC, NCMNS, NCDPR, Mecklenburg County Parks & Recreation, Howell Woods Environmental Learning Center, Weymouth Woods State Nature Preserve, Cornell Lab of Ornithology, Institute of Bird Population Studies, Southern Appalachian Raptor Research, Volunteers	
Project Feederwatch	Mecklenburg County Parks & Recreation Cornell Lab of Ornithology, Howell Woods Environmental Learning Center, Volunteers	
MAMMALS		
Avid Rabbit Hunter Survey	NCWRC	
Chronic Wasting Disease (CWD) Surveillance	NCWRC, volunteers	Every 5 years
White-nose Syndrome (WNS) Bat Monitoring	NCWRC, USFS, USFWS, UNC-Greensboro, Indiana State University	

Table 7.3 Activity and Project Specific Monitoring

Initiative/Program	Collaborators	Frequency (Annual unless otherwise noted)
OTHER		
Blue Ridge Parkway Survey Plots	NPS, Mars Hill University	
INRMP Plan Monitoring (multiple species)	DOD Installations, Volunteers	
Management Indicator Species	USFS	
NHP G1/G2 Ranked Species Surveys	NCNHP, NCWRC, International Paper, Weyerhaueser Company, Coastal Land Trust, TNC	
Trapper Harvest Surveys	NCWRC, licensed trappers	Every 5 years