

## CHAPTER 5: STATEWIDE CONSERVATION STRATEGIES

Through the SWAP prioritization process, 496 animal species were identified in this iteration of the Plan. Each species or guild had specific threats unique to them or their taxa, but most had the same overarching challenges. Although each species is discussed in detail in the **Supplemental Volume: Priority Species Accounts**, the common issues affecting all priority species can be compiled into nine broad needs or themes that translate into “Conservation Action Areas” (CAAs). These CAAs are presented in Box 5-1.

Within each CAA, conservation actions were condensed from the recommendations prepared for each animal on South Carolina’s Priority Species List. Some of the actions identified will affect all species included in the SWAP, while others may affect only a few species. Within each of the nine CAAs, specific strategies were prioritized as “highest”, “high”, or “moderate” based on the most immediate needs. Therefore, the priority of each action is identified in brackets beside it. Some specific activities are repeated in several sections where appropriate.

### BOX 5-1: NINE CONSERVATION ACTION AREAS (CAAS)

- Education and Outreach
- Habitat Protection
- Invasive and Non-native Species Control
- Private Land Cooperation
- Public Land Management
- Regulatory Actions
- Survey and Research Needs
- Urban and Developing Lands
- Climate Change [NEW]

In the first iteration of the Plan in 2005, Conservation Action Committees were deemed necessary to address each CAA and determine how to prioritize the specific strategies therein. Experts on the various topics ranged from Department staff to partners from educational institutions, federal agencies, industries, and organizations. Six criteria were to be used to determine the priority status of the various conservation actions. Box 5-2 summarizes these. Two Conservation Action Committees—those for Education and Outreach and Urban and

### BOX 5-2: SIX CRITERIA USED FOR DETERMINATION OF PRIORITY CONSERVATION STRATEGIES

- **Feasibility:** Challenges can be mitigated; solutions are apparent. SCDNR can feasibly staff and implement the actions needed and the results will be beneficial.
- **Opportunity:** SCDNR is able to implement the conservation action (i.e., opportunities exist; SCDNR has the authority to carry out the action).
- **Benefit:** Implementation of the action will result in benefits to the natural diversity of South Carolina. Benefits are considered in terms of unit of effort to achieve those benefits; that is, implementation results in multiple benefits to a given species or multiple species are benefited by a single action.
- **Proactive:** Implementation will result in proactive changes to address challenges; actions are more than reactive responses to ongoing challenges.
- **Partnerships:** Partnership opportunities exist for implementation which provides the ability to leverage other resources.
- **Funding:** Implementation is eligible for SWG funding and/or matching funds exist.

Developing Lands—were convened prior to the completion of the Plan in 2005; the resulting conservation strategies are outlined within this chapter. Some of their suggestions were already ongoing actions of the Department; others have recently been implemented; and still others have simply been proposed. Additional committee meetings will be held as needed for the remaining CAAs as the SWAP continues to be implemented. Resulting conservation strategies will be included in future revisions of the South Carolina SWAP.

### CONSERVATION ACTION AREA 1: Education and Outreach

Education and outreach programs positively affect conservation activities by involving the broader community in these activities. As such, education and outreach programs are critical to successful wildlife and habitat conservation. In times of budgetary crises, when funding, personnel and resources become limited, education and outreach programs are often supplanted by more imminent needs associated with species and habitat protection. However, it may be most critical during such times to ensure that education and outreach programs are functioning; such programs can produce an informed public that can assist in achieving the goals of environmental conservation.

Each division within the SCDNR has its own education and outreach programs. Of special note, Outreach and Support Services Division (OSS) in the Columbia office manages Camp Wildwood. Box 5-3 outlines current programs that are based in the SCDNR or programs for which SCDNR is a major contributor or partner.

#### Box 5-3: SCDNR EDUCATION AND OUTREACH PROGRAMS

##### EDUCATION PROGRAMS

- **Alligator Seminars:** These seminars are provided intermittently and cover topics such as the current year's applicant statistics, capture and handling techniques, hunting regulations, allowable hunting equipment, processing, and other helpful information about this priority species.
- **Boater Education Program:** This program teaches basic boating safety including proper safety equipment, navigation rules, boat trailering, and preventative routine boat maintenance.
- **Camp Wildwood:** A week-long camp designed for high school students to encourage leadership skills and increase their knowledge and experience with natural resources management.
- **Carolina Coastal Discovery Program:** A cruise is conducted within the Coastal Zone aboard SCDNR's educational vessel, *Discovery*. Passengers learn about immediate areas of concern within the coastal and inland regions of South Carolina such as water quality, endangered species, and threatened habitats. When the trawl drags in an array of marine species, groups have the opportunity to discuss the biology of estuarine animals and plants with hands-on learning.
- **Certified DNR Fishing Instructor Program:** A volunteer opportunity for individuals to become trained fishing instructors to conduct Family Fishing Clinics for the agency.
- **Envirothon:** A hands-on learning experience in the form of a team competition to stimulate high school students and provide incentive to learn about their role in nature. Winners receive scholarships.

**BOX 5-3: SCDNR EDUCATION AND OUTREACH PROGRAMS (CONTINUED)****EDUCATION PROGRAMS (CONTINUED)**

- **Family Fishing Clinics:** SCDNR hosts an introductory class on fishing where skills such as how to tie fishing knots, how to rig a rod and reel, and casting are taught. Participants get to actually fish.
- **Graduate Student Guidance and Training:** This program provides logistical and staff support to state colleges and universities for graduate and undergraduate training of natural resource students.
- **Hunter Education Program:** This program provides instruction in hunter safety and techniques. Students also learn about hunting ethics, hunter/landowner relations and basic conservation and wildlife management principles.
- **Master Naturalist Program:** This program recruits volunteer citizen scientists by training them in the basics of geology, ecology, species-specific needs, and human impacts on the landscape within their ecoregion. Certification requires completion of a 12-week course plus 30 hours of volunteer service which includes 8 hours of advanced training. Housed within Clemson Extension, these courses rely on SCDNR biologists to teach parts of the courses. Copies of the SWAP are distributed to participants as the class textbook.
- **Master Wildlifer Course:** This is a Clemson Extension course designed for landowners, land managers, and wildlife enthusiasts who are interested in integrating wildlife considerations into their current land use and management activities. The latest research and management information is presented by instructors who are experts in their field. Game species are emphasized but multi-species management is discussed. SCDNR is a partner in this program.
- **Minorities in Marine and Environmental Sciences (MIMES):** This is a 12 week internship program hosted by the SCDNR Marine Resources Division on James Island, SC and funded by the National Science Foundation. The focus of this research experience for undergraduates (REU) program is to increase minority participation in marine and environmental science disciplines, in which minority candidates are underrepresented. Students engage with scientific mentors to design and complete their own rigorous individual research project, take classes, participate in field work, present their work to peers, and have the chance to meet successful minority scientists.
- **OSHER Lifelong Learning Program:** Clemson University, in partnership with SCDNR, provides a series of lectures and field trips on the natural history and status of SC habitats and species.
- **Reel Art:** Students from kindergarten through 12th grade in private, public and home schools learn about aquatic habitats and their inhabitants in an art contest held annually by SCDNR.
- **South Carolina Institute for Natural Resource Conservation:** This workshop provides hands-on studies in topics such as soils, forestry, land and water management, reclamation, wildlife, conservation leadership and career opportunities.
- **South Carolina Oyster Restoration and Enhancement Program (SCORE):** This program provides hands-on/living classroom lessons to school groups and interested citizens. The program also offers lectures and conducts workshops at coastal education centers.
- **Trapper Education Program:** This program provides information on furbearer biology, history of the fur trade, wildlife management principles, fur harvest regulations and ethical conduct.
- **Trout in the Classroom:** A partnership program with Trout Unlimited, teachers are trained on how to rear trout from eyed eggs in the classroom allowing students to explore the importance of healthy watersheds and learn about trout habitat and biology.
- **Wild Quail Management Seminar:** This 3-day seminar presents information on the latest research about quail natural history, biology, diseases and parasites, predation and other factors affecting populations. Speakers include wildlife and forestry professionals from state and federal agencies. Field demonstrations and classroom instruction will focus on habitat practices.

