APPENDIXES

Abbreviations, Acronyms, and Glossary

A

Abbreviations & Acronyms

ACEP	Agricultural Conservation Easement Program
ADFPTF	Agricultural Development and Farmland Preservation Trust
AEC	Areas of Environmental Concern
AFS	American Fisheries Society
AFWA	Association of Fish and Wildlife Agencies
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
ACJV	Atlantic Coast Joint Venture
AMJV	Appalachian Mountains Joint Venture
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
C	Candidate species
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, now Wildlife Action Plan
CWMTF Clean Water Management Trust Fund
CFACC Cape Fear Arch Conservation Collaborative
DA Drainage area
DDT dichloro diphenyl trichloroethane
DMAP Deer Management Assistance Program
DO Dissolved oxygen
DOD United States Department of Defense
E Endangered species
EBCI Eastern Band of Cherokee Indians
EELE Environmental Education Learning Experience
EEP 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
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
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
HFRP	Healthy Forests Reserve Program
HMS	Highly migratory species
HQW	High quality waters
HUC	Hydrologic unit code
IAA	International Association of Astacology
IAFWA	International Association of Fish and Wildlife Agencies
IBA	Important Bird Areas
INRMP	Integrated Natural Resource Management Plan (in DOD)
IBI	Index of Biotic Integrity
IUCN	International Union for Conservation of Nature
LRMP	Land and Resource Management Plan (in USFS)
LTWA	Little Tennessee Watershed Association
LIDAR	Light Detection and Ranging
LWCF	Land and Water Conservation Fund
MAFMC	Mid-Atlantic Fisheries Management Council
MAPS	Monitoring Avian Productivity and Survivorship
MFC	Marine Fisheries Commission
MMPA	Marine Mammal Protection Act
NAAMP	North American Amphibian 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
NC GAP North Carolina Gap Analysis Project
NCGS North Carolina General Statute
NCDACS North Carolina Department of Agriculture and Consumer Services
NCDENR North Carolina Department of Environment and Natural Resources
NCDEMLR North Carolina Division of Energy, Mineral and Land Resources (in NCDENR)
NCDCM North Carolina Division of Coastal Management (in NCDENR)
NCDFR North Carolina Division of Forest Resources, now NC Forest Service
NCDMF North Carolina Division of Marine Fisheries (in NCDENR)
NCDOT North Carolina Department of Transportation
NCDPR North Carolina Division of Parks and Recreation (in NCDENR)
NCDSW North Carolina Division of Soil & WAter Conservation (in NCDACS)
NCDWQ North Carolina Division of Water Quality (in NCDENR)
NCDWR North Carolina Division of Water Resources (in NCDENR), formerly NCDWQ
NCEEP North Carolina Ecosystem Enhancement Program, now Mitigation Services (in NCDENR)
NCFS North Carolina Forest Service (in NCDACS), formerly NCDFR
NCHS North Carolina Herpetological Society
NCMNS North Carolina Museum of Natural Sciences (in NCDENR)
NCNHP North Carolina Natural Heritage Program(in NCDENR), now Land and Water Stewardship
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 (also called Commission)
NERR National Estuarine Research Reserve

NGO Non-governmental organization

NMFS National Marine Fisheries Service (in NOAA), currently abbreviated as NOAA Fisheries

NOAA National Oceanic and Atmospheric Administration

NOAA Fisheries National Marine Fisheries Service, formerly abbreviated as NMFS

NPDES National Pollution Discharge Elimination System

NPS National Parks Service

NRCS Natural Resources Conservation Service (in USDA)

NRI National Resources Inventory, conducted by NRCS

NWAC Nongame Wildlife Advisory Committee

NWR National Wildlife Refuge (in USFWS)

NABat North American Bat Monitoring Program

NABCI North American Bird Conservation Initiative

OPR Office of Protected Resources (in NOAA Fisheries)

ORW Outstanding resource waters

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

RC & D Resource Conservation and Development Councils

RCPP Regional Conservation Partnership Program (in NRCS)

RRCC Robust Redhorse Conservation Committee

SA One of three primary surface water classifications for coastal waters established by the EMC; shellfishing waters

SAE Southern Appalachian Ecoregion

SAFMC South Atlantic Fisheries Management Council

SAIN Southern Appalachian Information Node

SAMBI South Atlantic Migratory Bird Initiative

SAV Submerged aquatic vegetation

SC Special Concern

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
SNHA	Significant Natural Heritage Area
SREL	Savannah River Ecology Laboratory
Strategy	Comprehensive Wildlife Conservation Strategy, now WAP
SGCN	Species of Greatest Conservation Need
SALCC	South Atlantic Landscape Conservation Cooperative
SAMBI	South Atlantic Migratory Bird Initiative
SBDN	Southeastern Bat Diversity Network
SARP	Southeast Aquatic Resources Partnership
SARR	Southern Appalachian Raptor Research
SLAMM	Sea Level Affecting Marshes Model
SLEUTH	Slope, Land use, Excluded, Urban, Transportation and Hillshade (model)
SWG	State Wildlife Grants
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
TWW	Teaming With Wildlife
UNC	University of North Carolina
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

VAD	Voluntary Agricultural District
VOA	Voice of America
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
WUI	Wildlife–urban interface

Glossary

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

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.

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.

Benthic—Associated with the bottom area of bodies of water.

Benthic macroinvertebrates—Organisms living in or on the bottom substrate of aquatic habitats, including 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.

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 where 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.

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.

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.

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 (e.g., 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.

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

Exotic species (also commonly called *alien*, *non-indigenous*, or *nonnative*)—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.

Forage—v.: 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.

GSM Transmitter—Tracking device that uses wireless telecommunications standards set for digital cellular networks (i.e., cell phones). GSM transmitters are used to track and log the locations of wildlife, especially birds or land animals.

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 used 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.

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) that 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.

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)

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 purpose of rearing young.

Migration—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.

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 (nonliving: 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 they occur.

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.

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 NCDWQ classification intended to protect unique and special waters having excellent water quality and being of exceptional state or national ecological or recreational significance.

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 Inland–Coastal 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 that 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.

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—Horizontal, 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 deepwater 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.

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 that 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, Inland–Coastal 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.

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.

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.

Executive Summary

B

Understanding the Impacts of Climate Change on Fish and Wildlife in North Carolina

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.

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

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.

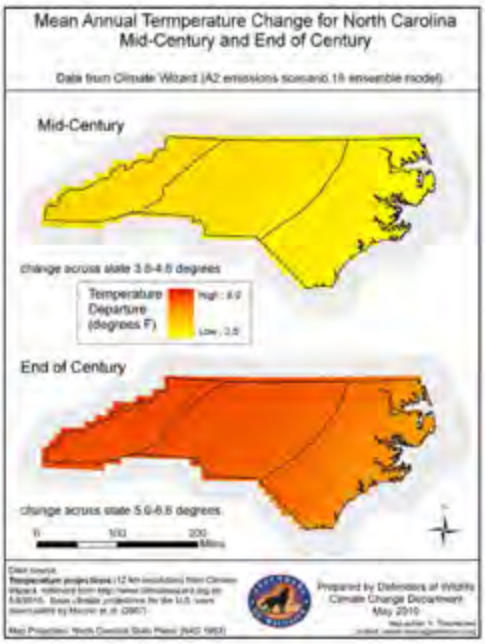

Figure 1. Projected change in mean annual temperature for North Carolina by mid and end of the century. Projections are based on a high emissions scenario (A2) and the ensemble average of 16 GCMs statistically downscaled to 12 km.

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.

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

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.

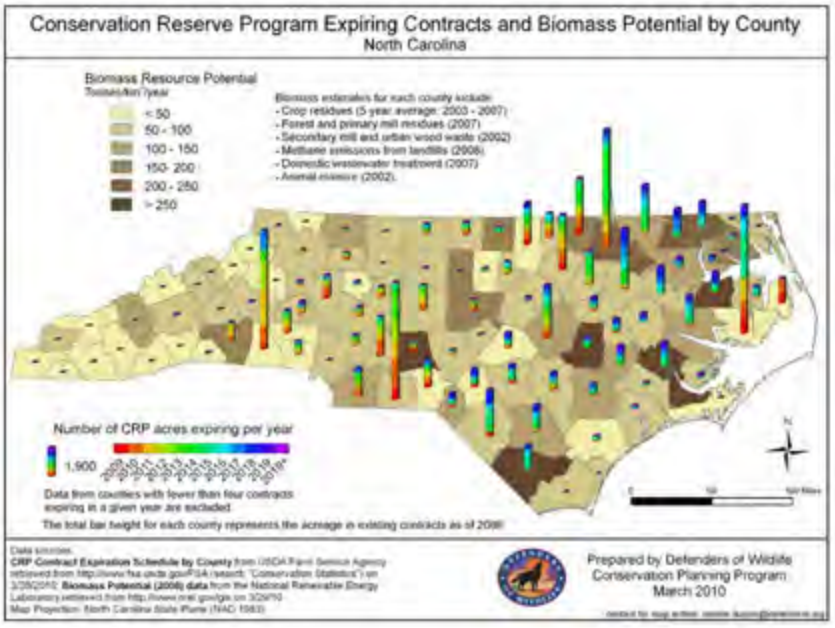

Figure 2. Conservation Reserve Program expiring contracts and biomass potential by county in North Carolina. Dark shaded counties have higher biomass resource potential. The height of the bar in each county indicates the acreage in existing contracts as of 2009 (expiration dates are color coded within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

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

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

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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Key Participants and Letters of Support

C

Key Participants

WAP Coordinator

Cindy Carr, Habitat Conservation Division

WAP Steering Committee

Allen Boynton, Wildlife Diversity Program

Ken Bridle, Piedmont Land Conservancy and Nongame Wildlife Advisory Committee

Shannon Deaton, Habitat Conservation Division

Todd Ewing, Aquatic Diversity Program

Chris McGrath, Wildlife Diversity Program

David Sawyer, Surveys and Research Program

Perry Sumner, Wildlife Diversity Program

Technical Team

NCWRC 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. The Team convened work groups as needed.

Dave Allen
Scott Anderson
Cindy Carr
Steve Fraley
Joe Fuller
Jeff Hall
Ryan Heise
Brad Howard
Tommy Hughes
Jeff Marcus
Rob Nichols
Jake Rash
Vann Stancil
Gordon Warburton
Kendrick Weeks
Bennett Wynne

Ranking Criteria Work Group

A Technical Team subcommittee tasked with review and revision of the methodology for identifying Species of Greatest Conservation Need and prioritizing conservation, research, and management efforts on behalf of priority species.

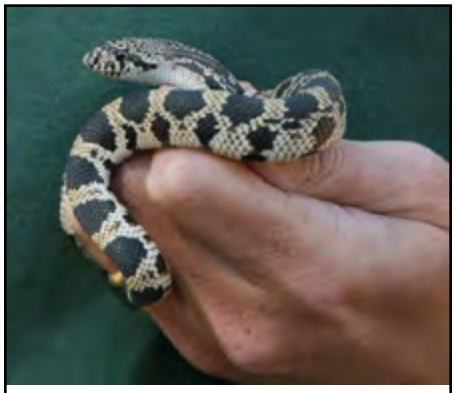
Dave Allen
Scott Anderson
Cindy Carr
Joe Fuller
Rob Nichols
Vann Stancil
Kendrick Weeks

Taxa Teams

Eight subcommittees comprised of species experts convened by the Technical Team and tasked with applying the ranking criteria to evaluate the state's fish and wildlife species and develop priorities for conservation, research, and management needs.

Amphibian and Reptile Taxa Teams

Jeff Beane, NC Museum of Natural Science
Ed Corey, NC Division of Parks and Recreation
Sara Finn, NC Wildlife Resources Commission
Gabrielle Graeter, NC Wildlife Resources Commission
Jeff Hall, NC Wildlife Resources Commission
Jeff Humphries, NC Wildlife Resources Commission
Kendrick Weeks, NC Wildlife Resources Commission
Lori Williams, NC Wildlife Resources Commission



Pine Snake (Jeff Hall/NCWRC)

Bird Taxa Team

Dave Allen, NC Wildlife Resources Commission
Scott Anderson, NC Wildlife Resources Commission
John Carpenter, NC Wildlife Resources Commission
Joe Fuller, NC Wildlife Resources Commission
Walker Golder, Audubon North Carolina

Eastern Bluebirds (Geoff Cantrell/NCWRC)

Mark Jones, NC Wildlife Resources Commission
Christine Kelly, NC Wildlife Resources Commission
Harry LeGrand, NC Natural Heritage Program
Jeff Marcus, NC Wildlife Resources Commission
Curtis Smalling, Audubon North Carolina
John Stanton, US Fish and Wildlife Service
Gordon Warburton, NC Wildlife Resources Commission
Craig Watson, US Fish and Wildlife Service
Kendrick Weeks, NC Wildlife Resources Commission

Crayfish Taxa Team

Tyler Black, NC Wildlife Resources Commission
Ed Corey, NC Department of Parks and Recreation
Rob Nichols, NC Wildlife Resources Commission
TR Russ, NC Wildlife Resources Commission
Jeff Simmons, Tennessee Valley Authority
Chris Skelton, Georgia College

Acuminate Crayfish (Cambarus sp. C) (TR Russ/NCWRC)

Freshwater Fish Taxa Team

Steve Fraley, NC Wildlife Resources Commission
Fred Harris, NC Wildlife Federation
Ryan Heise, NC Wildlife Resources Commission
Brian McRae, NC Wildlife Resources Commission
Sarah McRae, US Fish and Wildlife Service
Rob Nichols, NC Wildlife Resources Commission
Jake Rash, NC Wildlife Resources Commission
Fritz Rohde, NOAA Fisheries
Wayne Starnes, NC Museum of Natural Science
Chad Thomas, NC Wildlife Resources Commission
Bryn Tracy, NC Division of Water Resources

Tangerine Darter (Melissa McGaw/ NCWRC)

Freshwater Mussel Taxa Team

Art Bogan, NC Museum of Natural History

Steve Fraley, NC Wildlife Resources Commission

Ryan Heise, NC Wildlife Resources Commission

Sara McRae, US Fish and Wildlife Service

Rob Nichols, NC Wildlife Resources Commission

Judy Ratcliffe, NC Natural Heritage Program

Tim Savidge, The Catena Group

Ryan Heise/NCWRC

Mammal Taxa Team

Lisa Gatens, NC Museum of Natural Science

Ben Hess, NC Museum of Natural Science

Matina Kalcounis-Rüppell, University of North Carolina at Greensboro

Christine Kelly, NC Wildlife Resources Commission

Colleen Olfenbuttel, NC Wildlife Resources Commission

Brandon Sherrill, NC Wildlife Resources Commission

David Webster, University of North Carolina at Wilmington

Kendrick Weeks, NC Wildlife Resources Commission

Carolina Northern Flying Squirrel (Melissa McGaw/NCWRC)

Snail Taxa Team

Art Bogan, NC Museum of Natural Science

Dan Doursin, Belize Foundation for Research & Environ. Education

Steve Fraley, NC Wildlife Resources Commission

Brena Jones, NC Wildlife Resources Commission

Rob Nichols, NC Wildlife Resources Commission

Judy Ratcliffe, NC Natural Heritage Program

Unidentified snail species in Dare County (Travis S/ FLICKR https://flic.kr/p/dwT84X) Used under a Creative Commons Attribution-NonCommercial 4.0 International License

Anthropod Taxa Team

Striped Grannom (*Brachycentrus lateralis*) in case (Erik Fleek/NC Division of Water Resources)

Nancy Adamson, Natural Resources Conservation Service

John Amoroso, NC Department of Parks and Recreation

Susan Cameron, US Fish and Wildlife Service

Ed Corey, NC Department of Parks and Recreation

Steve Hall, NC Natural Heritage Program

Kathleen Kidd, NC Department of Agriculture and Consumer Services

Andrea Leslie, NC Wildlife Resources Commission

Harry LeGrand, NC Natural Heritage Program

Dave Lenat (retired NC Division of Water Quality)

Dave Penrose (retired NC Division of Water Quality)

David Stephan, NC State University

David Tarpy, NC State University

Rob Trickel, NC Forest Service

ad Hoc Committees, Work Groups, and Peer Review Assistance

Individuals representing many different partners and stakeholder organizations participated on several *ad hoc* committees, work groups, and peer review groups and assisted with review of species, habitats, spatial data, and priorities and contributed document content.