**BOX 5-3: SCDNR EDUCATION AND OUTREACH PROGRAMS (CONTINUED)****OUTREACH PROGRAMS (CONTINUED)**

- **SC's National Archery in the Schools Program:** This program promotes student education, physical education and participation in the life-long sport of archery (Junior Olympic style).
- **Take One Make One Program:** An outdoor education and mentoring program aimed at developing South Carolina's youth and young adults into lifetime participants in conservation, hunting, angling and shooting sports activities through conservation education and adult mentoring.
- **Youth Bass Fishing Clubs:** The South Carolina Department of Natural Resources has partnered with The Bass Federation and B.A.S. S. to encourage middle and high schools to start Youth Fishing Clubs. The agency provides an overall Youth Bass Fishing Championship each year.
- **Youth Hunts:** These hunts allow youth to have an educational hands-on experience in hunter safety and hunting techniques and exposes youth to basic wildlife management practices and hunting ethics.

**ONLINE RESOURCES**

- **Climatology (Climate for Kids):** This resource provides weather facts and summaries from past seasons as well as games and activities.
- **Geology for Teachers:** This is an earth science education series covering topics such as earthquakes, erosion, minerals, rock types and cycles, landforms, topography, geomorphology, and plate tectonics.
- **South Carolina Oyster Restoration and Enhancement Program (SCORE):** Information, lesson plans, and an online tutorial are available on the project website.

**OUTREACH EVENTS**

SCDNR participates in many events throughout the state that disseminate information and program materials that are centered around the agency's mission including the following:

**Boat shows (Law Enforcement and Clean Vessel Act)**

**Legislative Reception**

**Pee Dee Deer Classic**

**Palmetto Sportsmen's Classic**

**National Hunting and Fishing Day**

**Shooting Range Field Day**

**Southeastern Wildlife Exposition (SEWE)**

**PUBLICATIONS**

SCDNR provides many publications around all programs which includes the following:

**Brochures**

**Books**

**In-depth Reports**

**Magazine: *South Carolina Wildlife***

**Manuals**

**Newsletters (printed and emailed)**

**Websites**

**MEDIA**

**DNR YouTube channel**

**Facebook**

**RSS feed**

**Radio:** SCDNR hosts a radio show called "**Your Day**" once a month on NPR/SCETV where SCDNR staff members are on hand to discuss DNR related topics such as deer hunting, the Palmetto Sportsman's classic, Boater Safety, and species-specific information. Listeners are encouraged to call in with their questions.

**Twitter**

**Educational videos**

**BOX 5-3: SCDNR EDUCATION AND OUTREACH PROGRAMS (CONTINUED)****OUTREACH PROGRAMS**

- **Audio/Visual Programs:** All programs within the SCDNR have representatives available to provide audio/visual presentations about the goals and objectives of those programs at the request of partners, educational facilities and private citizen groups.
- **Beach Sweep/River Sweep:** In partnership with the South Carolina Sea Grant Consortium, SCDNR coordinates an annual, nationwide, one-day cleanup of inland and coastal waterways.
- **Coastal Training Program:** The CTP aims to provide science-based training to coastal decision-makers and to increase collaborative networking opportunities within the coastal area. By offering scientific information and skill-building training sessions, the CTP ensures that coastal decision-makers have the knowledge and tools they need to address resource management issues concerning local communities.
- **Fishing Rodeos:** Youth fishing rodeo events are designed to provide youth with opportunities to catch fish.
- **Fishing Tackle Loaner Program:** Several tackle loaner sites are set up around the state at various state and county parks to provide an opportunity for adults, kids, and families to try their hand at fishing.
- **Jr. Duck Stamp Contest:** This contest enables students in grades K-12 to express their feelings of natural resources through their art and increases awareness of environmental concerns in an artistic manner. There is an adult version of the contest as well (SC Migratory Waterfowl Stamp Contest).
- **Monofilament Recovery and Recycling Program:** Volunteers put up and maintain monofilament collection bins and mail the contents in for recycling.
- **Shotgun Shooting Sports:** This program promotes all three regimens of clay target shooting: sporting clays, trap, and skeet. The SCDNR has assisted this growing program by off-setting costs for shot shells and targets, as well as providing training for coaches and students in firearms safety and hunter education.

Although education and outreach may not directly contribute to the management of natural resources, these programs can assist in garnering support for environmental programs. Public support can assist in ensuring the outstanding natural resources of South Carolina are conserved for future generations. In 2005, when public meetings were held throughout the State, SCDNR discovered that the public would genuinely like to assist in protecting natural resources but that they were unsure what they could do to help. Additionally, the goals and mission of the SCDNR were unknown to some segments of South Carolina's population. Discovery of this information underscores the need for natural resource education and outreach programs throughout South Carolina. Therefore, since these meetings, the SCDNR has been attempting to improve its method of information delivery to the public through a public awareness campaign including an Open House at the Marine Resources Center in 2008 that was attended by over 1,500 citizens.

What follows are a compilation of the comments from the public meeting as well as those from the 31 participants of the two Education and Outreach Conservation Action Committee meetings that were held in 2005 with invited partners. Examples of accomplishments have been noted in italics after each Specific Conservation Action but are not exhaustive lists of what has been done by the SCDNR or its partners. Each year, the SCDNR and its partners consistently reach well over 40,000 kids and adults through the various education and outreach programs. Efforts are ongoing and future measures of success might include: the number of web-products developed or updated; number of media/outreach products developed/updated; number of reports/publications developed and distributed; number of audiences reached; number of programs given; number of

partnerships created/supported; number of programs/products produced by partners; number of in-kind support hours received; and the number of participants/volunteers reached plus the number of new volunteers attracted.

### **Specific Conservation Strategies for Education and Outreach**

- 1) Develop and enhance education and outreach programs that highlight the importance and value of the species on South Carolina's Priority Species List and their contribution to the unique natural resource diversity of this state. [Highest priority]

*In 2007, the SCDNR in conjunction with SC Educational Television, produced a major video on sea turtles. Also, when biologists wanted to attract nesting seabirds to the newly protected Bird Key island, they purchased decoys and had Horry County school children paint them as part of an education program on SC's priority seabirds. These decoys were used in other projects to successfully attract nesting seabirds and continued to be part of an educational program for school groups.*

*Professional development programs have attracted 152 teachers over the past 6 years, exposing these participants to the importance of diversity for ecosystem function. Examples of coastal programs include: ACE Basin Adventure Workshop, Seeds to Shorelines Workshop, Estuaries 101, and vessel-based training. In addition, presentations by the Wading Bird Project, for example, attracted a total of 265 attendees. Three field trips were made to an active Wood Stork rookery. In addition, the importance of conserving habitat for the following priority species was also discussed: Black-crowned Night Heron, Glossy Ibis, Little Blue Heron, Snowy Egret, Tri-colored Heron, White Ibis, Yellow-crowned Night Heron. The Shorebird Project has highlighted the interaction between priority migratory shorebird species (e.g. Red Knot) and Atlantic horseshoe crabs. A workshop entitled, "Raising Awareness of Shorebirds in South Carolina" (2012) was one such venue.*

- 2) Develop and enhance education and outreach programs that encourage land stewardship values, particularly to private landowners in priority habitats. [Highest priority]

*The Safe Harbor Program has been, and continues to be, very successful in SC as a tool to protect and manage for the Red-cockaded Woodpecker and other habitat-related species.*

*Based on the outcomes of a SWG grant, a 76-page booklet entitled, "Best Management Practices for Wildlife in Maritime Forest Developments" was published in November 2009. This document reviewed the animal species of the maritime forest with emphasis on habitat requirements for each, and special emphasis was given to species of concern. This was followed by detailed descriptions of Best Management Practices (BMPs) at the community, neighborhood, and individual home levels. Immediately after printing, 225 copies were distributed to planners and other officials of coastal communities, the Office of Coastal Resources, Coastal Conservation Association, SC Forestry Commission,*

*various DNR staff, SC Sea Grant office, SC Wildlife Federation, Coastal Conservation Association, and a number of private citizens.*

- 3) Develop and enhance education and outreach programs that inform the public about the importance of prescribed burning to benefit wildlife species. [Highest priority]

*The Wild Quail Management Seminar as well as most other management workshops produced by SCDNR or its partner, the SCFC, incorporate prescribed burning benefits into the discussion. A variety of habitat management techniques for Bobwhite Quail and other priority shrub-scrub birds are discussed in detail.*

- 4) Ensure that accurate information about priority species and their habitats is made available, both within the SCDNR and to any interested parties outside of the department. Interested parties can include state and federal agencies, academic institutions, private landowners, local municipalities, organizations and industry. [Highest priority]

*Printed copies and CDs of the SWAP are sent to academic institutions around the State as well as to our partners and anyone else requesting one. Graduate students are encouraged to review the list of “conservation recommendations” contained within each species’ account and use this as a guide when choosing a project. The Master Naturalist course participants are given a printed copy of the SWAP as part of the studied text of the program.*

- 5) In consultation with SCDNR biologists, identify “poster species” that will highlight conservation messages in each ecoregion of South Carolina. Enhance existing education and outreach programs in SCDNR to include priority species and their habitats. [Highest priority]

*A new segment in SC Wildlife Magazine will include the highlighting of “poster species” by ecoregion. A handful of priority species from each taxa will receive coverage. In addition, a new display has been created for use at various venues around the State highlighting the SWAP and State Wildlife Grants. “Poster species” that dwell in unique habitats across the five ecoregions are highlighted.*

- 6) Ensure that all SCDNR employees are working to provide education and outreach information to partners and citizens of South Carolina by doing the following: [Highest priority]

- a. Dissemination of information to partners;

*One step in this direction is the closer working relationship the SCDNR has with the USFWS based on a renewed MOU. Information sharing has been a priority with the SWG Coordinator assisting with the Mega-petition species review process as many of these species are also listed in the SC SWAP.*

- b. Cataloguing education and outreach programs in the State;

*Completed; see item 16.*

- c. Updating the website catalogue annually; and

*Updates are done on a regular basis.*

- d. Coordinating priority species education and outreach efforts throughout the State.

- 7) Promote partnerships, both in development and implementation of education and outreach programs. [High priority]

*The approach utilized in the SWG grant, “Landscape Planning for Priority Wildlife Species on Agricultural Lands (T-10-P),” was to employ three technical guidance biologists to partner with USDA staff to engage in landscape level planning for priority wildlife species on private agricultural lands. Over the course of the grant period, 248 conservation plans potentially affecting 170,359 acres in 23 South Carolina counties were written. Technical guidance biologists also delivered 47 programs for a combined audience of 2,511 people. Nine news releases promoting habitat conservation for priority wildlife species were written and submitted, 6 technical brochures on various aspects of wildlife conservation were developed, and 22 fact sheets on threatened and endangered species were completed.*

- 8) Promote volunteer participation, both in education and outreach programs as well as in data collection. [High priority]

*Citizen Science programs are always popular in our state. For example, SC citizens participate in the Clemson firefly survey, Great Backyard Bird Count, Christmas Bird Count, Project Feeder Watch, Nest Watch, Celebrate Urban Birds, Yard Map, and Swallow-tailed Kite Surveys. Additionally, SCDNR has a reliable source of volunteers for our shorebird nest counts, wading bird/rookery counts, sea turtle volunteer network, and fish tagging. SCORE program (oyster reef restoration) volunteers number over 17,000 and have attracted 173 partnerships. Volunteers that contributed to the Carolina Herp Atlas amassed a total of 16,958 occurrence records online for the Carolinas! Additionally, various links on the SCDNR’s website direct people to reporting forms for Florida manatees and bat colonies.*

*The SCDNR is seeking help from anglers targeting cobia to collect DNA samples of fish caught in 2014 for ongoing research projects. These DNA samples will be used to identify hatchery released cobia and characterize the population structure of cobia captured along our coast. Fin clip collection kits can be ordered online or anglers can donate filleted carcasses to the freezer collection program. Four drop-off locations are available.*

*Another successful volunteer effort involving voluntary participation involves 20 high-rise owners allowing Least Terns to use their pea gravel rooftops for nesting. The*

*SCDNR staff has worked tirelessly to teach owners and tenants the importance of this manmade nest substrate substitute to this priority bird species. A new brochure explaining about the birds and their habits was created for businesses with appropriate rooftops and was distributed to 25 businesses and a number of patrons. A sign was made for the windows of the buildings explaining the importance of the site.*

*A SWG grant entitled, “Using Citizen Science in the Study and Conservation of Breeding Painted Buntings” assessed the effectiveness of this technique on a priority species of concern. A total of 1,379 Painted Buntings were captured and banded in South Carolina. An internet-based reporting system for the reporting of sighted birds was developed, and reporters were recruited using workshops, short newspaper articles, word of mouth, and through the website. Volunteers were encouraged to report sightings of birds—banded and un-banded—to the website. Following banding, 34,705 reports of Painted Buntings, banded and un-banded, were received at the website, demonstrating a high rate of interest in the process.*

- 9) Create a map that identifies locations of South Carolina’s priority species and their habitats and distribute the map to all natural resource education and conservation entities. [High priority]

*The revealing of specific locations of some species of concern is sometimes problematic as there is often a threat of vandalism to den sites, caves, or other habitat features required by these species. Sometimes the species themselves are in danger of being collected. In some cases, element of occurrence records are unavailable for some species, especially plants. In an effort to provide useful information on the potential location of priority species and habitats, GAP analysis was used to create maps of each ecoregion (see Chapter 4). An associated spreadsheet listing all of the species of concern and their potential habitats provides the best approximation of their occurrence. In addition, each species is discussed in detail in a species or guild account found in the Supplemental Volume: Priority Species, and range maps or specific locations are often included. Also, Chapter 4 contains a focus area map of where the SCDNR is focusing its efforts on priority habitats and species throughout the State. An interactive map is in production for the SWAP website.*

- 10) Create a database that contains available data and information for the species on our priority list and their habitats. Ensure that this database is available through the SCDNR website. [High priority]

*The current biological database system has been evaluated and is being revised. Much depends on the new computer program we hope to acquire. In addition, the SCDNR will implement a requirement that recipients of any SWG funding must submit a copy of their data (shapefiles, point locations, etc.) to the main database for storage and querying as needed by approved users. Sensitive data will be protected as needed. Chapter 6 of this SWAP discusses database needs as it relates to the SCDNR Monitoring Program.*

*SCDNR also has a GIS Data Clearinghouse. In addition, we participate in/link to the USGS Bat Population Database for the United States and Trust Territories.*