Federal Agencies

National Park Service

Natural Resources Conservation Service

NOAA Fisheries

US Fish and Wildlife Service

US Forest Service

US Geological Survey

State Agencies and Organizations

- Clean Water Management Trust Fund
- Georgia Museum of Natural History
- NC Department of Agriculture and Consumer Services
- NC Department of Environment and Natural Resources
- NC Department of Parks and Recreation
- NC Department of Transportation
- NC Wildlife Resources Commission
- Nongame Wildlife Advisory Committee
- Ohio Department of Natural Resources
- Virginia Department of Game and Inland Fisheries

Corporations

- Duke (Progress) Energy
- Unique Places Land Conservation, Restoration & Management
- Weyerhaeuser Company

Education Organizations

- Appalachian State University
- Auburn University
- Clemson University
- Davidson College
- Nash Community College
- NC State University
- Smith College
- Texas A&M University
- University of Georgia
- University of North Carolina at Greensboro
- University of North Carolina at Wilmington
- Wake Forest University
- Washington State University
- West Liberty University
- West Virginia University

Other Organizations, Partners, and Stakeholders

- Catawba Land Conservancy
- Conservation Trust for North Carolina
- Freshwater Mollusk Conservation Society
- Midwest Biodiversity Institute
- National Bobwhite Conservation Initiative
- Piedmont Land Conservancy
- The Nature Conservancy
- The Xerces Society

Workshops

Numerous partners representing federal and state agencies, regional and local organizations, corporations, nongovernmental organizations, and stakeholder groups participated in planning workshops held early in the revision process.

September 2010 Climate Change Workshop (Raleigh)

140 participants from:

- 6 federal agencies: EPA, USFWS, USGS/NC Cooperative Fish & Wildlife Research Unit, NPS, USDA-NRCS, USFS
- 13 state agencies: UNC Greensboro, UNC Charlotte, NCSU, NC Sea Grant, NHTF, WRC, NHP, MNS, NCFS, EEP, DWR, NCDENR, APNEP
- 13 nongovernmental organizations: Carolina Mountain Land Conservancy, CTNC, Defenders of Wildlife, EDF, LTA, NCWF, NWF, Open Space Institute, Pacolet Area Conservancy, Piedmont Land Conservancy, Southern Appalachian Highlands Conservancy, TNC, Wildlands Network
- 3 regional/local government organizations: NWAC, City of Highpoint, Triangle Greenways Council
- 5 private companies: Weyerhaeuser Timber, Progress Energy, Recreation Resources Service, HDR, Duke University

March 2011 Regional Workshop (Williamston)

44 participants from:

- 3 federal agencies: NPS (Cape Lookout), USFWS, USDA-NRCS
- 9 state agencies: APNEP, CWMTF, NHP, NC Sea Grant, DCM, WRC, Halifax SWD, Martin SWD, Nash SWD
- 4 nongovernmental organizations: Audubon NC, National Wildlife Federation, The Conservation Fund, The Nature Conservancy
- 1 regional/local government organizations: Onslow County
- 1 private company: Weyerhaeuser Timber

April 2011 Regional Workshop (Burgaw)

33 participants from:

- 1 federal agency: DOD-USMC
- 6 state agencies: DCM, DSW, Brunswick SWD, NHP, DOT, WRC
- 4 nongovernmental organizations: Audubon NC, Coastal Land Trust, NC Coastal Federation, The Nature Conservancy
- 1 regional/local government organizations: City of Wilmington
- 2 private companies: J.M. Waller Associates, Meredith Wolf Education and Conservation Den

April 2011 Regional Workshop (Lenoir)

20 participants from:

- 3 state agencies: DSW, NHP, WRC
- 4 nongovernmental organizations: Audubon NC, Southern Appalachian Highlands Conservancy, Lake James Wildlife and Nature Society, Catawba Lands Conservancy
- 2 regional/local government organizations: Mecklenburg County Parks and Recreation, Rutherford County

April 2011 Regional Workshop (Waynesville)

56 participants from:

- 1 federal agency: USFWS
- 5 state agencies: NHP, EEP, WRC, University of South Carolina, NC State University
- 10 nongovernmental organizations: Southern Appalachian Highlands Conservancy, Haywood Waterways Association, The Nature Conservancy, Highlands-Cashiers Land Trust, Wild South, Elisha Mitchell Audubon Society, Hiwassee River Watershed Coalition, Little Tennessee Watershed Association, Southern Appalachian Forest Coalition, Land Trust for Little Tennessee
- 3 regional/local government organizations: Bethel Rural Community Organization, Land-of-Sky Regional Council, Haywood County

- 4 private companies: LTA Consulting, Gresham, Smith & Partners, Equinox Environmental, Luther E. Smith & Associates
- 1 federally-recognized tribe: Eastern Band of Cherokee Indians (EBCI)

May 2011 Regional Workshop (Asheboro)

55 participants from:

- 1 federal agency: USFWS
- 10 state agencies: NC Zoo, WRC, NHP, UNC Greensboro, South Carolina DNR, Small Business Association, Conservation, Planning and Community Affairs, Cabarrus SWD, DPH, DOT
- 7 nongovernmental organizations: Piedmont Land Conservancy, The Nature Conservancy, Land Trust for Central NC, Sandhills Conservation Partnership, BASS, Conservation Trust for North Carolina, AFWA
- 4 regional/local government organizations: Orange County, Mecklenburg County, Town of Aberdeen, Wake County
- 4 private companies: Independent consultant, Carolinas Integrated Sciences and Assessments, SciWorks Science Center, HDR
- 1 other stakeholder group: Private citizen

Draft Review

The draft Wildlife Action Plan was made available through the internet for review by NCWRC staff, partners, and stakeholder groups. An electronic comment form was provided to submit comments and the telephone number and email address was provided to contact the Wildlife Action Plan Coordinator.

2014 Peer Review

The results of the Taxa Team evaluations were made available to the public 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.

2015 NCWRC Review

The draft Wildlife Action Plan was made available to NCWRC's Commissioners and members of the Nongame Wildlife Advisory Committee (NWAC) beginning in May 2015 for review and download as PDF files. Comments have been incorporated as appropriate into this document.

2015 Public Review

The draft Wildlife Action Plan was made available to the public for review and download as PDF files (most content) and Excel files (some Appendices) from the NCWRC website. The document was available from July 20 to August 18. 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. Comments were submitted by 11 individuals and have been incorporated into the document as appropriate.

Volunteers and Contributions (In-Kind and Donations)

Volunteers are an integral and necessary part of numerous NCWRC conservation projects, initiatives, and partnerships. A volunteer's time can be used to provide the state portion of SWG-funded projects through 'in kind' match, a form of non-cash contribution.

Other types of contributions are important sources of money that is used for projects that benefit nongame species or priority habitats. One example is the sale of T shirts donated by Neuse Sport Shop of Kinston at the NC State Fair. Another example is land and easements donated for wildlife habitat and improved access to boating and public fishing access areas.

In-kind Volunteer Match—Average annual contribution: $1,310,000 (based on 2011–2014 fiscal year estimates).

NC Tax Check-Off for Nongame and Endangered Wildlife—10-year average contribution: $352,259 (based on state income tax form Line 27)

NC Division of Motor Vehicle license plates purchases—5-year contribution summary: $138,360 (based on 2008–2013 sales)

North Carolina Wildlife Federation Letter of Support

North Carolina Wildlife Federation
Affiliated with the National Wildlife Federation

1346 Saint Julien St.
Charlotte, NC 28205
(704) 332-5696

1024 Washington St.
Raleigh, NC 27605
(919) 833-1923

August 24, 2015

Mr. Gordon S. Meyers, Executive Director
North Carolina Wildlife Resources Commission
1701 Mail Service Center
Raleigh, NC 27699-1701

SUBJECT: North Carolina Wildlife Action Plan

Dear Mr. Myers,

The North Carolina Wildlife Federation would like to submit this letter of support for the 2015 draft Wildlife Action Plan (WAP or Plan) and offer an enthusiastic commendation to the North Carolina Wildlife Resources Commission for a job well done.

The improved readability and search features of the updated Plan will make it more useful for resource agencies and other stakeholder partners. The inclusion of a number of additional species in need of conservation attention is very important improvements for the success of the new Plan. Additionally, the habitat descriptions and recommendations will be very helpful to land resource managers, resource agencies and landowners who must make decisions regarding species and habitat protection. Recommendations in the Plan will be used to implement conservation efforts and influence management decisions over the next 10 years. There is no doubt that the prospects for successful species and habitat conservation efforts will be enhanced by the quality of this Plan.

Several members of our Board of Directors have expressed appreciation to Cindy Carr, the WAP coordinator, who worked so well with so many stakeholders. Her leadership, flexibly and close attention to detail enhanced the process and the high quality of this document.

We look forward to working with the Commission on finalizing the Plan and stand ready to assist in its implementation for the betterment of all wildlife species and habitat conservation in North Carolina.

Congratulations again on a commendable achievement.

Sincerely yours,

Tim Gestwicki, CEO
North Carolina Wildlife Federation

Cc: Mr. John L. Clark, Chair, North Carolina Wildlife Resources Commission
Mr. John Robbins, Chair, NCWF Board of Directors

North Carolina Chapter of the American Fisheries Society Letter of Support

APPENDIX C

NORTH CAROLINA CHAPTER

31 July 2015

North Carolina Wildlife Resources Commission
Attention: Ms. Cindy Carr
1721 Mail Service Center
Raleigh, N.C. 27699-1721

Dear Ms. Carr:

The North Carolina Chapter of the American Fisheries Society (NC AFS) is a 104-member society of scientists representing state and federal regulatory and resource agencies, academic institutions, and private institutions. The American Fisheries Society (AFS) was founded in 1870 and is the oldest and largest professional society representing fisheries scientists from across North America. The AFS promotes quality scientific research and enlightened management of aquatic resources for optimum use and enjoyment of the public.

The NC AFS is offering this letter in support of the NCWRC's State Wildlife Action Plan (draft dated July 23, 2015) and commends you and all of the contributors for their expertise and efforts addressing this critically-needed conservation and restoration plan. This in-depth and exhaustive document, which took more than five years to develop, identified existing and future threats to aquatic and terrestrial communities and provides a detailed road map for the next 10 years regarding protection and restoration of species, populations, communities and habitats. Ultimately, the success of the plan will depend upon the cooperative workings of a multitude of resource and regulatory agencies and non-governmental organizations. By having this plan in place, the NCWRC will be positioning itself to focus dedicated funds on those species where the need is the greatest and where successes can reasonably be achieved.

Thank you very much for the opportunity to comment on this very well-written report. We urge its finalization and adoption as soon as possible.

Sincerely,

Kimberly Sparks, President
The North Carolina Chapter of the American Fisheries Society
http://nc.fisheries.org/

U.S. Dept. of Interior, Fish and Wildlife Service Letter of Acknowledgement

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Boulevard
Atlanta. Georgia 30345

APR 11 2012

In Reply Refer to:
FWS/R4/WSFR

Mr. Gordon S. Myers, Executive Director
Wildlife Resources Commission
1701 Mail Service Center
Raleigh, North Carolina 27699-1701

Dear Mr. ~~Myers:~~ Gordon

We have received your letter dated March 26, 2012 informing us of the Wildlife Resources Commissions' intent to begin the comprehensive review/revision of your Wildlife Action Plan (WAP), as required, at a minimum of every 10 years.

Thank you for notifying us of your intentions to begin the comprehensive review/revision of North Carolina's WAP prior to the mandated date of October 1, 2015. When conducting your WAP review, please pay particular attention to Section A "Requirements for Planned Review/Revision of Entire Plan" (pp. 3-4) of the current Guidance for WAP Review and Revision, dated July 2007. We look forward to working with your staff to facilitate this review process.

Please contact me at (404) 679-4154 or Mr. Wayne Waltz at (843) 727-4707 ext 225, if you have any questions.

Sincerely yours,

Michael L. Piccirilli
Chief - Wildlife and Sport Fish Restoration

Public Review and Peer Review Media Announcement

10/2/2015 Peer Review

Search

Project Entry

Download instructions in Adobe PDF format for entering project information on the Conservation Registry

Peer-Review Assistance is Requested

The N.C. Wildlife Resources Commission (NCWRC) is in the process of revising the N.C. Wildlife Action Plan (WAP) for publication in 2015. The revision process includes identification of Species of Greatest Conservation Need (SGCN) and other priority species. The SGCN and priority species represent wildlife for which there are conservation concerns, knowledge gaps, or management needs. They will be a focal point for discussion in the revised WAP.

- The first step in identification of these species involves application of 20 ranking metrics that are described in a white paper published by NCWRC biologists in 2013. A copy of the white paper in PDF format can be downloaded by clicking on this link:

  2013 Ranking Criteria Whitepaper (PDF)

- Teams of species experts (Taxa Teams) were convened in mid-2013 and asked to use the ranking metrics to evaluate species in the following eight taxonomic groups:

  - Amphibians
  - Birds
  - Crayfish
  - Freshwater fish
  - Freshwater mussels
  - Mammals
  - Reptiles
  - Snails

The Taxa Teams have completed their evaluations and the NCWRC is requesting peer-review assistance from biologists and scientists with expertise and knowledge about North Carolina's wildlife species.

You are invited to assist the NCWRC by providing peer review of the evaluation results.

If you are interested in providing peer-review input, please provide your contact information and tell us which taxonomic group(s) you can review by completing a brief survey. We will use this information to provide secured access to an online database with the Taxa Team evaluation results.

Sign up for Peer Review

If you have any questions or concerns please contact Cindy Carr:

Cindy Carr
Wildlife Action Plan Coordinator
North Carolina Wildlife Resources Commission
1721 Mail Service Center
Raleigh, NC 27699-1721
(919) 707-0227 Direct
(919) 707-0028 FAX

The 2005 NC Wildlife Action Plan describes 371 priority wildlife species and 23 priority habitats as well as 17 river basins in the state. The Plan matches each priority species to the habitat type or river basin where it is found, identifies the most important threats facing each habitat, and details the critical actions required to protect and conserve these habitats.

Related Information

Participate in the Revision Process

2011 Spring Regional Workshops

2010 September Climate Impacts Workshop

Conservation Registry

Return to N.C. Wildlife Action Plan

Contact Information

Please contact the N.C. Wildlife Resources Commission with questions about the workshop, the N.C. Wildlife Action Plan or the climate change website.

Cindy Carr
Wildlife Action Plan Coordinator
North Carolina Wildlife Resources Commission
1721 Mail Service Center
Raleigh, North Carolina 27699-1721
(919) 707-0227 Direct
(919) 707-0028 FAX

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Mailing Address: 1701 Mail Service Center, Raleigh, NC 27699-1701
Phone: 919-707-0010

http://www.ncwildlife.org/Plan/PeerReview.aspx 1/2

Search

Participate in the Wildlife Action Plan Revision Process (Continued)

The Wildlife Resources Commission would like your participation during the revision effort.

The Wildlife Resources Commission is seeking participation and input from our partners and interested citizens because you are important stakeholders in conservation of North Carolina's natural resources.

Several *ad hoc* Stakeholder Advisory Committees (Stakeholder Committees) will be formed "as needed" to help us review draft materials.

- The first Stakeholder Committee will review and comment on draft habitat vulnerability assessment reports and strategies and recommendations for addressing climate change impacts to fish and wildlife species. These reports were drafted by the NC Natural Heritage Program and staff of the Wildlife Resources Commission is currently reviewing them.
- Please note, you will not need to join a Stakeholder Committee to help us with revision of the Wildlife Action Plan. Future opportunities to review chapters or the entire draft document after they are developed will be announced on the Wildlife Resources Commission's Conserving web page.

If you would like to participate on a Stakeholder Committee, click on the "Complete A Volunteer Form" button to complete a form.

Complete a Volunteer Form

If you have questions, contact Cindy Carr, Wildlife Action Plan Coordinator.

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Headquarters: 1751 Varsity Drive, Raleigh, NC 27606
Mailing Address: 1701 Mail Service Center, Raleigh, NC 27699-1701
Phone: 919-707-0010
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Report Website Issue

Related Information

Participate in the Revision Process
2011 Spring Regional Workshops
2010 September Climate Impacts Workshop
Conservation Registry
Return to N.C. Wildlife Action Plan

How to Use Information in the NC WAP

D

Example 1: How to Use Information in the NC Wildlife Action Plan

The Eastern Spotted Skunk is statutorily defined as a furbearer mammal and trapping of this species is currently allowed in North Carolina (see www.ncwildlife.org/Trapping/WhattoTrap.aspx). Review of Taxa Team evaluation results (see Appendix G) for this species indicates that a knowledge gap exists, making Eastern Spotted Skunk a priority species for survey, monitoring, and other population research measures. For example, the results for

Eastern Spotted Skunk (Source: http://www.nps.gov/archive/tont/nature/skunk.htm)

- Metrics 10 through 13 indicate that there is a need for information about its distribution and population size statewide; populations are not currently being monitored; and we know little about what factors affect its population size or distribution; and
- Metric 20 shows that there may be low to moderate management needs but it is likely that current levels of action are not sufficient to maintain long-term viable populations.

A review of the species–habitat association table for mammals (see Appendix H) indicate it uses low elevation flatrocks, cliffs, and rock outcrop communities in the Mountain ecoregion.

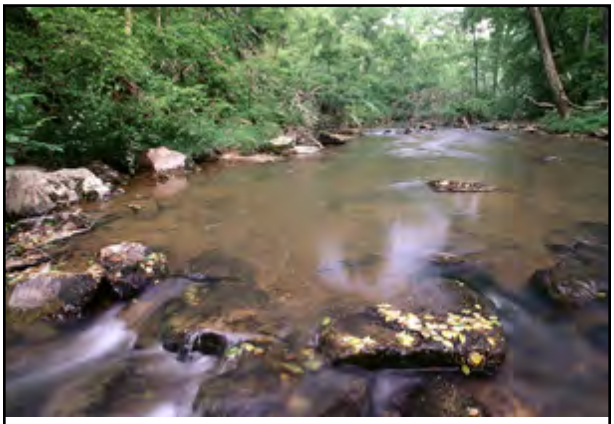
Projects that are designed to collect distributional information, to detect presence/absence, and/or to monitor known populations over time would implement survey and monitoring objectives and strategies recommended in both Chapter 3 for mammals (Section 3.5) and in Chapter 4 for low- to high-elevation communities that include dry coniferous woodlands, especially where rhododendron, Mountain Laurel, or other dense, tall shrub layers are present (Section 4.4).

Project goals and objectives developed following the recommendations outlined in Chapter 6 will support WAP Goal 1 objectives (1.A and 1.B) to expand the information base for priority species and improve our knowledge about long-term trends (see Table 6.1, Appendix K).

Collaborating with partners that manage large tracts of land in the Mountain ecoregion (USFS, NCFS, and NCDPR) to coordinate and conduct distribution surveys or to manage habitat for Eastern Spotted Skunk will support WAP Goals 1 and 2 objectives (1.D, 2.A, 2.B, 2.D).

Using the results of project data to set bag limits for trapping of Eastern Spotted Skunk will support WAP Goal objectives 1.E and 2.E.

Example 2: How to Use Information in the NC Wildlife Action Plan



Piedmont stream with riparian buffer (NCWRC)

Chapter 4 notes that riparian vegetation is critical to the overall stream and streambank stability and moderation of water temperatures for all aquatic habitats. Lack of riparian vegetation or inadequate forested buffer widths can cause streambank erosion and sedimentation. In addition to stabilizing streambanks, riparian vegetation serves as nutrient input to the stream community, filters pollutants, and helps regulate stream temperature by providing shade. Lack of sufficient vegetation cover contributes to rising water temperatures, especially where water depths are shallow enough that the entire water column is subject to solar heating.

Lack of riparian buffers is ranked as one of the greatest threats to cold- and coolwater aquatic communities (see 4.2.3.4) and is a high threat to headwater and small stream communities (see 4.2.7). Headwater and small stream systems are described as important aquatic habitats that are vulnerable to impacts from land use changes because they are less likely to be protected by regulatory requirements such as avoidance and minimization measures and conservation of riparian buffers.

- Review of the habitat-association information in Appendix H shows numerous SGCN and other priority species use headwater and small streams in all ecoregions of the state. Projects that protect, enhance, or restore riparian habitats on headwater and small stream systems support the goals of this WAP (see Chapter 6 and Appendix K), particularly Goal 2 Objectives 2.A and 2.C.

- Recommendations in Section 4.2.2 call for management of riparian habitats to promote natural evolution and movement of woody debris in streams and the preservation or restoration of riparian vegetation to maintain stable streambanks and dissipate water runoff energy that can contribute to sedimentation in stream waters. Collaborating with and supporting partners that manage land with headwater and small streams will support WAP Goals 1 and 2 objectives (1.D, 2.A, 2.B, 2.D).

Common and Scientific Names

E

Invasive or Nonnative Species

Common Name	Scientific Name
a terrestrial snail	*Bulimulus tennuissimus*
a terrestrial snail	*Bulimulus tennuissimus puellaris*
Alligator Weed	*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*

Common Name	Scientific Name
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*
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*

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

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 serotina*
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*

Wildlife Action Plan 2015 Revision Process White Paper

Ranking Criteria for Prioritizing Wildlife Species for Conservation and Management

F

Introduction[1]

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 US Congress to provide funding for nongame species not traditionally covered under most previous federal funding programs. The US Fish and 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, making them 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.

1 Developed by Wildlife Action Plan Revision Technical Team Ranking Criteria Work Group (D. H. Allen, S. K. Anderson, C. S. Carr, J. C. Fuller, R. B. Nichols, V. F. Stancil, and K. C. Weeks)

2005 Prioritization Process

The need for an iterative process to identify species conservation priorities was acknowledged during development of the 2005 North Carolina Wildlife Action Plan (WAP). To meet the need, a Technical Team comprised of North Carolina Wildlife Resources Commission (NCWRC) biologists considered a number of different planning and prioritization efforts in order to evaluate the utility of using a preexisting methodology versus developing a new process. Criteria included consideration for species that are currently rare or designated as at-risk, those for which we have knowledge deficiencies, and those that have not received adequate conservation attention in the past.

The USFWS, NatureServe, Partners In Flight, American Fisheries Society, and numerous other organizations regularly generate lists of species for which they have conservation concern or which warrant levels of protection. It would be easy to use one or more of these lists as a means of identifying priority species, but the varying methodologies were considered insufficient for identifying vulnerable taxa at a scale relevant to North Carolina (Breininger et al. 1998). Following the 2005 review team's evaluation, it was determined that an independent prioritization process would best meet the goals for identifying North Carolina's SGCN and priority species. The following requirements were used to develop the SGCN and priority species list:

- Consider all species within each taxon (regardless of status or threat) at the start of the process;
- Collect information not previously measured in existing prioritization efforts (e.g., degree of knowledge about a species); and
- Develop a process that reflects the NCWRC's mission and goals since the agency carries responsibility and authority for managing the state's wildlife resources.

The 2005 ranking evaluations focused on eight taxonomic groups based on jurisdictional and traditional programmatic boundaries. The groups were amphibians, birds, crayfish, freshwater fish, freshwater snails, freshwater mussels, mammals, and reptiles. Teams of species experts (Taxa Teams) were convened to evaluate taxonomic groups using review criteria that considered conservation concern and knowledge for each species. Taxa Team member responses to the review criteria resulted in ranking scores for each species that were used to develop a prioritized species list. Chapter 2 in the 2005 WAP more fully describes the prioritization review process and provides lists of SGCN and priority species by taxa group (NCWRC 2005).

Following publication of the 2005 WAP, members of the Technical and Taxa Teams reviewed the ranking criteria and prioritization process and recommended future

iterations include a reevaluation of the criteria and methodology. It was recommended that conservation plans, prioritization methodologies, and species groups that were not considered for the first edition be evaluated for inclusion in the WAP during future updates and revisions (NCWAP 2005).

Review and Revision of the 2005 Prioritization 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 WAPs (AFWA TWW 2012). The AFWA-TWW guidance includes a recommendation to use clearly defined procedures for assessing conservation status and setting conservation priorities (AFWA TWW 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).

Following recommendations from the 2005 WAP Review Team as well as AFWA-TWW's best practice guidance, the 2015 WAP 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 NCWRC 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 (UNEP-WCMC 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 de Grammont 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 the creation of 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 have been incorporated into the metrics.

2015 Prioritization Process

The revised ranking criteria are represented by metrics developed by the Work Group and are described in this white paper report. The criteria will be used to evaluate all wildlife in the amphibian, bird, crayfish, freshwater fish, freshwater mussel, mammal, reptile, and snail taxa groups found in North Carolina in order to identify SGCN and priority species. The results of this ranking process will be used to prioritize conservation efforts (including research needs), and identify species of management concern. As with the 2005 SGCN evaluation, the Work Group recommendation calls for all game species (those that are hunted, fished, or trapped) to be included in the ranking process so species experts and peer reviewers can consider the broad interrelationships between species and their habitats (Wells et al. 2010; Tear et al. 2005). Including game species also allows consideration of how the

variability of likely climate change impacts, as currently understood, may affect the state's wildlife species during the next decade.

The ranking criteria metrics were developed to be a robust measure of our understanding about the status, trends, and risks of species in the state. 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 different taxa. 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 occurrences in North Carolina.

Species Ranking. The ranking process used to identify SGCN and priority species 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 complete the ranking evaluation for 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 that made scoring adjustments are:

- Amphibians and Reptiles (Herps): The Conservation Concern score calculation was adjusted for the Metric 9 threat assessment responses by multiplying the evaluation score by 0.25 and adding the adjusted score to the cumulative 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 multiplying the Metric 5 score 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 Taxa Team added consideration for those species where nonbreeding, breeding, or both populations occurred in North Carolina by adding 6, 8, or 10 points (respectively) to the Conservation Concern cumulative total. The Taxa Team also decided to include responsibility species as SGCN based on global and NC importance. Global responsibility species are those that occur in North Carolina 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. NC global responsibility species are those species for which 8% or more of the global breeding or wintering population occurs in North Carolina 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 NCWRC's Portal Access to Wildlife Systems (PAWS) website, 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. Responses for each metric will be entered by Team members into the PAWS database.

2. Taxa Teams will be convened to review the metric responses submitted by their Team members. The metric responses will be compiled in a preliminary report automatically generated by the PAWS database. For each species where a metric response varies, Taxa Team members will collaboratively review the responses to determine whether calculation of an average score based on the range of responses is appropriate or if a final response should be designated.

3. Final ranking scores will be automatically calculated by the PAWS database using the results of the Taxa Team review of the metric responses. Taxa Team members will review ranking scores for all species in their taxa group and will recommend minimum Conservation Concern and Knowledge Gap scores for a species to be designated SGCN.

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.

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. Recommendations to modify a ranking evaluation 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 the 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 2015 WAP as a list of SGCN and priority species within each taxa group. 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 recommends 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 Acknowledgments

Members of the Technical and Taxa Teams reviewed the ranking process used to identify SGCN and priority species for the 2005 WAP and made a recommendation to revise the process during the next WAP revision cycle. The 2015 WAP Revision Technical Team formed a Ranking Criteria Work Group to develop recommendations for a new species prioritization process. This Work Group reviewed several existing ranking processes over the course of nine months and worked collaboratively to develop a draft prioritization process and ranking criteria that considers the status of Conservation Concerns, Knowledge Gaps, and Management Concerns for all species in North Carolina.

Peer-review and technical input was sought from technical and species experts from the Cooperative Fish and Wildlife Unit at NCSU, NWAC, NCNHP, NCWRC, and the 2015 WAP

Revision Steering Committee. The Technical Team and Ranking Criteria Work Group recommend these proposed ranking criteria be used to evaluate and prioritize species for publication in the 2015 revision of the WAP.

All of the participants listed in this white paper contributed to the development and implementation of the taxa evaluation process. NCWRC staff involved in development of the ranking criteria and the technical and species experts and peer-review participants providing input include the following:

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2015 Ranking Criteria Metrics

The ranking criteria metrics were developed to assist with the prioritization process that will identify SGCN and are divided into three categories: Conservation Need, Knowledge Gap, and Management Concern. 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 elsewhere, the Knowledge Gap and Management Concern metrics consider only the occurrences in North Carolina.

A. Conservation Need Category

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).

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 make a selection.)

(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

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.

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 2001; 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 the state may be relatively large and represent a significant portion of the total known population for a species that has a range beyond North Carolina 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 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 threated 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

3. Range Size. As noted for population size, geographic distribution is an important measurement of a species' rarity (Manne and Pimm 2001; 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 North Carolina. 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, anadromous 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 125,919.81 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

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 the 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.

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. (2011) note that 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 nonbreeding populations; transient populations should be included in the nonbreeding 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

6. Range Size in North Carolina. A species may be widespread and secure within its total range, but populations in North Carolina 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 North Carolina 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 nonbreeding ranges in North Carolina, 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 North Carolina 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: 1–36 HUCs (12-digit)

(b) Terrestrial: 3–5 counties, or Fish, Mussels, Crayfish: 37–90 HUCs (12-digit)

(c) Terrestrial: 6–10 counties, or Fish, Mussels, Crayfish: 91–180 HUCs (12-digit)

(d) Terrestrial: 11–25 counties, or Fish, Mussels, Crayfish: 181–450 HUCs (12-digit)

(e) Terrestrial: 26–50 counties, or Fish, Mussels, Crayfish: 451–900 HUCs (12-digit)

(f) Terrestrial: More than 50 counties (or statewide), or Fish, Mussels, Crayfish: More than 900 HUCs (12-digit)

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 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 North Carolina (Millsap et al. 1990). Base the evaluation on the most restricted area (range) within North Carolina 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)

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 North Carolina

(b) Majority concentrates at 2–10 terrestrial locations or stream reaches in North Carolina

(c) Majority concentrates at 11–25 terrestrial locations or stream reaches in North Carolina

(d) Majority concentrates at >25 terrestrial locations or stream reaches in North Carolina

(e) The species does not congregate or aggregate in North Carolina

9. Threats. Following a best-practice guide recommendation (AFWA TWW 2012), a list of the 11 threats most likely to impact wildlife is 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 CMP 2012), with modifications. The threat of geologic events (volcanic eruptions, earthquakes, 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. The list of threats to be considered is provided in Table F.1. Subcategories (1.1, 1.2, 1.3, etc.) for threat categories 1 through 10 are described by Salafsky et al. (2008) and were included as examples to help define the threat categories and are not scored individually. A threat category for wildlife disease was added because impacts from the spread of infectious disease (e.g., white-nosed syndrome) can pose a significant threat to some species. Threat category 11 (Disease & Pathogens) and the subcategories for this threat were developed by the 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 assigned to each of these risk categories and the final threats score will reflect a calculated average for each of the 11 threats listed in Table F.1.

TABLE F.1 The threats most likely to impact wildlife

Threat Category	
1	Residential & commercial development
	Threats 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.
2	Agriculture & aquaculture
	Threats 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.
3	Energy production & mining
	Threats from production of nonbiological resources, and exploring for, developing, and producing petroleum and other liquid hydrocarbons. Includes oil and gas drilling; mining and quarrying; and renewable energy.

Table F.1 The threats most likely to impact wildlife (cont.)

Threat Category	
4	Transportation & service corridors
	Threats 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.
5	Biological resource use
	Threats 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.
6	Human intrusions & disturbance
	Threats 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).
7	Natural system modifications
	Threats 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.).
8	Invasive & other problematic species & genes
	Threats from nonnative 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 nonnative/alien species; problematic native species (e.g., beavers); introduced genetic material (e.g., genetically modified insects; hatchery- or aquaculture-raised species).
9	Pollution
	Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources. Includes household sewage and urban wastewater; industrial and military effluents; agricultural and forestry effluents; garbage and solid waste; airborne pollutants; and excess energy (e.g., ambient noise, sonar, cold or hot water from power plants, beach lights, etc.).
10	Climate change & severe weather
	Threats from 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.
11	Disease & pathogens
	Threats from bacteria, viruses, protozoa, fungi, and parasites. This category includes exotic or introduced pathogens, prion (nonviral, nonbacterial) disease, and zoonotic diseases. Wildlife species may act as hosts or reservoirs.

Classification of Threats (1–10) adopted from Salafsky et al. (2008).

Table F.2 Threat Scope and Severity

THREAT–SCOPE		THREAT–SEVERITY	
(a) Pervasive	Affects all or most (71%–100%) of the total population or occurrences	(a) Extreme	Likely to destroy or eliminate occurrences, or reduce the population 71%–100%
(b) Large	Affects much (31%–70%) of the total population or occurrences	(b) Serious	Likely to seriously degrade/ reduce affected occurrences or habitat or reduce the population 31%–70%
(c) Restricted	Affects some (11%–30%) of the total population or occurrences	(c) Moderate	Likely to moderately degrade/ reduce affected occurrences or habitat or reduce the population 11%–30%
(d) Small	Affects a small (1%–10%) proportion of the total population or occurrences	(d) Slight	Likely to only slightly degrade/reduce affected occurrences or habitat, or reduce the population 1%–10%
(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	

Table F.3 Scope and severity risk categories used for assigning threat scores

	SCOPE (How many are affected?)					
SEVERITY (How bad is it?)	Pervasive (71 - 100%)	Large (31 - 70%)	Restricted (11 - 30%)	Small (1 - 10%)	Unknown	None
Extreme (71 - 100%)	VERY HIGH	HIGH	Medium	Low	Medium	n/a
Serious (31 - 70%)	HIGH	HIGH	Medium	Low	Medium	n/a
Moderate (11 - 30%)	Medium	Medium	Low	Low	Low	n/a
Slight (1 - 10%)	Low	Low	Low	Low	Low	n/a
Unknown	Medium	Medium	Low	Low	none	none
None	n/a	n/a	n/a	n/a	n/a	none

B. Knowledge Gap Category

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 CMP 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.

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 North Carolina), 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 have been documented throughout the state.