*In addition, a SWG grant allowed for the creation of a novel web-based South Carolina Stream Conservation Planning Tool that enables a spatially explicit understanding of how human activities affect the biological condition of wadeable streams, intended to support decisions about aquatic conservation actions. The Oracle-based system is composed of a searchable database for data input, editing, and analysis.*

- 11) Develop and enhance education and outreach programs that inform the public about the detrimental impacts of litter on priority species. [Moderate priority]

*The annual River/Beach Sweep sees between 6,000 and 3,000 volunteers per year. SCDNR staff members also visit schools to do presentations on the dangers of litter to both terrestrial and aquatic wildlife and their habitats. The fishing line recycling program has been heavily promoted as well. Most workshops include the topic of the impacts of litter on wildlife and habitats.*

*An outreach program was initiated as part of SWG grant T-56-R to inform the public and fishermen about the risks of abandoned crab traps to marine life such as SWAP priority fish, blue crabs, and diamondback terrapins. An online survey was created so that the public could report abandoned crab traps to aide in their removal from coastal waterways. The reef systems created from the old refurbished traps have become demonstration areas for the public with documented use by at least 46 marine species, 18 of which are listed within the SWAP (or former CWCS) as a priority.*

*The SWG Coordinator presented a PowerPoint presentation to kindergarteners at Laurel Hill Primary School in Mt. Pleasant, SC on the American alligator, a priority species, as well as other related reptile species. A lesson on litter impacts on wildlife was incorporated into the discussion.*

- 12) Educate motor vehicle operators of the negative effects of crossing streams at multiple locations and using stream bottoms as trails. [Moderate priority]

- 13) Develop and enhance programs that educate fishermen about employing correct techniques for capture and release of marine mammals, fish, and invertebrates and programs that emphasize the importance of reporting ship strikes and entanglements to authorities. [Moderate priority]

*In 2008, the SCDNR successfully implemented a stakeholder process to acquire public input, build public support, develop legislative recommendations, and implement regulation changes to protect, enhance, and recover the Santee Cooper Striped Bass population.*

*The SCDNR Marine Division developed a campaign including a brochure on how to catch, handle and release large fish, like tarpon, to improve their chances of survival.*

*Staff assisted crab fishermen on new rules related to weak-link releases for their buoy lines to facilitate escape of entangled marine mammals. A campaign was begun to encourage hook and line fishermen to use “circle hooks” to reduce mortality of caught and released fish. Training was conducted for recreational fishermen who voluntarily catch and tag fish. This included methods for handling fish with minimal damage. SCDNR continues to promote “cull in place” for both commercial and recreational oyster harvesters. This minimizes unnecessary loss of oyster shell from the natural habitat. The Division has conducted research and provided information on the use of turtle excluder devices in crab traps to prevent capture of diamondback terrapins. The Division also headed up a program to recycle fishing line that otherwise might have been discarded into the water to potentially entangle animals.*

- 14) Utilize a variety of methods for information dissemination including:  
[Moderate priority]

a. Printed materials

*The SWAP is available as a printed document, a CD, and an online pdf file. The South Carolina Wildlife Magazine regularly publishes articles on priority species and their habitats. The SWAP is also distributed to participants in the Master Naturalist program as the accompanying textbook. The Freshwater Fisheries section developed and printed the Fish Species of Concern Coloring Book (2009) which can also be found online at <http://www.dnr.sc.gov/aquaticed/pdf/SCFishesofConcernColoringBook.pdf>.*

*Various feature articles in South Carolina Wildlife Magazine have introduced some of the State’s species of concern to over 50,000 subscribers as a way of informing the public about the threats faced by these species and their habitat requirements. Examples include diamondback terrapins (May-June 2009), Swallow-tailed Kites (May-June 2011), freshwater aquatic species (September-October 2011), and diamondback rattlesnakes (September-October 2012). A short article in the magazine’s Roundtable section (May-June 2004) highlighted the importance of the Plan and its present status, while another article (May-June 2012) on bat roosting towers demonstrated how SWG funding was used to provide habitat for state endangered Rafinesque’s big-eared bats. A special magazine supplement entitled, “Treasure Our Wildlife—Plan to Keep Them” (September-October 2005) came out after completion of the first edition of the Plan and explained its purpose and highlighted species that would benefit from future SWG funding.*

*In an effort to better inform the public about the various roles of SCDNR’s divisions, the South Carolina Wildlife Magazine began running a series highlighting each division and important aspects of the jobs housed in each. For example, the magazine started with the Law Enforcement Division and has since rotated through Marine, Freshwater Fisheries, Wildlife Management, and other divisions. This will become a standard feature of the magazine from this point*

*forward as we try to inform South Carolina's citizens about the nature of the Agency and the work that we do to protect and manage species and their habitats.*

*In the 2005 version of the SWAP (CWCS), we recommended the creation of a Wildlife Initiative Newsletter. We have decided to incorporate this idea into the existing South Carolina Wildlife Magazine as a new bi-monthly feature that will highlight a species of concern and what the public can do to help mitigate threats to the species. This "What you can do to implement the Plan" feature will help engage the public in the management process.*

*Other printed material distributions include brochures and bumper stickers. For example, over 500 of these materials were distributed in 2013 for the SCORE program alone.*

*SCDNR strives to not only inform the public about conservation issues but also motivate them to get involved with resolving conflicts. At the 30<sup>th</sup> Annual Palmetto Sportsman's Classic, a one-page flyer entitled "What You Can Do to Help Implement South Carolina's State Wildlife Action Plan" was distributed at the SWAP booth that listed specific actions citizens could take that would improve the welfare of both priority species and their habitats. Annually, the Classic hosts over 35,000 visitors.*

b. Websites; social media

*The SCDNR posts stories and news releases to its website and Facebook page as well as its Twitter account. The SWAP is web-enabled and can be found online as a single PDF file or by chapters. The Supplemental Volume is also available in pdf format for each species/guild account. Information on the State Wildlife Grants Program and related documents are also housed on this site. The link can be found at <http://www.dnr.sc.gov/cwcs/index.html>.*

*The Freshwater Fisheries section compiled information and photographs for nongame fish description web pages which are currently in development. Also, the Blackwater River Guide and associated interactive Powerpoint were created: <http://www.dnr.sc.gov/education/pdf/BlackwaterInteractivePoster.pdf> and <http://www.dnr.sc.gov/education/pdf/BlackwaterRivEdGuide.pdf>.*

*We have added a link to our website for the Battle For Bats video produced by USFWS and USFS (through Ravenswood Media) highlighting WNS. See <http://www.dnr.sc.gov/wildlife/batswns.html>.*

c. Formal or informal education/outreach programs

*Although some popular programs were dissolved due to budget cuts, new ones have taken their place. For example, the Trout in the Classroom program deals directly with the Brook Trout, a species of concern in SC, and has 36 schools now participating. The Trapper Education Program has been held 6 times since 2006*

*with a total attendance of 95. Priority species such as the mink and spotted skunk were discussed. In addition, 18 Alligator Seminars have been conducted since 2008 attracting 1,385 total attendees.*

d. Updates to existing education curricula

*Updates that include the latest scientific information can be found at such sites as the Climatology website, Geology for Teachers, and the SCORE program module.*

e. Demonstration sites

*SCDNR continues to work with Clemson University to create demonstration sites within Clemson Experimental Forest for habitat enhancement. Landowner tours are often given here. All Wildlife Management Areas are “outdoor classrooms” where hunters and other wildlife enthusiasts can see effective management techniques in action. The Marine Center also did a demonstration project where they installed a rainwater recovery cistern and irrigation system. Artificial reefs created through refurbishing crab pots are considered demonstration areas for the public.*

f. Landowner workshops

*The Wild Quail Management Seminar focuses on providing habitat for Bobwhite Quail, a priority species, as well as a myriad of other shrub-scrub and grassland species. Since 2005, over 100 participants have gone through the program.*

g. Media

*The September 2013 e-newsletter for the Southeastern Section of The Wildlife Society released a status report on the revision process for South Carolina’s SWAP. This informative newsletter reaches a vast majority of our partners across the State and nation.*

*A new radio talk show, “Your Day” airs on National Public Radio once a month and conservation topics are discussed. Listeners are encouraged to call in with their questions. Often, the topic of priority species and the SWAP is raised (e.g. Stream Team’s freshwater fish surveys, bear hair snare DNA research, etc.).*

- 15) Develop and enhance education and outreach programs that discourage stocking, release, and transplanting non-native animal and plant species throughout South Carolina.