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.

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.

13. Population Size (survey, monitoring, and research priorities). Some populations are naturally dynamic because of life history strategies (r- 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 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 Assessment (research priorities). This metric is to independently prioritize each threat described in Metric 9 (see Conservation Concern category) 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 Wildlife Action Plan on a 10-year cycle.

Each of the 11 threat categories will be ranked for priority as a research subject using a scale of 1–11 depending on the expected likelihood it will impact the species, with 1 representing the lowest priority and 11 representing the highest priority. For example, pollution may be considered a high 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 result in a high (9–11), medium (5–8), or low (1–4) priority ranking based on the need for research. The frequency of the scores will be reported for each threat as a means of evaluating and prioritizing research needs.

Metric 14 Threat Categories (see also Conservation Concern Metric 9)	
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

Classification of Threats (1–10) adopted from Salafsky et al. (2008).

C. Management Concerns Category

The Wildlife Resources Commission has jurisdictional authority and stewardship responsibility for all wildlife as defined in GS 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 (Arponen 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).

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) A dead-end host is not able to maintain the infection/disease without an external source

(b) A spillover host is able to maintain the infection/disease for a time but requires periodic input from another source

(c) A maintenance host is able to maintain infection without further transmission from another species.

While dead-end and spillover hosts may become disease vectors, transmitting 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 requiring periodic reexposure 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 reexposure. Management may not be required because transmission may be naturally controlled.

(d) Unknown at this time.

(e) Not a vector.

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 nonnative 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.

17. Economic Influence in North Carolina. 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 contributes 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 North Carolina.

(b) This species is part of a group that collectively has a high economic influence in North Carolina.

(c) This species (individually or as part of a group) has a moderate economic influence in North Carolina.

(d) Unknown.

(e) This species (individually or as part of a group) has a low to no economic influence in North Carolina.

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.

19. Period of Occurrence. Application of management or conservation actions on behalf of wildlife may need to take into account the degree to which a species is available by considering 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 nonbreeding season.

(d) Migrates through.

(e) Transient or rare occurrence.

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.

Table F.4 Metric Response Cheat Sheet

Metric	Explanation	Scale
Conservation Concern		
1. Conservation Protection Status	What is the current conservation protection status? • This information will be provided and reviewers will not need to make a selection.	(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)? • North Carolina has 125,919.81 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	Explanation	Scale
Conservation Concern (cont.)		
5. NC Population Size	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
6. NC Range Size	What is the estimated range size for the species in North Carolina? • If a species has distinct breeding and nonbreeding ranges in North Carolina, use the smaller range to determine a score. • Assign scores based on the most restricted area (range) within North Carolina 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: 1–36 HUCs (12-digit)] (b) [Terrestrial: 3–5 counties] or [Fish, Mussels, Crayfish: 37–90 HUCs (12-digit)] (c) [Terrestrial: 6–10 counties] or [Fish, Mussels, Crayfish: 91–180 HUCs (12-digit)] (d) [Terrestrial: 11–25 counties] or [Fish, Mussels, Crayfish: 181–450 HUCs (12-digit)] (e) [Terrestrial: 26–50 counties] or [Fish, Mussels, Crayfish: 451–900 HUCs (12-digit)] (f) [Terrestrial: More than 50 counties (or statewide)] or [Fish, Mussels, Crayfish: More than 900 HUCs (12-digit)]
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 North Carolina • Assign scores based on the most restricted area (range) within North Carolina 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.	(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)

<table>
<tr><th>Metric</th><th>Explanation</th><th>Scale</th></tr>
<tr><td colspan="3">Conservation Concern (cont.)</td></tr>
<tr><td>8. NC Population Concentration</td><td>Is the species known or suspected to concentrate (or aggregate) in North Carolina?
Populations that are so rare they are restricted to small areas can be considered aggregations.</td><td>(a) Majority concentrates at single location or stream reach in North Carolina

(b) Majority concentrates at 2–10 terrestrial locations or stream reaches in North Carolina

(c) Majority concentrates at 11–25 terrestrial locations or stream reaches in North Carolina

(d) Majority concentrates at > 25 terrestrial locations or stream reaches in North Carolina

(e) The species does not congregate or aggregate in North Carolina</td></tr>
<tr><td>9. Threats</td><td>1: THREAT—SCOPE<table><tr><td>(a) Pervasive</td><td>Affects all or most (71%–100%) of the total population or occurrences</td></tr><tr><td>(b) Large</td><td>Affects much (31%–70%) of the total population or occurrences</td></tr><tr><td>(c) Restricted</td><td>Affects some (11%–30%) of the total population or occurrences</td></tr><tr><td>(d) Small</td><td>Affects a small (1%–10%) proportion of the total population or occurrences</td></tr><tr><td>(e) Unknown</td><td>There is insufficient information to determine the scope of threats</td></tr><tr><td>(f) None</td><td></td></tr></table></td><td>2: THREAT—SEVERITY<table><tr><td>(a) Extreme</td><td>Likely to destroy or eliminate occurrences, or reduce the population 71%–100%</td></tr><tr><td>(b) Serious</td><td>Likely to seriously degrade/reduce affected occurrences or habitat or reduce the population 31%–70%</td></tr><tr><td>(c) Moderate</td><td>Likely to moderately degrade/reduce affected occurrences or habitat or reduce the population 11%–30%</td></tr><tr><td>(d) Slight</td><td>Likely to only slightly degrade/reduce affected occurrences or habitat, or reduce the population 1%–10%</td></tr><tr><td>(e) Unknown</td><td>There is insufficient information to determine the severity of threats</td></tr><tr><td>(f) None</td><td></td></tr></table></td></tr>
<tr><td colspan="3">Knowledge Gaps</td></tr>
<tr><td>10. Statewide Distribution (survey priorities)</td><td>What is the level of knowledge about statewide distribution?</td><td>(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.</td></tr>
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<table>
<tr><th>Metric</th><th>Explanation</th><th>Scale</th></tr>
<tr><td colspan="3">Knowledge Gaps (cont.)</td></tr>
<tr><td>11. Statewide Population Trends (monitoring priorities)</td><td>What is the status of monitoring statewide population trends?</td><td>(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.</td></tr>
<tr><td>12. Population Limitations (research priorities)</td><td>What is the level of knowledge about factors that affect a species' population size or distribution in the state?</td><td>(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.</td></tr>
<tr><td>13. Population Size (survey, monitoring, and research priorities)</td><td>What is the level of knowledge about the species' population size in North Carolina?</td><td>(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.</td></tr>
<tr><td>14. Threats (research priorities)</td><td>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</td><td><table><tr><td>1</td><td>Residential & commercial development</td></tr><tr><td>2</td><td>Agriculture & aquaculture</td></tr><tr><td>3</td><td>Energy production & mining</td></tr><tr><td>4</td><td>Transportation & service corridors</td></tr><tr><td>5</td><td>Biological resource use</td></tr><tr><td>6</td><td>Human intrusions & disturbance</td></tr><tr><td>7</td><td>Natural system modifications</td></tr><tr><td>8</td><td>Invasive & other problematic species & genes</td></tr><tr><td>9</td><td>Pollution</td></tr><tr><td>10</td><td>Climate change & severe weather</td></tr><tr><td>11</td><td>Disease & pathogens</td></tr></table></td></tr>
</table>

Metric	Explanation	Scale
Management Information		
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 requiring periodic reexposure 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 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.
17. Economic Influence in North Carolina	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 North Carolina (b) This species is part of a group that collectively has a high economic influence in North Carolina. (c) This species (individually or as part of a group) has a moderate economic influence in North Carolina. (d) Unknown. (e) This species (individually or as part of a group) has a low to no economic influence in North Carolina.

Metric	Explanation	Scale
Management Information (cont.)		
18. Cultural Value	What is the nonconsumptive 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 nonbreeding 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 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.

* Threat Categories (Descriptions from Salafsky et al. 2008):	
9.1	Residential and commercial development. Threats 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 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 from production of nonbiological resources, and 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 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 nonnative 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 nonnative/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 wastewater; industrial and military effluents; agricultural and forestry effluents; garbage and solid waste; airborne 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. Threats from 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 (nonviral, nonbacterial) disease. Hosts and reservoirs. Zoonotic diseases.

Timber Operations can be Evaluated Under Different Threat Categories

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 with nonnative 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.

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North American Bird Conservation Initiative (NABCI)

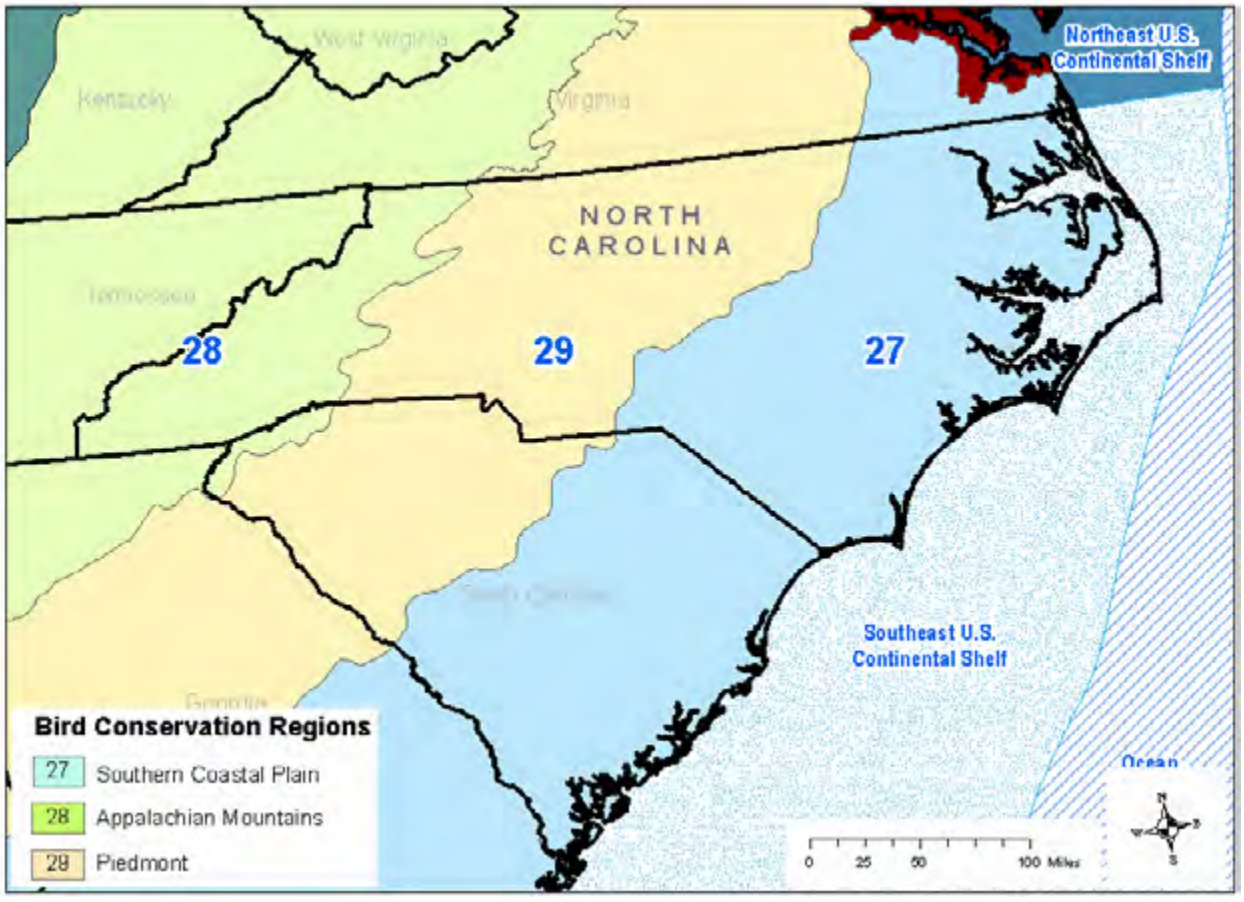
1

Bird Conservation Regions

BCR 27: Southern Coastal Plain www.nabci-us.org/bcr27.html

BCR 28: Appalachian Mountains www.nabci-us.org/bcr28.htm

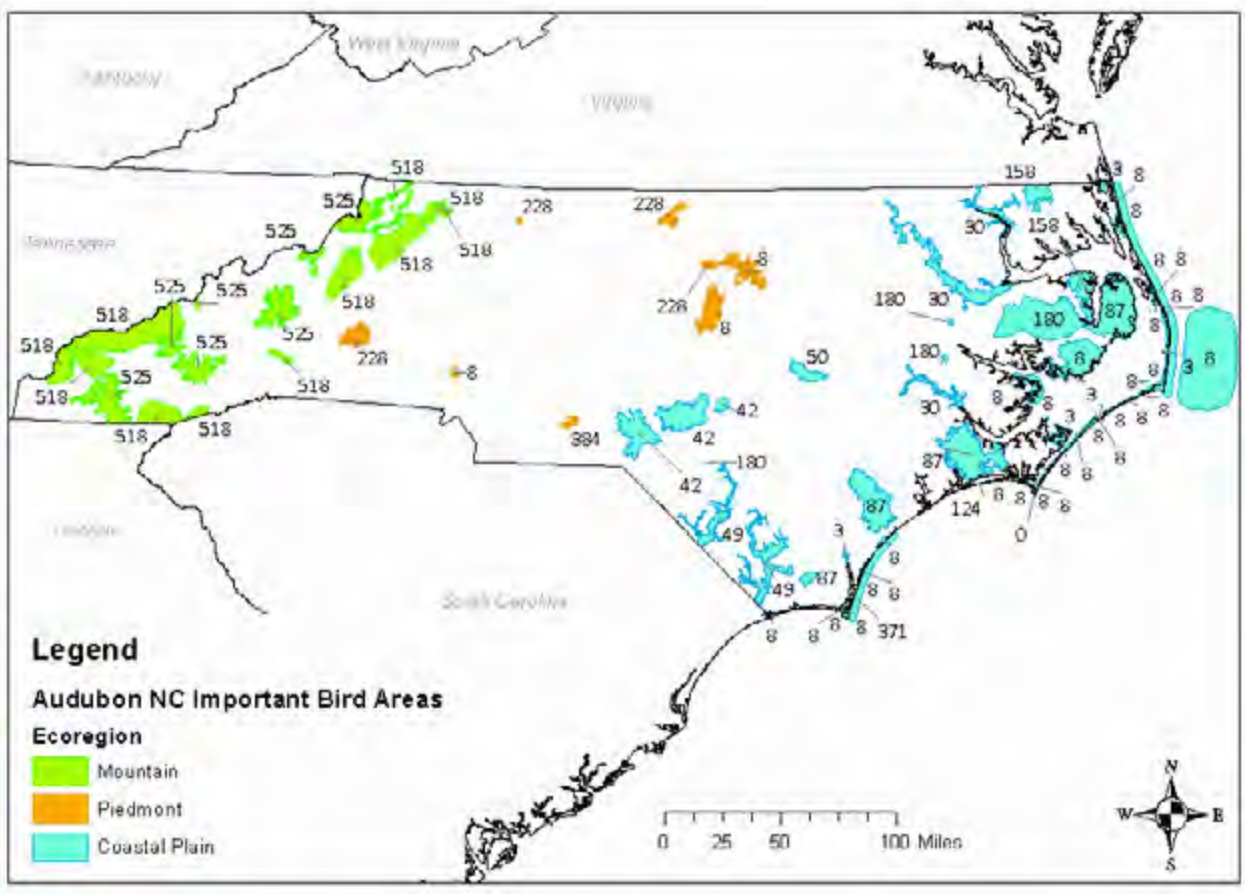
BCR 29: Piedmont www.nabci-us.org/bcr29.html



Audubon North Carolina Important Bird Areas

http://ncaudubonblog.org/iba/

0 Sheep Island
3 Tidal Marsh
8 Open Water
30 Cypress–Gum Floodplain Forest
42 Xeric Longleaf Pine
49 Coastal Plain Oak Bottomland Forest
50 Coastal Plain Mixed Bottomland
87 Pocosin Woodlands and Shrublands
124 Maritime Scrubs and Tidal Shrublands
158 Coastal Plain Nonriverine Wet Flat Forests
180 Agricultural Fields
228 Piedmont Dry–Mesic Oak and Hardwood Forests
371 Maritime Grasslands
384 Piedmont Mixed Bottomland Forests
518 Dry Mesic Oak Forest
525 Appalachian Oak Forest



Objectives and Example Strategies and Priority Actions

K

TABLE K.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

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.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 nonnative 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
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 K.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	• Reestablish 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
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

Goal 2. Improve wildlife habitat and manage populations to support sustainable ecosystem services.	
Objective 2.D—Foster partnerships and cooperative efforts (cont.)	
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
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

Federal Programs and Information Resources

L

L-1 USFWS Programs and Information Resources

Endangered Species

http://www.fws.gov/raleigh/es.html

Major goals are to protect endangered and threatened species, and then pursue their recovery and to conserve candidate species and species-at-risk so that listing under the Endangered Species Act is not necessary.

Partners for Fish & Wildlife

http://www.fws.gov/raleigh/pfw.html

Restores, improves, and protects fish and wildlife habitat on private lands through alliances between the USFWS, other organizations, and individuals, while leaving the land in private ownership.

Safe Harbor Agreements

http://www.fws.gov/endangered/landowners/safe-harbor-agreements.html

A voluntary agreement involving private or other nonfederal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the ESA.

Fish and Aquatic Conservation (National Fish Habitat Partnerships)

http://www.fws.gov/fisheries/whatwedo/NFHAP/nfhap.html

Working with partners to restore and maintain fish and other aquatic resources for the benefit of the American public. Partnerships in North Carolina include the Atlantic Coastal FHP and Eastern Brook Trout Joint Venture.

Wildlife Refuge Comprehensive Conservation Plans (CCP)

http://www.fws.gov/southeast/planning

Final CCPs are available for the Alligator River, Cedar Island, Pea Island, Pee Dee, and Pocosin lakes, and Roanoke River NWRs. Draft CCPs are available for the Currituck, MacKay Island, Mattamuskeet, and Swanquarter NWRs. CCP documents are also available for download from the Administration Planning web page of each NWR.

Coastal Program

http://www.fws.gov/raleigh/cp.html

Supports voluntary restoration, enhancement, and protection of high-priority coastal habitats.

Environmental Contaminants Program

http://www.fws.gov/raleigh/ec.html

Investigates and evaluates the effects of contaminants with the goals of pollution prevention and environmental restoration.

Migratory Bird Program

http://www.fws.gov/columbiawildlife

Provides leadership in the conservation and management of migratory birds and their habitats with the goal to maintain healthy migratory bird populations.

Forest Landbird Legacy Program

http://www.fws.gov/nc-es/es/partners/landassist.html

A voluntary wildlife conservation program for private non-industrial forest landowners who want to management mature forests to benefit forest dwelling landbirds with a focus on migratory birds of conservation concern (as identified by PIF).

Project Planning and Consultation

http://fws.gov/raleigh/pp.html

Provides expertise to large-scale planning efforts in the areas of energy, transportation, navigation, water supply, hydroelectric power, private development, recreation, stream-bank and shoreline protection, and beach nourishment.

Geospatial Services

http://www.fws.gov/gis/index.html

Geospatial data, applications, and mapping services are available and include data sets depicting ecosystem regions, national wetlands inventory, species critical habitats, migratory bird conservation areas, and National Wildlife Refuge System locations.

L-2 USFS Programs and Information Resources

USFS Region 8, National Forests of the South

http://www.fs.usda.gov/main/r8/home

The Southern Region encompasses 13 States, from VA to FL and OK and includes Puerto Rico. There are 14 National Forests and two special units within the Southern Region.

Forest Inventory and Analysis

http://www.fia.fs.fed.us or http://www.fia.fs.fed.us/library/bus-org-documents/default.asp

FIA reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. FIA is managed by the Research and Development organization within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems.

Land and Resource Management Plans

http://www.fs.usda.gov/main/nfsnc/landmanagement/planning

Forest Plans describe how the forest will be managed for the 10-15 year period for which it is adopted. Plans for Croatan NF, Uwharrie NF, and Nantahala and Pisgah NF describes what activities will be implemented and what public benefits are anticipated.

Resource Management

http://www.fs.usda.gov/main/r8/landmanagement/resourcemanagement

Aquatics, Conservation Planning, Forest Health Protection, Soils, Watershed Improvement, Wildlife, and Non-native Invasive Plant Species information.

Resource Planning

http://www.fs.usda.gov/main/r8/landmanagement/planning

Ecosystem Assessments, Forest Planning, Environmental Analysis, Monitoring, Regulatory and Legal Requirements, Vegetation Management, and Administration information.

Template for Assessing Climate Change Impacts and Management Options (TACCIMO)

http://www.fs.fed.us/ccrc/tools/taccimo.shtml

TACCIMO is a web-based tool that connects forest planning to current climate change science. It was developed through a collaborative endeavor of the Eastern and Western Threat Centers and Regional Forest Planning units of the USDA Forest Service.

FSGeodata Clearinghouse

http://data.fs.usda.gov/geodata/

Vector and raster data depicting land status and boundary management of National Forest System lands.

L-3 National Park Service in NC

http://www.nps.gov/state/nc/list.htm?program=parks

The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this

and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

National Park Service Publications

http://www.nps.gov/aboutus/publications.htm

An online library of both contemporary, historical, and new reports and documents that explain decisions, documents information, and shares knowledge about NPS.

Planning, Environment, & Public Comment

http://parkplanning.nps.gov/parks.cfm

Planning documents guide NPS in managing park resources and can range from site-specific impact analyses on facility locations to broader park-wide plans for future use and management of a park. Current planning and environmental documents are also available through the Management page of each NC park's website.

Inventory & Monitoring

http://science.nature.nps.gov/im/reports/index.cfm

The primary repository for reports and publications produced by the Inventory & Monitoring Program. Materials are searchable by park, subject, author, or content terms.

Natural Resource Publications Management

http://www.nature.nps.gov/publications/nrpm

A resource to find NRTR, NRR, and NRDS documents, including inventory, monitoring, species status, and research study reports; protocols, monitoring plans, and data management plans; and preliminary, periodical, or annual data summary reports.

Data and Information

http://www.nps.gov/gis/data_info

A data and information clearinghouse that uses a web-based search application to identify GIS and other data sets available from NPS. Data includes the occurrence and status of species in the national parks and information on species abundance, breeding status, nativity and management concerns.

L-4 NRCS Programs and Information Resources

NRCS in North Carolina Technical Resources

http://www.nc.nrcs.usda.gov/technical

Conservation planning, ecological science, natural resources assessment, engineering, economics and other tools to help natural resource conservation.

National Resources Inventory

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/?cid=nrcs143_014196

A statistical survey of land use and natural resource conditions and trends on U.S. nonfederal lands. The current inventory was published in 2007.

Natural Resource Conservation Programs

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs

Programs to reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. NRCS provides funding opportunities for agricultural producers and other landowners through these programs.

Long Leaf Pine Initiative

http://www.nc.nrcs.usda.gov/programs/EQIP/Longleaf_Pine_North_Caorlina.html

The Longleaf pine ecosystem provides critical habitat for 29 threatened and endangered species and is a priority resource concern. Incorporates both technical and financial assistance to help NC landowners improve habitat on agricultural land, nonindustrial private forest and Tribal land by implementing conservation practices including planting longleaf pine, installing firebreaks, conducting prescribed burning and controlling invasive plants.

Plants and Animals

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals

Technical information and guidance to assist conservationists and landowners with enhancing plant and animal populations and addressing invasive plant and pest concerns.

Geospatial Data Gateway

http://datagateway.nrcs.usda.gov

Access to download census, climate precipitation and temperature, easement, elevation, geology, hydrography, land use land cover, soils, and several other data layers. Data layers are available for individual counties or statewide.

L-5 NOAA—Fisheries Programs and Information Resources

NOAA Fisheries, Beaufort Lab

http://www.sefsc.noaa.gov/labs/beaufort/index.htm

The Beaufort Lab is operated in partnership between NOAA Ocean Service, NOAA Fisheries Service Southeast Fisheries Science Center, and the NC Coastal Reserve and Estuarine Research Preserve.

NC Coastal Reserve & National Estuarine Research Reserve (NERR)

http://www.nccoastalreserve.net

The program protects a network of 10 sites covering more than 42,000 acres of estuarine land and water, which provides essential habitat for wildlife; offers educational opportunities for students, teachers and the public; and serves as living laboratories for scientists.

National Center for Coastal Ocean Science (NCCOS), Center for Coastal Fisheries and Habitat Research

http://www.ccfhr.noaa.gov/about/beaufort.aspx

Provides scientific information to coastal managers useful in their roles as coastal stewards and decision makers. Conducts research to describe, map, and characterize coastal habitats such as salt marshes, seagrass meadows, and coral reefs to develop an understanding of the processes that determine their functioning and utilization by humans and other species.

Maps and GIS Data

http://sero.nmfs.noaa.gov/maps_gis_data/fisheries/s_atlantic/index.html
http://www.nmfs.noaa.gov/gis/data/index.htm

NOAA Fisheries, Southeast Regional Office produces data sets on habitat protection (Critical Habitats, Essential Fish Habitats and Habitats of Particular Concern), marine mammal tracking, stock assessments, protected resource management, and general fisheries management along with many others.

L-6 USEPA Programs and Information Resources

Watershed Conservation Approaches and Tools

http://water.epa.gov/polwaste/nps/watershed/conservation.cfm

Examples of conservation and protection approaches and tools that are generally site-specific and tailored to the particular situation. Watershed managers are encouraged to use these examples as guidance in developing their own conservation and protection strategies. Approaches that have been found to be effective at maintaining watershed health and integrity, especially when combined, include:

- Habitat and Biodiversity Conservation
- Green Infrastructure and Landscape Conservation
- River Corridor Protection
- Land Protection Programs and Local Land Use Ordinances
- Hydrology

Ecosystem Science Resources

http://www2.epa.gov/science-and-technology/ecosystems-science-resources

EPA's research mission is to conduct leading-edge research and foster the sound use of science and technology to fulfill EPA's mission to protect human health and safeguard the natural environment. Ecosystem science resources include:

- Ecosystems Research
- Environmental Indicators

- Risk and Exposure
- Aquatic Ecosystems
- Regional Vulnerability Assessment

Water Science Resources

http://www2.epa.gov/science-and-technology/water-science

Research and scientific information and innovative technologies that support the Clean Water Act and Safe Drinking Water Act. Resources include:

- Drinking Water and Systems
- Water Quality Research
- Water Monitoring
- Water Tools and Technology

Climate Impacts in the Southeast

http://www3.epa.gov/climatechange/impacts/southeast.html

Information from research conducted to understand the environmental and health impacts of climate change and to provide sustainable solutions for adapting to and reducing the impact from a changing climate. Topics include climate change and air quality, mitigation; health, ecosystems, and energy as well as resources for models, tools and databases and grants and funding.

Sustainable Practices Science

http://www2.epa.gov/science-and-technology/sustainable-practices-science

Agency researchers and their partners from across a wide spectrum of investigative fields are working together to form a deeper understanding of the balance between the three pillars of sustainability - environment, society, and economy. Resources include information on sustainable communities, green technology, sustainable transportation, and green chemicals.

Wetlands Conservation

http://water.epa.gov/type/wetlands

The Wetlands Program is designed to protect one of our most important ecosystems. Wetlands provide numerous beneficial services to aquatic communities and are vital to the health of our waters. The website describes wetland habitats and values, regulatory and enforcement programs, and financial and educational references.

Watersheds

http://water.epa.gov/type/watersheds

A watershed approach provides a scientific framework for identifying and prioritizing aquatic habitats that have been degraded and are in need of restoration. EPA works with states and other partners to assist in cleaning up polluted waters. The link provides Information on using a watershed approach for restoring degraded waters, relevant laws, training opportunities, publications, technical tools and news.

Coastal Resources

http://water.epa.gov/type/oceb

EPA's marine and coastal programs help prevent pollution in sensitive habitats that are critical to many aquatic species, including those that are rare, that migrate and that contribute significantly to commerce. The website overviews coastal habitats, relevant policies, pollution prevention, protection actions, monitoring and assessment, existing partnerships and educational resources.

Urban Waters

http://www2.epa.gov/urbanwaters

Right now in cities across the nation, urban waters are being threatened like never before. New and different environmental challenges are appearing nationwide. The range of challenges we face will require traditional and innovative strategies, as well as broad partnerships to address. The link engages urban communities in the restoration and protection of their local waters.

Geospatial Resources

http://www2.epa.gov/geospatial

EPA's National Geospatial Program coordinates the Agency's geospatial data, applications, policies and programs. This website provides an overview of EPA's geospatial data and resources.

L-7 USGS Programs and Information Resources

Nonindigenous Aquatic Species (NAS)

http://nas.er.usgs.gov/

A central repository for spatially referenced biogeographic accounts of introduced aquatic species. The program provides scientific reports, online/realtime queries, spatial data sets, regional contact lists, and general information.

National Water Information System (NWIS)—Surface Water

http://nc.water.usgs.gov/infodata/surfacewater.html

Current and historical surface water conditions at selected sites based on the most recent data from on-site automated recording equipment.

NWIS—Groundwater

http://waterdata.usgs.gov/nc/nwis/gw/

The USGS annually monitors groundwater levels in thousands of wells in the US. Current and historical groundwater conditions are collected and summary data are available online.

NWIS—Water Quality

http://waterdata.usgs.gov/nc/nwis/qw

The USGS collects and analyzes chemical, physical, and biological properties of water, sediment and tissue samples for current conditions and maintains historical observation data.

Water Use Data

http://nc.water.usgs.gov/infodata/wateruse.html

County-wide water-use data compiled from numerous sources and represents estimates of the amount of public- and self-supplied water used for commercial, domestic, industrial, irrigation, livestock, mining, power generation, and other purposes.

North Carolina Projects and Studies

http://nc.water.usgs.gov/projects/index_topic.php?topic=programs

Programs for the management of natural resources, regulatory control, and process research with hydrologic and water-quality monitoring and modeling.

Designing Sustainable Landscapes

http://www.basic.ncsu.edu/dsl/

A collaborative effort to develop a consistent methodology and to enhance the capacity of states, joint ventures and other partners to formulate conservation design schemes at landscape levels to sustain bird populations and other wildlife in the Eastern United States.

Environmental Decision Analysis

http://www.basic.ncsu.edu/eda/projects.html

A research group that brings together experience in conservation planning, fish and wildlife ecology, and statistics to develop novel approaches to support adaptive management and monitoring. Projects aim to ensure that local-scale conservation objectives, decisions, and measures of success are informed by landscape-scale patterns and processes.

L-8 USACE Programs and Information Resources

Regulatory Permit Program (Section 404 and Section 10)

http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram.aspx

The Wilmington District's Regulatory Program manages and protects North Carolina's aquatic resources through fair, flexible, and balanced permit decisions. Aquatic resources that we regulate include wetlands, rivers, stream channels, lakes, and ponds.

Ecosystem Restoration

http://www.saw.usace.army.mil/Missions/EcosystemRestorationCAPStudies.aspx

Projects include restoration of intertidal and shallow subtidal patch eastern oyster reef habitat and fringing salt marsh habitats in targeted estuarine systems.

Recreation Programs and Public Land Management

http://www.saw.usace.army.mil/Missions/Recreation.aspx

The Wilmington District manages 5 lakes and 3 locks and dams as well as the land surrounding these facilities for conservation and recreation.

Falls Lake Master Plan (2013)

http://www.saw.usace.army.mil/Locations/DistrictLakesandDams/FallsLake.aspx

Falls Lake includes the dam, approximately 12,400 acres of open water, and approximately 25,600 acres of surrounding land. This land includes the Falls Lake State Recreation Area, portions of the Butner-Falls of Neuse Game Land, as well as lands leased to local governments.

L-9 DOD Programs and Information Resources

Legacy Resource Management Program

denix.osd.mil/cr/LRMP/index.cfm

This program provides financial assistance to the DOD for efforts to preserve our natural and cultural heritage. A Legacy project may involve regional ecosystem management initiatives, habitat preservation efforts, archaeological investigations, invasive species control, Native American consultations, and/or monitoring and predicting migratory patterns of birds and animals. Through partnerships, the program strives to access the knowledge and talents of individuals outside of DOD.

DOD Partners in Flight (DOD PIF)

http://DODpif.org

The DOD PIF provides a scientific basis for maximizing the effectiveness of resource management and enhancing the biological integrity of DOD lands through use of proactive,

habitat-based management strategies. Program representatives assist installation natural resources managers in improving the monitoring and inventory, research and management, and education programs involving birds and their habitats. The DOD PIF Strategic Plan identifies actions that support and enhance the military mission while also working to secure bird populations. These actions can be incorporated into installation Integrated Natural Resources Management Plans and Bird/Animal Aircraft Strike Hazard (BASH) plans. DOD PIF works beyond installation boundaries to facilitate cooperative partnerships, determine the current status of bird populations, and prevent the listing of additional birds as threatened or endangered. DOD PIF.

Conserving Shorebirds on DOD Lands

http://DODpif.org/publications/shorebird-guidebook.php

For managers seeking to focus on a particular type of wetland and/or a particular species of shorebird, it is essential to know when management opportunities can be scheduled to properly coincide with targeted bird migration schedules. This booklet identifies important shorebird management opportunities by providing: (1) information on migration timing of various 'habitat guilds' and (2) information on the relative abundance of different species of shorebirds in different regions of the country during spring and autumn migrations.