[Moderate priority]

- 16) Develop a catalogue of all natural resources education and outreach programs offered in South Carolina, including educational curricula. This catalogue will include a description of program/curricula content and contact information for the person(s) responsible for

program development and implementation. The catalogue should be updated annually and made available on the SCDNR website. [Moderate priority]

*Users of the SCDNR website have more than tripled since 2002 with annual increases still occurring. In an effort to reduce printing costs and since many people now look first to the Internet for information, an online version of the catalogue described above has been created and can be accessed at <http://www.dnr.sc.gov/education/contacted.html>. A second tab on the website directs the user to a more detailed description of each program: <http://www.dnr.sc.gov/education/environed.html>.*

## **CONSERVATION ACTION AREA 2: Habitat Protection**

Habitat protection has been identified as one of the most important actions to assist in the protection of South Carolina's priority species by SCDNR biologists, species experts, and attendees at the public information meetings held throughout the State (for a thorough discussion of these meetings, see Chapter 7). The importance that the SCDNR places on habitat protection for the benefit of South Carolina's wildlife is evident in the many programs currently in place at the SCDNR and in the partnerships SCDNR has forged with other state and federal agencies, organizations, academic institutions, and industries. A list of the SCDNR habitat protection programs and partnerships is presented in Box 5-4.

Historically, species conservation and management efforts have been employed to address single species to the exclusion of others occurring in the same habitat. The SCDNR, however, has recognized the importance of employing habitat- or ecosystem-based conservation. By focusing on whole habitats or ecosystems, we are able to protect several species in a more cost-effective manner. Since 2005, the SCDNR has gained an additional six properties totaling 1,338 ha (2,306 ac.) of property which is under wildlife management. Loss and fragmentation of habitat have been identified as major threats to many of the species included in South Carolina's SWAP.

#### **BOX 5-4: SCDNR HABITAT PROTECTION PROGRAMS**

- **The Heritage Trust Program:** The purpose of this program is to inventory, evaluate, and protect the elements considered the most outstanding representatives of South Carolina's natural and cultural heritage.
- **Forest Legacy Program:** The purpose of this program is to identify and protect environmentally important forest land from conversion to non-forest uses through the use of conservation easements and fee-simple purchases.
- **Focus Area Program:** The purpose of this program is to conduct landscape-level conservation efforts that include private lands. There are 12 habitat conservation focus area task forces in South Carolina; these are operated through the Atlantic Coast Joint Venture. Further description of the Focus Area Program is provided below in the discussion of the ACE Basin Project.
- **ACE Basin Project:** The first of the SCDNR's Focus Areas, the ACE Basin Project is a unique partnership of state and federal governmental representatives, nonprofit conservation organizations, and private landowners that works to maintain the natural character of the Basin by promoting wise resource management and continuing traditional uses with improved public access. While encouraging traditional land uses such as agriculture, timber production, hunting, and fishing, the overall management goal is to maintain the area's ambiance while restricting industrial and resort development. To date, well over 660,191 acres in the Basin have been protected through conservation easements, management agreements, and fee-simple purchases by the SCDNR and its partners.
- **Scenic Rivers Program:** The goal of this program is the conservation of South Carolina's river heritage through the proper management of the natural and cultural character of the State's river corridors. This program has the purpose of protecting "unique or outstanding scenic, recreational, geologic, botanical, fish, wildlife, historic or cultural values" of selected rivers or river segments in the State.
- **The South Carolina Conservation Bank Act:** This act preserves the most significant natural and historic lands in our state by either purchasing the land outright or buying conservation easements from willing sellers. Dedicated funding is provided for the protection of wildlife habitat, parks, greenways, prime farmlands, historic sites, wildlife habitat, and other biologically sensitive areas in the State. Funds come from a percentage of South Carolina's deed-recording fees, which are collected when real estate is sold in the State. A volunteer board made up of conservationists, sportsmen, scientists, and business leaders from across the State oversee the disbursement of grants to protect land. The SCDNR acts as an advisor to this Board.
- **National Estuarine Research Reserve System:** In partnership with the National Oceanic and Atmospheric Administration, the SCDNR helps communities develop strategies to deal successfully with coastal resource issues including habitat restoration.
- **South Carolina Land Trust Network:** The SCDNR is a member of this network which facilitates the preservation of the natural and cultural character of South Carolina through the exchange of information among land trusts. The network creates awareness and seeks support of the general public to conserve natural resources of the State.
- **Beach Sweep/River Sweep:** In partnership with the South Carolina Sea Grant Consortium, the SCDNR coordinates an annual, nationwide cleanup of inland and coastal waterways.

There are many ways to prevent habitat loss and reduce the effects of past losses and fragmentation. One of the most expensive conservation tools is land acquisition; further land acquisition is frequently driven by land availability, not by what is required for high priority species. Acquiring land, however, is likely the most beneficial method of ensuring wildlife and habitat protection. Conservation easements are also extremely beneficial for habitat protection. It is imperative that the SCDNR continue to partner with other agencies and organizations to acquire and manage lands that are available for conservation.

Statewide acreages in conservation now total 469,392 acres state-owned, 990,443 federal, 671,900 private (land trusts and other organizations), and 91,235 military. By ecoregion, this equates to 57% of the Blue Ridge being of conservation status, 6% of the Piedmont, 14% of the Sandhills, 10% of the Coastal Plain(s), and 29% of the Coastal Zone. This equals 11% of the total ~2,219,777 conservation acres.

Even if the SCDNR or its partners do not own lands, there are ways of protecting habitats. Coordination of wildlife goals and strategies during land planning processes and the ability of SCDNR to review development and environmental impact plans for relevance to priority species can also assist in protecting habitats. An ever-present theme throughout the SWAP, education and outreach is imperative in the protection of the State's habitats.

Some of the following recommendations are ongoing within the Department while others have recently been implemented; still others have simply been proposed. Future measures of success might include: the number of acres acquired or protected across the State by SCDNR and its partners; number of long-term cooperative habitat protection projects; number of completed site inventories; number of acres or sites restored and species/population response to the restoration; improvements in measures of diversity/species composition; number of acres prescribe burned; number of miles of streams restored; percent decrease in non-native invasive species; measures of water quality improvements; number of BMPs developed; percentage of recommendations implemented; number of plans or permits commented on; number of site visits; number of threats mitigated; percent increase in priority species and habitats; amount of technical guidance given; number of data exchanges; percentage of a watershed in protection; percentage of a given ecoregion or habitat type protected; number of programs developed; and the number of individuals trained.