Kirtland's Warbler Recovery Team

http://DODpif.org/kiwa/about.php

The team represents the three managing agencies [Michigan Department of Natural Resources, USFS, and USFWS] involved in the recovery activities for the species. The work of the Kirtland's Warbler Recovery Team over the last 25 years successfully brought an endangered species back from the brink of extinction despite impossible odds. The partnerships, techniques and process are available through an inventory of information containing nearly 1,400 items, including articles, book chapters, cooperative agreements, correspondence, interviews, meeting minutes, maps, outreach, photos, policy, press releases, recovery and habitat management plans, reports, papers, sighting and banding records, theses and dissertations. Also contains an Access Database of all materials.

DOD Partners in Amphibian and Reptile Conservation (DOD PARC)

http://www.DODnaturalresources.net/DOD-PARC.html

A network through which the DOD can work to avoid future mission restrictions while providing stewardship for threatened and endangered herpetofauna. DOD PARC focuses

on habitat and species management; inventory, research, and monitoring; and enducation, outreach, and training. It provides a framework for the effective management of amphibians and reptiles by the military services and their installations.

Defense Environmental Network Information eXchange (DENIX)

https://www.denix.osd.mil/nr/

Information and resources about all DOD Environmental Programs, including the NR Program. Topics on the site include Conservation Program Information; Legislation and Policy; Fish and Wildlife; Threatened, Endangered, and At Risk Species; Vegetation and Habitat; and the Natural Selections Newsletter.

Conserving Biodiversity on Military Lands, A Guide for Natural Resources Managers

http://DODbiodiversity.org

A thorough introduction to understanding biodiversity and how it applies to the military mission, including the scientific, legal, policy, and natural resources management contexts. Includes practical advice from 17 case studies about biodiversity conservation. The DOD Biodiversity Conservation Toolbox provides a list of online resources related to biodiversity conservation on DOD lands.

Integrated Natural Resource Management Plans (INRMP) and Natural Resources Conservation Metrics

http://www.denix.osd.mil/nr/IntegratedNaturalResourceManagementPlan.cfm

INRMPs are planning documents that allow DOD installations to implement landscape-level management of their natural resources while coordinating with various stakeholders. The Natural Resources Conservation Metrics assist decision makers in assessing INRMP implementation and measuring how well conservation efforts are being applied while ensuring no net loss of military testing and training lands across the various installations. These performance metrics provide a better understanding of a conservation program's support of the installation mission and are an indication of the success of partnerships with the USFWS, state fish and wildlife agencies, and, when applicable, with NOAA.

Southeast Regional Partnership for Planning and Sustainability (SERPPAS)

http://serppas.org

A six-state partnership comprised of state and federal agencies that promotes collaboration in making resource-use decisions supporting conservation of natural resources, working lands, and national defense. The region covered by SERPPAS includes North Carolina, South Carolina, Georgia, Alabama, Florida, and Mississippi. Projects include the Marine Coastal Initiative, Sustainable Forestry Initiative, Strategic Lands Inventory (SLI), and a climate change focus group.

Marine Corps Installations East—Marine Corps Base Camp Lejeune (MCIEAST-MCBCL), Environmental Management Division, Integrated Natural Resources Management Plan (INRMP)

http://www.lejeune.marines.mil/OfficesStaff/EnvironmentalMgmt.aspx

Integrated Natural Resources Management Plans (INRMPs) help installation commanders manage natural resources more effectively and in a way that provides for sustainable, healthy ecosystems, complies with all applicable environmental laws and regulations, and provides for no net loss in the capability of military installation lands to support the military mission of the installation. The Camp Lejeune INRMP is intended to provide a benefit to, and gain a critical habitat exemption for, the following species: red-cockaded woodpecker, loggerhead sea turtle, green sea turtle, leatherback sea turtle, bald eagle, piping plover, rough-leaved loosestrife, sea-beach amaranth, Hirsts' panic grass, and coastal goldenrod.

Defense Coastal/Estuarine Research Program, Marine Corps Base Camp Lejeune

https://dcerp.rti.org

The Strategic Environmental Research and Development Program (SERDP) implemented the Defense Coastal/Estuarine Research Program (DCERP) to accomplish DOD's ecosystem-based management approach for military lands along coastal and estuarine shorelines in two contract periods. DCERP1 focused on understanding coastal and estuarine ecosystem composition, structure, and function within the context of a military training environment and was completed in 2013. DCERP2 was developed to understand how coastal and estuarine ecosystems respond to climate change and to assess the carbon cycles in these ecosystems and will be completed by 2017.

Fort Bragg Environmental Division, Environmental Management Branch Natural Resources Team (NRT)

http://www.bragg.army.mil/directorates/dpw/envdiv/emb/Pages/NRT.aspx

The NRT plans, organizes, and implements a program for the proper assessment of major construction projects, natural resource management activities, military training exercises and work orders for impacts on endangered species and wetlands. The NRT provides internal and external guidance and procedures to our customer for the environmental review process in compliance with the Endangered Species Act Section 7 and provides oversight on the environmental review process for wetlands, according to the Clean Water Act section 404/401.

Fort Bragg Environmental Division, Endangered Species Branch

http://www.bragg.army.mil/directorates/dpw/envdiv/endangeredspecies/Pages/default.aspx

Responsible for ecologically managing lands for the persistence and growth of threatened, endangered, and native species within the Sandhills longleaf pine ecosystem.

Fort Bragg Environmental Division, Forestry Branch

http://www.bragg.army.mil/directorates/dpw/envdiv/forestry/Pages/default.aspx

Branch is responsible for on the ground implementation of land management activities such as prescribed burning, wildfire fighting, commercial thinning operations, as well as fire break and road maintenance.

SERPPAS Geospatial Resources and The National Map

http://serppas.org/Maps.aspx
http://nationalmap.gov/viewer.html

Managed by the USGS National Geospatial Program to provide access to eight primary data themes of The National Map. Data includes topographic map products, elevation, orthoimagery, hydrography, geographic names, boundaries, transportation, structures, and land cover. The National Map Viewer allows visualization and identification queries (but not downloads) of other featured data, to include scanned topo maps, ecosystems, protected areas, gap analysis program land cover, wetlands, public land survey system, and national park service boundaries. Also included is a Natural Hazards panel to view hazards-related information, such as for earthquakes, floods, wildfires, and weather, along with the U.S. National Grid for emergency response.

State Programs and Information Resources

M

M-1 NCWRC Programs and Information Resources

NC Wildlife Action Plan (WAP)

http://www.ncwildlife.org/plan.aspx

The WAP is a comprehensive management tool developed by NCWRC and numerous partners to help conserve and enhance the state's full array of fish and wildlife species and their habitats.

Listing of Endangered and Threatened Wildlife and Wildlife Species of Special Concern

http://www.ncwildlife.org/Portals/0/Conserving/documents/protected_species.pdf

Following the requirements set forth in GS 113 Article 25, the Nongame Wildlife Advisory Committee (NWAC) convenes a Scientific Council of species experts to identify species that are at risk of extirpation from the state and need to be included on a list of protected animals.

Fisheries Research

http://www.ncwildlife.org/Fishing/LearnResources/MonitoringSurveys.aspx

Survey and monitoring reports and data for several sportfish species: catfish, crappie, perch, shad, sunfish, temperate bass, trout, and walleye.

Game Lands Programs

http://www.ncwildlife.org/Conserving/Programs/GameLandsPrograms.aspx

Some 2,000,000 acres of public and private lands in North Carolina are managed by the NCWRC for public hunting, trapping, and fishing, and are designated collectively as Game Lands.

Green Growth Toolbox (GGT)

http://www.ncwildlife.org/Conserving/Programs/GreenGrowthToolbox/AboutGGT.aspx

A technical assistance tool designed to help communities conserve high-quality habitats alongside new homes, workplaces, and shopping centers.

Habitat Conservation Program

http://www.ncwildlife.org/Conserving/Programs/HabitatConservationProgram.aspx

Works to protect, manage, and conserve aquatic, wetland, and upland habitats for the benefit of fish and wildlife populations.

Wildlife Friendly Development Certification

http://ncwildcertify.org/

A smart-growth collaboration between the NCWRC, NC Wildlife Federation, and the NC chapter of the American Society of Landscape Architects that allows developments to be recognized as wildlife friendly.

Wildlife Land Conservation Program

http://www.ncwildlife.org/Conserving/Programs/LandConservationProgram.aspx

This program allows landowners who have owned their property for at least five years and want to manage for protected wildlife species or priority wildlife habitats to apply for a reduced property tax assessment.

Conserving NC's Wildlife Resources

http://www.ncwildlife.org/Conserving.aspx

Wildlife conservation and habitat management information for landowners, municipalities, counties, and the public on species, habitats, and programs.

Cooperative Upland habitat Restoration and Enhancement (CURE)

http://www.ncwildlife.org/CURE/CUREDecliningHabitatDecliningWildlife.aspx

CURE addresses the ecosystem of species requiring brushy, grassy, and weedy landscapes of early-successional habitats.

Learning About NC's Wildlife—Conservation Education

http://www.ncwildlife.org/Learning.aspx

Help sustain North Carolina's wildlife and habitats by learning more about them. It's as easy as signing up for classes or workshops, visiting one of our education centers or checking out our videos and publications. There are four Wildlife Education Centers location regionally across the state: Pisgah (Mountains), Centennial Campus (Raleigh), John E. Pechmann Fishing Education Center (Fayetteville), and the Outer Banks (Corolla). Each education center offers a variety of programs year-round that are geared toward K–12 and adults.

M-2 NCMNS Programs and Information Resources

Research & Collections

http://naturalsciences.org/research-collections

The Research & Collections Section comprises a diverse scientific staff located in three facilities: the main Museum, the Nature Research Center, and the Research Laboratory. Collectively, the R&C staff curates the Research Collections (with >3 million specimens), conducts original academic research projects, actively participates in public education and outreach, and assists in Museum exhibit design. MNS researchers have expertise in a large variety of scientific disciplines, and conduct cutting edge research with local, regional, national, and international scopes.

Prairie Ridge Ecostation

http://naturalsciences.org/prairie-ridge-ecostation

Prairie Ridge has 45 acres of Piedmont prairie, forest, ponds, a stream, and sustainable building features integrated with a wildlife-friendly landscape. The site furthers the Museum's mission of enhancing public understanding and appreciation of the natural environment by providing an outdoor learning space while acting as a model for renewable and sustainable energy.

Online Collections

http://collections.naturalsciences.org/

Efforts are underway to database and georeference the Museum's Research Collections. The goal of this project is to allow rapid and remote accessibility of the museum's collections to researchers, resource managers, the public, and other user groups across the region and world. Searchable databases are available through the internet for the amphibians and reptiles, fishes, and invertebrates collections.

M-3 NCNHP Programs and Information Resources

Registered Heritage Areas

http://www.ncnhp.org/web/nhp/registered-heritage-areas

Through voluntary agreements with landowners, this program establishes reserves for populations of endangered, threatened, rare, or otherwise important species of plants and animals and protects outstanding examples of the natural diversity occurring in North Carolina.

Natural Area Inventories

http://portal.ncdenr.org/web/nhp/county-inventory-map

NHP biologists conduct inventories for rare animals, plants, wetlands, riparian areas, and plant communities at the scale of a single parcel all the way to an entire county. By identifying and describing the locations of North Carolina's rarest species and habitats, this work is critical for supporting conservation activities statewide. Information from these projects has been instrumental in some of North Carolina's biggest conservation successes over the

past 30 years, such as Chimney Rock State Park in the mountains and the Roanoke River landscape-level nature preserves.

Rare Animal List & Rare Plant List

http://portal.ncdenr.org/web/nhp/nhp-publications

NHPNatural Heritage Program surveys locations throughout the state for new populations of rare and protected species. The program gathers and assesses information from a wide variety of sources to determine imperilment and conservation needs of high-priority species. Rare plant and animal lists are comprehensively reviewed and updated every two years.

Natural Communities Classification (3rd and 4th Approximations)

http://portal.ncdenr.org/web/nhp/nhp-publications

A classification of NC natural communities has been developed that describes more than 340 habitat types ranging from the grassy balds in the mountains to the maritime forests of the barrier islands. The NHP documents the best examples of these natural communities throughout the state, with site reports, element occurrence records, and GIS-based maps.

NC Conservation Planning Tool (CPT)

http://portal.ncdenr.org/web/cpt/

View natural resource conservation priorities across the state. The Conservation Planning Tool maps compile data from a variety of state agencies and conservation organizations, prioritize the significance of resources for Biodiversity and Wildlife Habitat, and provide a map of Open Space and Conservation land. CPT data are a primary component of the NCWRC Green Growth Toolbox conservation GIS dataset.

Natural Heritage Data Explorer

https://ncnhde.natureserve.org/

The data explorer website was created to improve public access to natural heritage data. Anyone can freely view and create maps of conservation value and access information on conservation priorities and status.

Conservation Incentives Program

http://portal.ncdenr.org/web/ctc/conservation-incentives-program

The Conservation Incentives Program assists landowners and conservation organizations with NC conservation tax credits and with information about other state and federal conservation incentive programs. The program was established as mandated by GS §113A-231, §105-130.34, and §105-151.12 to be an incentive for private landowners to voluntarily conserve their land. The program promotes conservation of ecosystem functions (fish and wildlife conservation and conservation of natural areas), ecosystem services (farmland conservation), and other public benefits (public access to public trails, waters, and beaches).

Geospatial Data

http://portal.ncdenr.org/web/nhp/gis-download

Download GIS shapefiles of NHP data, including element occurrences (rare species, natural communities, and special animal habitats), dedicated nature preserves, conservation lands, and significant natural heritage areas. Natural Heritage GIS data and much more are available at NC OneMap Geospatial Portal.

M-4 NCDMF Programs and Information Resources

Coastal Habitat Protection Plan (CHPP)

http://portal.ncdenr.org/web/mf/55

The CHPP provides information on the ecological role and function of aquatic coastal habitats for fisheries, provides status and trends information on fish habitats, describes and documents threats, and identifies research and management needs.

Oyster Sanctuary Program

http://portal.ncdenr.org/web/mf/nc-oyster-sanctuary-program

Oyster sanctuaries are constructed reefs built to attract native oyster larvae, as well as clams, juvenile finfish, crabs, and marine organisms, which in turn attract larger fish, enhancing hook-and-line fishing. Harvest of oysters and the use of bottom-disturbing gear are prohibited in the sanctuaries, allowing a brood stock of oysters to develop. Currently,

there are twelve existing oyster sanctuaries located in estuarine waters from Dare to Carteret counties.

Shellfish Habitat and Abundance Mapping Program

http://portal.ncdenr.org/web/mf/shellfish-habitat-mapping

In order to promote shellfish production and protect vital shellfish habitat, the DMF maps estuarine bottom to identify shellfish resources and locate areas that are well suited for growing shellfish. Mapping is limited to areas potentially supporting shellfish (Roanoke Island south) and less than 12 ft. water depth. The program also maps submerged aquatic vegetation, marsh, and type of soft bottom within those areas. To date, the DMF has mapped over 95,000 acres of waters from the Cape Fear River to the Newport River, including South River and areas in Core and Roanoke sounds.

Shellfish Rehabilitation Program

http://portal.ncdenr.org/web/mf/shellfish-rehabilitation-program

During the summer months, the DMF "plants" shell and rock (called cultch) to provide additional habitat for larval oysters and clams. Planting sites are located in coastal waters from Dare to Brunswick counties, to provide additional fishing opportunities for both commercial and recreational fishermen. In order to promote increased oyster production, most of the sites are managed with varying levels of fishery restrictions, ranging from all harvest on the site (research sanctuaries) to prohibiting certain bottom-disturbing gear.

Artificial Reef Program

http://portal.ncdenr.org/web/mf/artificial-reefs-program

DMF has constructed eight artificial reefs in estuarine waters. The reefs are constructed primarily of rock, concrete, reef balls, and steel to provide structure. While enhancing fishing opportunities, the reefs also provide fish habitat. Bottom-disturbing gear is prohibited, and all oyster harvest is prohibited on some.

Stock Status Reports

http://portal.ncdenr.org/web/mf/stock-status-reports

Stock status reports are issued annually and serve as a general barometer of the overall health of North Carolina's fishery resources. The data in the stock status reports are used to prioritize development of fishery management plans and subsequent plan amendments.

Fisheries Management Plans

http://portal.ncdenr.org/web/mf/fishery-management-plans-details

The Fisheries Reform Act of 1997 requires DMF to prepare Fisheries Management Plans for all commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources. The goal of these plans is to ensure long-term viability of these fisheries.

Habitat Mapping and Monitoring

http://portal.ncdenr.org/web/mf/58

In addition to the habitat maps produced through the shellfish habitat and abundance program, DMF compiled spatial fish habitat data from multiple agencies into one map. The map is included in the CHPP and available on DMF's website.

GIS Maps to View and Print

http://portal.ncdenr.org/web/mf/maps-to-view-and-print

Maps are also available for existing ecological designations such as Anadromous Fish Spawning Areas (AFSAs), Primary Nursery Areas (PNAs), Permanent and Special Secondary Nursery Areas, and Strategic Habitat Areas. Areas where fishery regulations apply, such as Albemarle Sound/Chowan River Herring Management Areas, are also available in GIS maps.

M-5 NCDCM Programs and Information Resources

Beach & Waterfront Access

http://www.nccoastalmanagement.net/web/cm/beach-and-water-front-access

The Division of Coastal Management awards matching grants to local governments for projects to improve access to the state's beaches and waterways. Local governments may use access grants to construct public access facilities, including parking areas, restrooms, dune crossovers, and piers. Projects range in size from small, local access areas to regional access sites with amenities such as large parking lots, bathrooms, and picnic shelters. Towns and counties also may use the grants to replace aging access facilities. In addition, local governments can use the funds to help acquire land for access sites or to revitalize urban waterfronts.

Coastal Wetlands Data: Interactive GIS Mapping

http://portal.ncdenr.org/web/cm/-interactive-mapping

Information on wetland restoration, creation, enhancement, and preservation sites in the 20 coastal counties of North Carolina. It includes restored, created, enhanced and preserved wetlands, and submerged aquatic vegetation (SAV) or "sea grass beds" constructed for compensatory mitigation, shoreline stabilization, conservation, mitigation banking, and research.

North Carolina Coastal Region Evaluation of Wetland Significance (NC-CREWS)

http://portal.ncdenr.org/web/cm/nc-crews-wetland-functional-assessment

A watershed-based wetlands functional assessment model that uses GIS software and data to assess the level of water quality, wildlife habitat, and hydrologic functions of individual wetlands. The primary objective of the NC-CREWS wetland functional assessment is to provide users with information about the relative ecological importance of wetlands for use in planning and the overall management of wetlands.

North Carolina Coastal Reserve (NCCR)
National Estuarine Research Reserve System (NERR)

http://www.nccoastalreserve.net/

The state-supported sites in the NCCR are Kitty Hawk Woods, Emily and Richardson Preyer Buckridge, Buxton Woods, Permuda Island, Bald Head Woods, and Bird Island.

The NERR is a network of ten protected sites established for long-term research, education, and stewardship. Four of the Reserve components are designated as NERR sites: Currituck Banks, Rachel Carson, Masonboro Island, and Zeke's Island.

CAMA Handbook for Development in Coastal North Carolina

http://portal.ncdenr.org/web/cm/cama-handbook-for-development

A guide to the CAMA permit program designed for those who want to develop or build in the 20 coastal North Carolina counties.

Clean Marina Program

http://portal.ncdenr.org/web/cm/clean-marinas

Clean Marina is a nationwide program developed by the National Marine Environmental Education Foundation, a nonprofit organization that works to clean up waterways for better recreational boating. It is a voluntary program designed to show that marina operators can help safeguard the environment by using management and operations techniques that go above and beyond regulatory requirements. The Clean Marina program is a partnership between NC Boating Industry Services, the NC Marine Trade Association, the Division of Coastal Management, the Albemarle-Pamlico National Estuary Program, NC Sea Grant, the US Power Squadron, US Coast Guard Auxiliary, and NC Big Sweep.

Coastal & Estuarine Land Conservation Program (CELCP)

http://portal.ncdenr.org/web/cm/nccelcp

Federal funding program that helps states protect coastal and estuarine lands that are important for their ecological, conservation, recreational, historical, or aesthetic values. The program provides state and local governments with matching funds to purchase significant coastal lands or easements from willing sellers. Lands or easements acquired with CELCP funds are protected in perpetuity so that they may be enjoyed by future generations.

NC Clean Boater Program

http://portal.ncdenr.org/web/cm/clean-boater-program?doAsUserId=OlmSb%2BpteAE%3D%2F-%2Fblogs%2Frss

The NC Clean Boater program is a complementary part of the Clean Marina program. By pledging to adopting pollution prevention measures while boating Clean Boaters do their part to protect the environment.

NC Marine Sewage Pumpout Station Grant Program

http://portal.ncdenr.org/web/cm/north-carolina-s-pumpout-program

The program was established under the federal Clean Vessel Act of 1992 and provides financial assistance to marinas and other boat-docking facilities for the installation and renovation of pumpout and dump stations in NC. Using funds from USFWS, the NCDCM has made grants of up to $15,000 available on a yearly basis to private and commercial marinas, gas/service docks, fish houses/seafood dealers and other boat docking facilities

in the 20 coastal counties. A 25% match is required from the marinas and from the local governments installing pumpouts at public docks.

Maps & GIS Spatial Data

http://portal.ncdenr.org/web/cm/download-coastal-wetlands-spatial-data

Data sets that represent the location, condition, trends, and patterns of a number of coastal features, including wetlands.

M-6 NCDWR Programs and Information Resources

Stream Fish Community Assessment Program

http://portal.ncdenr.org/web/wq/ess/bau/ncibi-data

Since 1990, more than 918 sites across the state have been assessed by the wadeable stream fish community assessment program and data is used to report on the general distribution of freshwater species in North Carolina by river basin. The data are used to develop the North Carolina Index of Biotic Integrity (NCIBI) scores and surface water quality ratings.

Ambient Monitoring System

http://portal.ncdenr.org/web/wq/ess/eco/ams

A network of stations established to provide site-specific, long-term water quality information on significant rivers, streams, and estuaries throughout the state. The program has been active for over thirty years. Stations are visited at least monthly for the collection of a variety of physical, chemical, and bacterial pathogen samples and measurements. Data produced by the AMS are also used to support several DWQ water quality management programs, including Basinwide Water Quality Management Plan development, biennial 305(b) and 303(d) reporting to EPA, TMDL development, and development of NPDES permit limits.

Basinwide Monitoring Program: Macrobenthics and Fish Communities

http://portal.ncdenr.org/web/wq/ess/bau

Biological assessments use the diversity, abundance, and pollution sensitivity of organisms that inhabit streams to assess the effects of water pollution. Biological information is

also used to define High-quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with management actions.

Basinwide Planning

http://portal.ncdenr.org/web/wq/ps/bpu

The new integrated DWR planning group is responsible for producing an integrated basinwide water quality and water quantity plan, which is a nonregulatory, basin- and watershed-based approach to identifying, quantifying, restoring, and protecting North Carolina's water resources. Basinwide water resource plans will be prepared for each of the 17 major river basins and are proposed to be presented in a dynamic online format.

401 Wetlands and Buffer Permitting

http://portal.ncdenr.org/web/wq/401bufferpermitting

A technical guidance and permitting program for Clean Water Action Section 401 certifications (required for any federally permitted or licensed activity that may result in a discharge to waters of the United States), state riparian buffers, and nonpoint source compliance.

M-7 NCEEP Programs and Information Resources

Watershed Priority Interactive Planning Map

http://portal.ncdenr.org/web/eep/priorities-map

Watershed priorities are watersheds within each of North Carolina's 17 river basins that demonstrate a balance of challenges and assets, and that represent the best opportunity for watershed improvement. Targeted Local Watersheds (TLWs) are 14-digit watersheds that are a focus of EEP planning and project implementation efforts. Local Watershed Plans (LWPs) are a subset of TLWs and represent those watersheds in which EEP has conducted detailed watershed assessment, and produced a Watershed Management Plan and Project Atlas.

River Basin Restoration Priorities

http://portal.ncdenr.org/web/eep/rbrps

Plans that EEP develops to identify priorities for the protection and enhancement of water quality, fisheries, wildlife habitat, and recreational opportunities. EEP uses the priorities to guide its stream, wetland, and riparian restoration and protection activities in the state's 17 major river basins. Priorities are identified as Targeted Local Watersheds, watersheds at the 14-digit hydrologic-unit scale that receive priority for EEP planning and restoration project funds.

Science and Analysis Technical Assistance

http://portal.ncdenr.org/web/eep/science-and-analysis

Technical assistance to EEP project teams and to the scientific community in watershed modeling, fluvial geomorphology, wetland ecology and hydrology, ecology, geographic information system analysis, statistical analysis, database design, and development.

GIS Data Sets

http://portal.ncdenr.org/web/eep/research-and-data

Includes TLWs, LWPs, LWP areas, site points, easements, IMS project table, and LWP and project documents.

M-8 NC Aquariums Programs and Information Resources

Roanoke Island, Pine Knoll Shores, Fort Fisher: Outer Banks Marine Mammal Stranding Network

http://www.ncaquariums.com/conservationresearch/conservation-projects

Roanoke Island staff support marine mammal stranding response in Currituck, Dare, and Hyde counties. Staff provided elevated response during Navy sonar training windows. Pine Knoll Shores and Fort Fisher work in Carteret and New Hanover counties to assist local responders.

Roanoke Island, Pine Knoll Shores and Fort Fisher: Sea Turtle Rehabilitation

http://www.ncaquariums.com/conservationresearch/sea-turtle-program

All three Aquariums respond to stranded sea turtles in conjunction with NC Wildlife Resources Commission. The Aquariums provide rehabilitation for threatened and endangered sea turtles. These turtles are either returned to the wild, released to a long-term care facility, or become part of a permanent Aquarium collection.

Pine Knoll Shores: Diamondback terrapin monitoring and incidental capture assessment

http://www.ncaquariums.com/conservationresearch/research-projects

Staff assists with monitoring abundance and incidental capture of Diamondback Terrapins in conjunction with NC DMF.

Fort Fisher and Roanoke Island: Beach Vitex Task Force

http://www.beachvitex.org/

Staff coordinates state-wide Beach Vitex removal and assists in removal efforts.

Pine Knoll Shores and Fort Fisher: Sea turtle tagging

http://www.ncaquariums.com/conservationresearch/research-projects

Staff adhere satellite tracking tags to yearling loggerhead sea turtles prior to release. Data is compiled to better understand movements of these threatened turtles.

Fort Fisher: Cape Fear Arch Conservation Collaboration

http://www.ncaquariums.com/fort-fisher/aquarium-partners
http://capefeararch.org/

Staff participates in and the Aquarium is part of the nonprofit partnership of organizations and individuals created in 2006 to realize a vision for the Cape Fear Arch region where humans' and nature's needs are properly balanced. The Aquarium joined the collaboration in 2011.

M-9 NC Zoo Programs and Information Resources

Hellbender Salamander Conservation

http://www.nczoo.org/subpages.aspx?pageID=12636&CNM=Saving%20Species&CID=214&subCatID=356&contentPage=true&desc=false&selfID=15009&jQDescPos=1&tab=tabs-1&listingID=4463

Conservation activities include participation in field surveys of Hellbender Salamanders in western North Carolina and collaborating with institutions and agencies in other states to develop a conservation plan for Hellbenders. Conservation actions include surveying and monitoring mountain streams and propagation programs for captive breeding.

Red Wolf Species Survival Plan

http://www.nczoo.org/subpages.aspx?pageID=12636&CNM=Saving%20Species&CID=214&subCatID=356&contentPage=true&desc=false&selfID=15009&jQDescPos=1&tab=tabs-1&listingID=4467

A program that closely monitors breeding and tracks the genetic heritage of specific red wolves. The Zoo has been home to at least 48 different Red Wolves and has captive-bred red wolves that were moved to Alligator River Wildlife Refuge in eastern North Carolina.

Ridges Mountain Natural Area Management

http://www.nczoo.org/subpages.aspx?pageID=12636&CNM=Habitat%20Conservation&CID=214&subCatID=357&contentPage=true&desc=false&selfID=15010&jQDescPos=2&tab=tabs-1&listingID=4468

The Natural Heritage Inventory of Randolph County lists Ridges Mountain as a site of State significance. The mountain supports several wildlife corridors that provide a link to other Natural Heritage priority areas. Ridges Mountain also provides breeding habitat for wildlife, including forest interior bird species and Central and South American migrants. The NC Zoo works with its partners to manage Ridges Mountain for conservation, research, recreational, and educational activities. Surveys conducted by NHP have focused on several moth species, including the genus Catocala (Underwing Moths).

Local Conservation Projects

http://www.nczoo.org/subpages.aspx?pageID=12636&CNM=Habitat+Conservation&CID=214&subCatID=357&contentPage=true&desc=false&selfID=15010&jQDescPos=2&tab=tabs-1&listingID=6504

Selma Cornelison Ward Nature Preserve and Arnett Branch Longleaf Pine Forest (a 323-acre nature preserve of uninterrupted high-quality mature hardwoods); Arnett Branch Longleaf Pine Forest (a 112-acre longleaf pine forest in the heart of the Greater Uwharries region); Schweinitz's Sunflower Recovery (transplanting Sunflowers from road widening projects and managing recovery sites); Box Turtle tracking; Cape Fear Shiner (study of a captive population); and other projects.

M-10 Office of Environmental Education & Public Affairs Programs and Information Resources

Environmental Literacy Center

http://www.eenorthcarolina.org/resource-center-elc.html

Located in the Nature Research Center, the new wing of the Museum of Natural Sciences, the Center has over 2,000 books and DVDs covering subject areas that include environmental science, popular natural science, conservation, sustainability, museum and nonformal education practices, and science education. These resources are catalogued through the State Library of North Carolina; choose "Environmental Education Office" under "Library Location" to search the catalog.

River Basin Publications

http://www.eenorthcarolina.org/riverbasins.html

Free publications include booklets, river basin posters, and brochures for any of the state's 17 river basins.

Resources for Educators

http://www.eenorthcarolina.org/educators--resources.html

Environmental education events and resources for North Carolina's preK–12 teachers as well as homeschool and nonformal educators. Resources include the NC Environmental

Literacy Plan, curricula, lesson plans, field trips, resource database, grants, and job openings.

M-11 NCFS Programs and Information Resources

NC Forest Action Plan

http://www.ncforestactionplan.com/PDF/NC%20Forest%20Assessment%20Complete.pdf

This state-wide assessment, along with its accompanying strategic plan and priority maps, represents a broad and collective vision for protecting and enhancing forest values and benefits over a five-year period. Provides details on six goals and associated performance measures.

North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Strategic Plan

http://ncforestservice.gov/strategic_plan/relationship_ncdacsplan.htm

A Department strategic plan that incorporates three key representative goals and associated performance measures and strategic initiatives from the NC Forest Action Plan and nine functional area initiatives specific to NCFS.

Key Initiatives

http://ncforestservice.gov/strategic_plan/initiatives.htm

Nine key initiatives have been incorporated into the NC Forest Action Plan as action items under appropriate goals and objectives. Initiatives that are intended to introduce new processes or make significant organizational changes that will improve performance and enhance the agency's ability to meet performance targets and better achieve its mission.

Forest Legacy Program

http://www.ncforestservice.gov/fsandfl/what_is_forest_legacy.htm

The program uses cost-sharing and conservation easements to help landowners, state and local governments, and private land trusts identify and protect environmentally important forest lands that are threatened by present and future conversion to non-forest uses. (See Section 6.9.2 in Chapter 6 for additional information.)

Urban & Community Forestry Grant Program

http://ncforestservice.gov/Urban/urban_grant_overview.htm

The program goal is to enhance the benefits and sustainable management of urban forests, which is accomplished by funding projects that lead to more effective and efficient management of urban and community forests. Local and state governments, public educational institutions, approved non-profit 501(c)(3) organizations, and other tax-exempt organizations are eligible to apply for a grant.

Community Firewise & Urban Interface Grant Program

http://ncforestservice.gov/Urban/urban_grant_forms.htm
http://www.firewise.org/

The program goal is to develop, educate, enhance, implement, and support the Firewise and healthy forest management concepts in Wildland–Urban Interface communities throughout North Carolina by encouraging citizen and community involvement. Fire department districts, townships, communities, neighborhoods, and private non-profit organizations are eligible to apply for a grant.

Present-use Value Program for Forestland

http://www.ncforestservice.gov/Managing_your_forest/managing_presentuse.htm

Generally speaking, all property is valued and taxed at its market value. Standing timber, pulpwood, seedlings, saplings, and other forest growth is classified as a special class of property under the authority of the North Carolina Constitution and, as such, is excluded from taxation (Sec. 105-275(15), G.S.). The purpose of this classification is to encourage proper forest management practices and to develop and maintain North Carolina's forest resources.

Forest Stewardship Plan Program

http://www.ncforestservice.gov/fsandfl/are_you_stewardship_material.htm

To encourage the development of recognized stewardship forests, the NCFS provided cost-share assistance that subsidized the writing of forest stewardship management plans by NCFS-approved plan writers. However, due to federal budget reductions, program funding was suspended during the 2012–2013 fiscal year.