### **Specific Conservation Strategies for Habitat Protection**

- 1) Acquire property for the protection of priority species and to ensure habitat linkage through fee-simple acquisition and conservation easements covering all priority terrestrial, freshwater aquatic, estuarine, and marine habitats outlined in Chapter 4 of this Plan.  
[Highest priority]

*The SC Forest Legacy Program is used extensively to provide funding for land purchases. Many corridor projects such as along the Catawba River have been made possible through a commitment to purchase riparian habitats of high conservation value for priority species. A wide variety of priority habitats have been protected across the*

*State from hammock islands along the coast to rock outcrops in the mountains, totaling 75,866 acres to date. Relevant to the SWAP, the purchase of Belfast Plantation Phase II was made possible in part through a SWG grant meant to protect priority habitats and their associated species.*

- 2) Continue to partner with private entities and other state and federal agencies to acquire land for habitat protection. Develop additional partnerships for land acquisition. [Highest priority]

*Appendix 3 lists the over 480 partners of the SCDNR. Many of these are active partners in the protection of lands within our focus areas which often overlap with theirs.*

- 3) Restore and enhance impaired habitat, where feasible and cost-effective. Habitat enhancements include:
  - a. Encourage nest/roost site retention/restoration
  - b. Employ prescribed burning
  - c. Restore natural stream courses and flows
  - d. Eliminate or reduce invasive and non-native species from habitats
  - e. Replant native plants
  - f. Wetland restoration

[Highest priority]

*Restoring and enhancing priority habitats across the State are ongoing tasks of the SCDNR and its partners. Recent projects of note include the SWG grant entitled, “Restoration of Longleaf Pine Forests on State-Owned Lands” (T-11-1-R), whose objective was to restore longleaf pine forests and associated herbaceous species on a minimum of 1,000 acres of state-owned lands using prescribed burning, selective herbicide treatments, and the planting of longleaf pine. The total longleaf habitat improvement ended up totaling 1,510 acres with new longleaf pine stands established on 1,135 acres. Several other grants have also been used to fund prescribed burns throughout the State as well as habitat restoration. Several thousand acres of upland habitats, such as grasslands, pine savannahs, and pine woodlands, were restored at Lewis Ocean Bay Heritage Preserve thanks to another SWG grant.*

*Prescribed burning in the mountains has resulted in better habitat for priority species and a 20% increase in their numbers (mainly birds).*

*Habitat restoration and enhancement efforts have also been conducted on North and South Williman Islands where tidal estuarine marshland and interspersed hammocks predominate. Feral goats (100) and Chinese tallowtree (~5,000) were removed while wood duck boxes were erected and native sweetgrass planted to enhance the native habitat. Other coastal areas have undergone marsh restoration through volunteers helping SCDNR biologists plant *Spartina*.*

*Bird Key was designated as a Seabird Sanctuary in March 2006 because of its importance as a seabird nesting island and the need to protect it from human*

*disturbance. Additional nesting islands have been protected from disturbance since that time. Islands that had become too overgrown for seabird nesting have been cleared. This includes 2 recent site restorations covering 5 acres.*

*Islands where Brown Pelicans nest often become infested with avian ticks. Spraying has been used to improve colony health (2004-2011). Targeted trapping of seabird predators such as mink has been utilized as well.*

*In 2007, the Indian Creek Wildlife Habitat Restoration Initiative was formed and involves the SCDNR, other governmental agencies, conservation organizations, and private landowners to restore and improve grassland habitats on approximately 16,000 acres statewide.*

*Over the last 5 years, the Oyster Shell Recycling program has collected an annual average of 21,000 bushels of recycled oyster shells for use in new oyster reef construction. During the same period, SCDNR replanted an average of 75,000 bushels of shells each year along SC's intertidal shorelines. These reefs provide structure and habitat for 26 priority species and a myriad of other marine species. Other types of artificial reefs are constructed along SC's coast at the average rate of 14 per year. The SCORE program received the Captain Pride award in 2013 from Charleston County's Community Pride, Inc. This award is given to the top 10 individuals, businesses, governments, or civic organizations that have undertaken tasks that have significantly improved the environment.*

*The SCDNR, in consultation with the NPS and SC Audubon Chapter, has been retrofitting Ft. Sumter and Ft. Moultrie with native plants for butterflies, which are important pollinators for priority plant species and members of the food web for many priority vertebrate species.*

- 4) Promote the importance of habitat protection and participation in conservation easement programs through education and outreach presentations. [Highest priority]

*SCDNR holds easements on over 23,000 acres across the State. However, many more tracts are in conservation easements through partners and private landowners. The Agency encourages all landowners of significant land holdings to consider long-term protection of the resources therein.*

- 5) Partner with other state and federal agencies, to promote habitat protection and provide technical support to private landowners. [Highest priority]

*Farm Bill programs are advertised and promoted by SCDNR staff for the Natural Resource Conservation Service (NRCS) to fund and implement the SWAP as well as benefit common species.*

- 6) Develop and implement protective Best Management Practices (BMPs) for habitats and land uses throughout South Carolina. [Highest priority]

*Best Management Practices were developed for sustaining wildlife in the Maritime Zone of South Carolina. This was accomplished through a SWG grant and resulted in a 76-page booklet that reviewed the animal species of the Maritime Forest with emphasis on habitat requirements for each, and special emphasis was given to species of concern. This was followed by detailed descriptions of BMPs at the community, neighborhood, and individual home levels. This document was given to local coastal community planners and officers, the SC Forestry Commission, non-governmental conservation organizations, and several private citizens.*

*The marine division partnered with private businesses in a non-regulatory program to encourage Best Management Practices at marinas and boat yards. Bathrooms and pump-out facilities were also provided to protect water quality.*

- 7) Participate in development and review of environmental plans (including FERC relicensing projects) to ensure appropriate habitat protection. [Highest priority]

*SCDNR routinely provides an average of 80 comprehensive environmental reviews per year to a variety of entities. These include environmental impact statement reviews, FERC relicensing projects, and others. SCDNR also assisted with the completion of the SC State Water Assessment, 2<sup>nd</sup> ed.*

*Two research projects undertaken by the Freshwater Fisheries section include “Twelve-mile Creek Monitoring of Dam Removal Effects” as well as “Developing Guidelines for the Effects of Sediment in the Broad River Basin.”*

*The Marine Resources Department of SCDNR wrote an assessment of wind energy, military maneuvers, and other human activity on sensitive maritime species and habitats (2011).*

- 8) Mitigate habitat threats that are caused by human practices such as entanglement in fishing gear, by-catch, boat strikes, dredging, chemical exposure, tower strikes, powerline strikes, nest disturbance, boat wakes, artificial light sources, and dewatering of streams. [Highest priority]

*South Carolina has had Turtle Excluder Devices (TEDs) on its shrimp fleets for many years. By-catch Reduction Devices (BRDs) are also used. Diamondback terrapin excluders are now being tested for use on crab pots to limit accidental drownings.*

*One mitigation accomplishment at Donnelley WMA was getting SCANA line crews to widen the power line conductors and install bird diverter devices so that wading birds like the Wood Stork could not get electrocuted. Since these changes have been implemented, no more fatalities have occurred.*

*Every year the SCDNR ropes off 10 beaches that are shorebird and seabird nesting hotspots and posts signs to keep dogs and people off the beaches. Three nesting islands have subsequently been given “sanctuary” status.*

*In addition to the shorebird nest site protection programs, the coastal “Lights Out for Loggerheads” initiative to protect hatchling sea turtles is still going strong, and bumper stickers can be seen on many coastal vehicles. Local ordinances have been put into effect to limit light pollution and obstructions on the beach. A list of these ordinances can be seen at <http://www.dnr.sc.gov/seaturtle/volres/ordinances.pdf>.*

*Another mitigation measure involves diadromous fish passages for American Eels, American Shad, and Blueback Herring as well as spawning and restocking programs for Striped Bass, Robust Redhorse, American Shad, and Red Drum.*

*Abandoned (ghost) crab trap recycling has been successful in repurposing these traps as structures used in oyster habitat enhancement efforts.*

- 9) Encourage city, county and state planning entities to consider habitat protection in all development projects. [Highest priority]

*Many local beach communities have consulted with SCDNR staff to minimize development impacts on native wildlife species. (See also BMPs for Maritime Zone mentioned in item 6.)*

- 10) Where possible, manage wildlife species and promote habitat protection on an ecoregions-wide and/or watershed-wide scale. [High priority]

*Already, 49.41% of the State’s basins are protected. The breakdown is as follows:*

<b>River Basins</b>	<b>Basin Area (ac.)</b>	<b>Basin Area (ha)</b>	<b>Conservation Area (ac.)</b>	<b>Conservation Area (ha)</b>	<b>% conserved</b>
ACE	5,239,572	2,120,379	660,191	267,170	12.6
Pee Dee	5,027,500	2,034,557	347,032	140,439	6.9
Savannah	2,942,779	1,190,901	624,064	252,550	21.21
Santee	6,770,046	2,739,740	589,108	238,404	8.7

*As new suitable habitat is located on public and private lands, some relocations have been conducted for the following priority species: Red-cockaded Woodpecker, mink, gopher tortoise, and Eastern diamondback rattlesnake. A new initiative to restore diamondback terrapins to vacant habitat is also being evaluated through a new SWG grant.*

*GIS modeling is being done for landscape-scale restoration projects and corridor creation. One study in particular looked at satellite images that revealed past alterations of the habitat to anticipate what restoration efforts would accomplish when the landscape was returned to its unaltered state.*

- 11) Continue to partner with private entities, private landowners, and other state and federal agencies to protect riparian areas from degradation. [High priority]

*Whenever SCDNR is involved in Forest Stewardship Plans, Streamside Management Zone recommendations are wider than those commonly used by the timber industry. The result has been more private and corporate landowners understanding the value of wider buffers for aquatic and terrestrial life forms.*

- 12) Continue SCDNR participation in Emergency Response training programs to ensure that the SCDNR has the most current information on planning logistics and technology for dealing with coastal oil and hazardous material releases, as well as the most effective program to deal with the aftermath. [Moderate priority]

*SCDNR coastal staff took an oil spill assessment course in 2010. Additional courses will be conducted as needed in conjunction with DHEC and the US Coast Guard. SCDNR's role in responding to spills is defined in the Oil and Hazardous Materials (HAZMAT) Spill Guidance document.*

### **CONSERVATION ACTION AREA 3: Invasive and Non-Native Species**

There are an estimated 50,000 non-native species in the US (Pimentel et al. 2005), although of that 4,300 are considered invasive (Corn et al. 1999), and the number is steadily increasing. Many of these represent serious threats to agriculture, horticulture, or forestry. Other non-native species are more likely to impact natural communities and individual populations of native wildlife species. Some estimates suggest that 90% of introduced species have resulted in detrimental effects on native wildlife (Hutchins 2011). Approximately 42% of the species listed as Endangered or Threatened under the federal Endangered Species Act are significantly impacted by invasive exotic species (Pimentel et al. 2005). On a national basis, the economic losses and environmental damage caused by exotic species total approximately \$120 billion per year (Pimentel et al. 2005). One survey of managers of 430 national wildlife refuges indicated that 80% of the refuges recognized problems with invasive exotic organisms. Refuge managers reported more than 790 invasive organisms, including 507 non-native plants, 208 non-native animals, and 76 plant and animal diseases (Simonson et al. 2004).

Invasive and non-native species constitute a significant threat to South Carolina's biological diversity. Many native species are declining due to increasing competition or habitat degradation from invasive and non-native species of plants, animals, and pathogens. A list of those known to be located in South Carolina and making a marked impact is presented in Box 5-5. Additional terrestrial and aquatic plant species are listed in Appendices 5 and 6. Some species are still being assessed for their impact severity to South Carolina's ecosystems and include English ivy, mimosa, the Asian jumping worm (*Amyntas agrestis*), Green Sunfish, South American cactus moth, kudzu bug, Chinese mystery snail, nine-banded armadillo, Mediterranean gecko, Ranavirus, Snake Fungal Disease (*Ophidiomyces ophidiicola*), Chytridiomycosis in frogs (no records in SC yet), black gill disease in shrimp, and Lymphoproliferative Disease Virus (LPDV) in turkeys. Sometimes the origins of an invasive are unknown as in the case of the pathogens that cause Oak Wilt, LPDV, and Amphibian Chytrid Fungus (Chytridiomycosis); they could be naturally occurring or introduced from abroad.

In addition, native plants and pathogens can become a nuisance when their populations increase above normal levels. Examples include native varieties of *Baccharis* sp. (plant) clogging coastal landscapes and the raccoon roundworm crossing the species boundary to infect the Eastern woodrat, a priority species in SC. Additional species—both native and non-native—affecting forest health in South Carolina can be found on the SC Forestry Commission website at <http://www.state.sc.us/forest/fra-pro.htm>.

**BOX 5-5: INVASIVE AND/OR NON-NATIVE SPECIES KNOWN TO THREATEN SOUTH CAROLINA’S NATIVE WILDLIFE & HABITATS**

**ANIMALS**

Aquarium/Ornamental Fish  
 Asian Clams  
 Asian Tiger Shrimp  
 Blue Catfish  
 Cactus Moth  
 Charrua Mussel  
 Common Carp  
 Feral Cats  
 Feral Dogs  
 Feral Hogs  
 Flathead Catfish  
 Green Mussel  
 Gypsy Moth  
 Green Porcelain Crab  
 Hemlock Wooly Adelgid  
 Indo-Pacific Lionfish  
 Island Apple Snail  
 Red Bay Ambrosia Beetle  
 Red Imported Fire Ant  
 Red Swamp Crayfish  
 Rapana Whelk  
 Zebra Mussel

**DISEASES**

*Anguillicoloides crassus* (eel swimbladder parasite)  
 Avian Vacuolar Myelinopathy (AVM)  
*Bonamia* spp. (in oysters)  
 Chestnut Blight  
 Dutch Elm Disease  
 Laurel Wilt Disease (via Red Bay Ambrosia Beetle)  
 Sudden Oak Death (SOD)  
 West Nile Virus (WNV)  
 White Nose Syndrome (WNS)

**AQUATIC PLANTS**

Alligatorweed  
 Brazilian Elodea  
 Common Reed (Phragmites)  
 Crested Floating Heart  
 Giant Salvinia  
 Hydrilla  
 Invasive Red Alga  
 Mediterranean Clone  
 Water Hyacinth  
 Water Lettuce  
 Water Primrose

**TERRESTRIAL PLANTS**

Autumn Olive  
 Asian Wisteria  
 Beach Vitex  
 Chinaberry  
 Chinese Privet  
 Chinese Tallowtree  
 Chinese Wisteria  
 Cogongrass  
 Japanese Honeysuckle  
 Japanese Privet  
 Japanese Stilt Grass  
 Kudzu  
 Multiflora Rose  
 Russian Olive  
 Thorny Olive  
 Wart Removing Herb

Invasive and non-native species that do not directly harm wildlife species can do so indirectly by reducing or eliminating food sources for those species. For example, gypsy moths can eliminate mast for birds and mammals. An exotic forest pest in the Blue Ridge Ecoregion of South Carolina, the hemlock wooly adelgid, is causing the decline of hemlock populations; loss of

streamside hemlocks can result in water temperature increases which negatively affect such priority species as Eastern Brook Trout. Feral cats kill wildlife such as songbirds, small mammals, and herpetofauna directly and kill indirectly by passing toxoplasmosis on to humans and wildlife (Hutchins 2011). Feral pigs disturb sensitive habitats with their wallowing and rooting behavior and compete directly with native wildlife for food resources.