Southern Pine Beetle Prevention Program

http://www.ncforestservice.gov/forest_health/fh_spbpp.htm

A cost-share program funded through a grant from the US Forest Service that aims to prevent outbreaks of the Southern Pine Beetle. The program reimburses non-industrial private forest landowners in North Carolina for some of the cost of practices to manage young pine stands for the prevention of Southern Pine Beetle infestations.

Conservation Reserve Program (CRP)

http://www.ncforestservice.gov/Managing_your_forest/crp.htm

A cost-share program designed to reduce water runoff and sedimentation by supporting conversion of cropland to forests, grasses and legumes, wildlife habitat, or combinations of permanent ground covers. Landowners may sign up for certain conservation practices during enrollment periods; enrollment in practices such as Longleaf Pine establishment, riparian forest buffers, wetland restoration, or bottomland timber establishment, are available year-round.

Conservation Reserve Enhancement Program (CREP)

http://www.ncforestservice.gov/Managing_your_forest/crep.htm

A state and federal partnership conservation program administered by the USDA Farm Service Agency that targets water quality, soil erosion, and wildlife habitat concerns in North Carolina. (See Section 6.9.2 in Chapter 6 for additional information.)

Environmental Quality Incentives Program (EQIP)

http://www.ncforestservice.gov/Managing_your_forest/eqip.htm

A voluntary conservation program that promotes agricultural production and environmental quality by allowing farmers to receive financial and technical assistance in installing or implementing structural practices or conservation practices such as forest stand improvement, fire and fuel breaks, prescribed burning, restoration and management of forest habitats, and tree establishment.

Prescribed Fire and Controlled Burning

http://www.ncforestservice.gov/fire_control/fc_prescribedfire.htm

In partnership with the National Interagency Prescribed Fire Training Center, NCFS works to train, plan, and coordinate with local fire services before a prescribed fire is started, and ensures that all burning regulations are obeyed.

M-12 PCP Programs and Information Resources

Plant Conservation Preserves

http://www.ncagr.gov/plantindustry/plant/plantconserve/documents/NCPCP2011InReview-FINAL.pdf

Plant Conservation Preserves are the only public lands established and managed specifically to protect imperiled plant species. To help accomplish PCP's mission of conserving native plant species in their natural habitats, each preserve was specifically designed with a core species in mind. To that end, 51 species are currently protected on preserves. There are 21 preserves that have lands permanently protected for the conservation of North Carolina's native flora and their habitats.

Protected Plant Species List

http://www.ncagr.gov/plantindustry/plant/plantconserve/plist.htm

The North Carolina Plant Conservation Board establishes a list of protected plant species in North Carolina. The list is published in NC General Statutes 02 NCAC 48F § 0300.

M-13 Soil & Water Conservation Programs and Information Resources

Agriculture Cost Share Program (ACSP)

http://www.ncagr.gov/SWC/costshareprograms/ACSP/index.html

ACSP addresses nonpoint pollution by providing technical and financial resources that include identifying and designing best management practices (BMPs) for agricultural operations to improve water quality.

Agricultural Water Resources Assistance Program (AgWRAP)

http://www.ncagr.gov/SWC/costshareprograms/AgWRAP/index.html

AgWRAP assists farmers and landowners with identifying opportunities to increase water use efficiency, availability and storage; implement BMPs to conserve and protect water resources; increase water use efficiency; and increase water storage and availability for agricultural purposes.

Community Conservation Assistance Program (CCAP)

http://www.ncagr.gov/SWC/costshareprograms/CCAP/index.html

CCAP addresses nonpoint pollution by providing technical and financial resources to improve water quality through the installation of BMPs on urban, suburban, and rural lands not directly involved with agriculture production.

Lagoon Conversion Program (LCP)

http://www.ncagr.gov/SWC/costshareprograms/Lagoon_Program/index.html

LCP works with farmers who want to convert existing swine lagoon and sprayfield systems to innovative animal waste management systems. It is administered as a component of the Agriculture Cost Share Program. LCP may also be used to help to establish centralized waste collection and treatment systems to serve existing swine waste management systems that employ the new technology.

M-14 NCDOT Programs and Information Resources

Project Development and Environmental Analysis (PDEA) Branch—Environmental Compliance

https://connect.ncdot.gov/resources/Environmental/Pages/default.aspx

NCDOT works diligently to ensure that all projects are conducted in compliance with the National Environmental Policy Act (NEPA). The PDEA Branch manages environmental compliance, environmental impact studies (EIS), and associated reports and procedures; coordinates Clean Water Act Section 404/401 permit information as well as environmental permits needed for project construction, and mitigation-related information; and manages the NEPA/Section 404 Merger Process.

Environmental Excellence Programs

http://www.ncdot.gov/programs/environment/functions/

Programs, units, divisions, and organizations that are involved in environmental stewardship and streamlining activities include the EPCC, Project Development and Environmental Analysis Branch (PDEA), and Division of Highway's Roadside Environmental Unit, as well as others.

Roadside Environmental Unit, Soil & Water Engineering Section

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/

Since 1970, NCDOT has been addressing stormwater pollution through the Department's sediment and erosion control program. The main importance of sediment and erosion control is to protect our waterways. The Soil and Water Engineering Section is responsible for designing sediment and erosion control plans for NCDOT's land-disturbing activities as well as developing design standards and training materials for erosion and sediment control. These plan designs are based on many factors including classifications of surrounding waters, critical habitat areas, environmentally sensitive areas, and any environmental concerns.

Office of Beautification, Litter Prevention

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/Beautification/

NCDOT's Office of Beautification Programs is attacking the litter problem by increasing funding for litter removal, using litter removal machinery, assigning more inmates to litter pickup duty, implementing anti-litter educational programs in the schools, increasing volunteer recruitment for Litter Sweep and Adopt-A-Highway, and partnering with public and private agencies to help reduce litter in our state.

Stormwater Program

http://www.ncdot.gov/programs/environment/stormwater/

The Stormwater Program has been an NCDOT-wide initiative to protect and improve water quality while fulfilling NCDOT's mission of providing and supporting a safe and integrated transportation system that enhances the state.

Environment-related Education Resources

http://www.ncdot.gov/programs/environment/education/

Links to environmental education resources available through AASHTO's Center for Environmental Excellence, NCSU Center for Transportation and the Environment, National Highway Institute, NCDENR's Office of Environmental Education, EPA's Office of Environmental Education, and USACE's Education Center.

Environmental Initiatives and Best Practices Database

http://www.ncdot.gov/programs/environment/development/database/

NCDOT Quality Enhancement Unit is currently maintaining two inventories within the department. The Best Practices Inventories and Environmental Initiatives are used to showcase projects, promote department process effectiveness and efficiency, develop positive communication about our projects, and to demonstrate an overall commitment to protecting North Carolina's natural, human, and cultural resources.

Environmental Management Systems

http://www.ncdot.gov/programs/environment/development/ems/

The North Carolina Department of Transportation (NCDOT) Office of Environmental Quality offers assistance to divisions/units in the implementation of an Environmental Management System (EMS). The EMS is based on the ISO 14001 standard as a way of demonstrating environmental leadership, environmental responsibility, and commitment to continual improvement. An EMS is a structured management methodology that allows a department, business unit, or organization to demonstrate a focus on meeting, or in some cases exceeding, regulatory compliance. It enables consistent and repeatable environmental performance, and accountability that promotes continual improvement by establishing policy, setting improvement goals, and establishing programs to achieve those goals.

Federal Endangered Species Recovery Plans

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Common Name	Scientific Name	Recovery Plan
Birds		
Piping Plover	*Charadrius melodus*	Recovery Plan for the Great Lakes Piping Plover population, 2003 https://ecos.fws.gov/docs/recovery_plan/030916a.pdf Piping Plover Atlantic Coast Population Revised Recovery Plan, 1996 https://ecos.fws.gov/docs/recovery_plan/960502.pdf
Red Knot	*Calidris canutus rufa*	Recovery Plan information is not available at this time. Listing information is available on the species profile page: https://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=B0DM#recovery
Red-cockaded Woodpecker	*Picoides borealis*	Recovery Plan for the Red-cockaded Woodpecker Second Revision, 2003 https://ecos.fws.gov/docs/recovery_plan/030320_2.pdf
Roseate Tern	*Sterna dougallii dougallii*	Roseate Tern Northeastern Population Recovery Plan, 1998 https://ecos.fws.gov/docs/recovery_plan/981105.pdf Recovery Plan Caribbean Roseate Tern, 1993 https://ecos.fws.gov/docs/recovery_plan/930924_v2.pdf
Wood Stork	*Mycteria americana*	Revised Recovery Plan for the US Breeding Population of the Wood Stork, 1997 https://ecos.fws.gov/docs/recovery_plan/970127.pdf

Common Name	Scientific Name	Recovery Plan
Fishes		
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Recovery Plan information is not available at this time. Listing information is available on the species profile page: https://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=E0A7#recovery
Cape Fear Shiner	*Notropis mekistocholas*	Cape Fear Shiner Recovery Plan, 1988 https://ecos.fws.gov/docs/recovery_plan/060313.pdf
Roanoke Logperch	*Percina rex*	Roanoke Logperch Recovery Plan, 1992 https://ecos.fws.gov/docs/recovery_plan/920320a.pdf
Shortnose Sturgeon	*Acipenser brevirostrum*	Final Recovery Plan for the Shortnose Sturgeon, 1998 https://ecos.fws.gov/docs/recovery_plan/sturgeon_shortnose_1.pdf
Smalltooth Sawfish	*Pristis pectinata*	Smalltooth Sawfish Recovery Plan, 2009 https://ecos.fws.gov/docs/recovery_plan/smalltoothsawfish.pdf
Spotfin Chub	*Erimonax monachus* *[Hybopsis monacha]*	Recovery Plan Spotfin Chub, 1983 https://ecos.fws.gov/docs/recovery_plan/831121.pdf
Waccamaw Silverside	*Menidia extensa*	Waccamaw Silverside 5-Year Review: Summary and Evaluation, 1993 https://ecos.fws.gov/docs/recovery_plan/WS_5yr%20review.pdf
Mammals		
Carolina Northern Flying Squirrels	*Glaucomys sabrinus coloratus*	Appalachian Northern Flying Squirrels, 1990 http://ecos.fws.gov/docs/recovery_plan/900924c.pdf
Finback Whale	*Balaenoptera physalus*	Draft Recovery Plan for the Fin Whale, 2006 http://www.nmfs.noaa.gov/pr/pdfs/recovery/draft_finwhale.pdf
Gray Bat	*Myotis grisescens*	Gray Bat Recovery Plan, 1982 https://ecos.fws.gov/docs/recovery_plan/820701.pdf
Humpback Whale	*Megaptera novaeangliae*	Final Recovery Plan for the Humpback Whale, 1991 https://ecos.fws.gov/docs/recovery_plan/whale_humpback.pdf

Common Name	Scientific Name	Recovery Plan
Indiana Bat	*Myotis sodalist*	Indiana Bat Draft Recovery Plan: First Revision, 2007 https://ecos.fws.gov/docs/recovery_plan/070416.pdf
North Atlantic Right Whale	*Eubalaena glacialis*	Recovery Plan for the North Atlantic Right Whale Revision, 2005 https://ecos.fws.gov/docs/recovery_plan/whale_right_northatlantic.pdf
Northern Long-eared Bat	*Myotis septentrionalis*	No recovery plan information is available at this time. Listing information is available on the species profile page: https://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A0JE#recovery
Red Wolf	*Canis rufus*	Red Wolf Recovery/Species Survival Plan, 1990 https://ecos.fws.gov/docs/recovery_plan/901026.pdf
Sperm Whale	*Physeter macrocephalus*	Final Recovery Plan for the Sperm Whale, 2010 https://ecos.fws.gov/docs/recovery_plan/Sperm_whale_Recovery_Plan.pdf
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	A Recovery Plan for the Ozark Big-eared Bat and the Virginia Big-eared Bat, 1984 https://ecos.fws.gov/docs/recovery_plan/840508.pdf
West Indian Manatee	*Trichechus manatus*	Florida Manatee Recovery Plan, Third Revision, 2001 https://ecos.fws.gov/docs/recovery_plan/011030.pdf
Freshwater Mussels		
Appalachian Elktoe	*Alasmidonta raveneliana*	Recovery Plan for the Appalachian Elktoe, 1996 https://ecos.fws.gov/docs/recovery_plan/960826.pdf
Carolina Heelsplitter	*Lasmigona decorate*	Recovery Plan for Carolina Heelsplitter, 1997 https://ecos.fws.gov/docs/recovery_plan/970117.pdf
Dwarf Wedgemussel	*Alasmidonta heterodon*	Dwarf Wedge Mussel Recovery Plan, 1993 https://ecos.fws.gov/docs/recovery_plan/dwm%20recovery%20plan.pdf

Common Name	Scientific Name	Recovery Plan
James Spinymussel	*Pleurobema collina*	James Spinymussel Recovery Plan, 1990 https://ecos.fws.gov/docs/recovery_plan/900924b.pdf
Tar Spinymussel	*Elliptio steinstansana*	Tar Spinymussel Recovery Plan, 1992 https://ecos.fws.gov/docs/recovery_plan/Tar%20River%20Spinymussel%20Recovery%20Plan.pdf
Reptiles		
Green Sea Turtle	*Chelonia mydas*	Recovery Plan for U.S. Population of Atlantic Green Turtle, 1991 https://ecos.fws.gov/docs/recovery_plan/911126c.pdf
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Recovery Plan for the Hawksbill Turtle in the U.S. Caribbean, Atlantic and Gulf of Mexico, 1993 https://ecos.fws.gov/docs/recovery_plan/931110.pdf
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle, Second Revision, 2011 https://ecos.fws.gov/docs/recovery_plan/kempsridley_revision2_with%20signature.pdf
Leatherback Sea Turtle	*Dermochelys coriacea*	Recovery Plan Leatherback Turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico, 1992 https://ecos.fws.gov/docs/recovery_plan/920406.pdf
Loggerhead Sea Turtle	*Caretta caretta*	Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle, Second Revision, 2008 https://ecos.fws.gov/docs/recovery_plan/090116.pdf
Snails		
Noonday Globe	*Patera clarki Nantahala*	Recovery Plan Noonday Snail, 1984 https://ecos.fws.gov/docs/recovery_plan/noonday%20snail%20recov%20plan.pdf
Class: Arachnida		
Spruce–fir Moss Spider	*Microhexura montivaga*	Recovery Plan for the Spruce-fir Moss Spider, 1998 https://ecos.fws.gov/docs/recovery_plan/980911b.pdf
Class: Insecta		
Saint Francis' Satyr Butterfly	*Neonympha mitchellii francisci*	Recovery Plan Saint Francis' Satyr, 1996 https://ecos.fws.gov/docs/recovery_plan/960423.pdf

Monitoring Efforts

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O-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	

Species Common Name (see Appendix G for Scientific Names)	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
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	
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, NCSU	
Roanoke Bass	NCWRC	Periodic
Robust Redhorse	RRCC (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, EBCI, 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-G	
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, NCHS	

O-2 Guild and Species Assemblage Monitoring

Guilds	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
Amphibians		
Anurans	NCWRC, NCMNS, USFS, USGS, DOD, NCPARC, NCHSNC 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, NCSU	Periodic (stock dependent)
Nongame Fishes	NCWRC, NCMNS, NCDWR, USFWS	
Marine Fishes (Fishery Management Plan [FMP] species)	NCDMF, NOAA-Fisheries, NCWRC	
Marine Species (NonFMP 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
Migratory Birds	NCWRC, PIF, Volunteers	Spring, Fall
Neotropical Songbirds	NCWRC, USFS, USGS, Audubon NC, SARR, Weyerhaueser Company-Cool Springs Environmental Education Center	

Guilds	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
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-G, 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	
Class: Insecta		
Butterflies and Moths (Summer counts)	NCNHP, Volunteers	
Other		
Federal- (Candidate, FSC) and State-listed Species	NCWRC, NCDWR, NCNHP, NCDOT, USFS, USFWS, TVA, NCSU, LTWA	Periodic (species, location specific)
Herpetofauna Surveys	NCWRC, Weyerhaueser Company-Cool Springs Environmental Education Center	

O-3 Activity- and Project-specific Monitoring

Initiative/Program	Collaborators (see Appendix A for a list of acronyms)	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)
IBI	USFS	
Nongame Aquatic Species Relocation, Augmentation, and Restoration Projects	NCWRC, NCDWR, NCDOT, USFS, USFWS, TNDEC, TVA, APGI, BRPP, University of TN- Knoxville, WCU	Periodic (project specific)
Stream Water Quality and Aquatic Invertebrate Monitoring	Weyerhaueser Company-Cool Springs Environmental Education Center	

Initiative/Program	Collaborators (see Appendix A for a list of acronyms)	Frequency (Annual unless otherwise noted)
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, SARR, 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, SARR, 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-G, Indiana State University	
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