As the climate changes, so too will species ranges, making it more difficult to determine what was introduced versus what arrived here on its own. The definition of “exotic” may evolve over time to encompass these new arrivals as they become part of the local ecosystem. [Hutchins 2011]

Impacts from non-native invasive species have been documented in South Carolina, and control measures have been implemented to address these impacts. SCDNR is currently working to control invasive aquatic plant species in lakes and rivers throughout the State. Further, SCDNR has partnered with other organizations to investigate ways to reduce invasive and non-native species in South Carolina. Future measures of success may include: the percentage of non-native/invasive species populations decreased or eliminated; number of areas surveyed; number of species/populations located; number of individuals removed; identification of causal factors in population change; number of species protocols established; number of media/outreach products on the subject created and distributed; number of programs given; number of audiences reached; number of volunteers utilized; number of partnerships developed; and number of MOUs developed.

### **Specific Conservation Strategies for Controlling Invasive and Non-native Species**

- 1) Prevent the spread of existing invasive and non-native species, eliminating them, where possible. [Highest priority]

*SCDNR staff and partners actively search for non-native, invasive species on select properties. For example, since 2005, 328 small coastal islands have been surveyed for invasive species.*

*Every year, SCDNR practices aquatic weed control on approximately 2,700 acres of management lands. Santee Cooper sprays an additional 2,500 acres, especially for crested floating heart. SCDNR utilizes triploid (sterile) grass carp in Lake Greenwood and elsewhere for hydrilla control. An average of 455 state acres per year is treated for phragmites.*

*As was previously mentioned in the Habitat Protection section above, 100% of feral goats and 90-95% of Chinese tallowtree infestations have been removed from several hammock islands in the North Williman Island complex in Beaufort County, SC.*

*According to Clemson University, South Carolina has scattered populations of cogongrass, 9 of which are active and 8 are inactive but monitored. The Cogongrass Task Force is an integral partner in monitoring and eradicating this highly invasive species.*

*In the mountain ecoregion, native rhododendron and other off-site species have taken over some sensitive habitats. With a determined effort by the SCDNR, 4,000 acres have been converted to more appropriate covertypes within our Wildlife Management Areas. Kudzu and royal paulonia (tree of heaven) have been eradicated from 6 sites. A protocol was developed for hemlocks, and 2 large stands of Carolina hemlock and 4 stands of Eastern hemlock were chemically treated for hemlock wooly adelgids. Predatory beetles (40,000), both *Sasjiscynmus tsugae* and *Laricobius nigrinus*, were used at 30 other sites as a biological control agent on a landscape level, but they were not as effective as the chemical treatments.*

*Along SC's beaches, the SCDNR's partner, the Beach Vitex Task Force, has been able to successfully contain 99% of the known population of this invasive dune species and has helped local municipalities draft ordinances to keep it from being replanted. Educational videos, signs, and pamphlets have been distributed to reach a wide audience. Two site visits per year are conducted by SCDNR staff to monitor for vitex re-infestations.*

*In 2008, the SCDNR provided early detection and rapid response strategies that were used in a cooperative effort to successfully control the spread of the highly invasive Island Apple Snail in Horry County and a toxic algae problem in Aiken County.*

- 2) Determine the impacts of invasive and non-native species on South Carolina's priority species and habitats used by those species. [Moderate priority]

*We know from past research the harmful effects of pasture grasses like fescue on rabbit fecundity when consumed by females as well as the mat it forms thus hindering quail chicks as they try to move through it. Sea turtle hatchlings can get tangled in beach vitex, while Chinese tallows can become a monoculture that deters native songbirds from nesting in these habitats. Research on coastal islands in SC has proven that feral hogs can destroy over 90% of sea turtle nests in one season and destroy sensitive habitats with their rooting behavior. We are also aware how detrimental the importation of species can be in the transmission of diseases to native populations. One control method, for example, has been the certification of shellfish to reduce the risk of *Bonamia* spp. infections. Continued research will reveal even more interactions and lead us to make better cases for the removal of invasive species across the landscape.*

*The SCDNR collaborates with the Southeastern Cooperative Wildlife Disease Study (SCWDS) on periodic updates for feral swine population distribution and/or density as well as with the Animal and Plant Health Inspection Service (APHIS) on feral swine disease profiles.*

- 3) Strive to prevent the importation of additional invasive and non-native species to South Carolina. [Moderate priority]

*Already, some plants are illegal to import and sell in SC such as the popular red cultivars of cogongrass, Japanese Blood Grass and Red Baron, as they can revert back to the green wild type. In addition, SC law states that it is unlawful for a person to import,*

*possess, or transport for the purpose of release or to introduce or bring into this State any live wildlife from a long list of species. A new law passed in 2012 prohibits the intentional release any aquatic species, regardless of the stage of its life cycle, into the waters of this State without a permit from the department.*

*It is also unlawful to use any non-indigenous fish as bait that is not already established in the water body being fished except for a short list of minnow species specified in the law. A person may not possess, sell, offer for sale, import, bring, or cause to be brought or imported into this State or release anywhere in this State detrimental species (e.g. piranhas and freshwater electric eels). Beneficial triploid grass carp stocked in public lakes are protected from take as they are used in the eradication of noxious aquatic weeds.*

- 4) Develop and conduct an education and outreach campaign to raise awareness of the impacts of introducing non-native species into South Carolina. [Moderate priority]

*The SCDNR partnered with the University of South Carolina and NRCS (USDA) to produce a video on the environmental impacts of Chinese tallowtree and appropriate eradication techniques. Additionally, an article on Chinese tallowtree appeared in South Carolina Wildlife Magazine in 2012, explaining its negative impacts on wildlife and habitats within the State. The SCDNR and its partners hosted a Chinese tallowtree workshop in 2008 at Nemours Plantation to educate landowners and land managers about this invasive species and eradication techniques.*

- 5) Develop partnerships with other entities in South Carolina to address impacts associated with invasive and non-native species. [Moderate priority]

*A Cooperative Agreement with the USFWS allowed for the follow-up treatment of Chinese tallowtree on “Goat Island” as well as the restoration of isolated wetlands on site. Agreements with Santee Cooper also have proven beneficial in the control of invasive aquatic plant species.*

*The SCDNR participates in multiple partnerships that address non-native, invasive species control. Some of these include the USFWS, Vitex Task Force, and Clemson University.*

#### **CONSERVATION ACTION AREA 4: Private Land Cooperation**

Currently, 77% of the land in South Carolina is under private ownership (SCFC 2010). As such, SCDNR has little authority over habitat conservation and wildlife management on those lands. Therefore, it is important that SCDNR enlist the cooperation of private landowners to protect priority species and their habitats. Encouragingly, many citizens in South Carolina recognize the importance of natural resources and the value of these resources for our quality of life. A number of programs are currently available to landowners through the SCDNR as well as other state and federal agencies and public and private entities. A list of the private land programs provided by SCDNR, both independently and with partners is presented in Box 5-6.

Despite the number of programs available in South Carolina, the changing urban landscape mandates that other programs are likely necessary. Further, many private landowners are not aware of the current programs available to them. Future measures of success may include: the number of partnerships developed; number of MOUs developed; number of conservation programs implemented; number of participants in programs; number of volunteers recruited; number of outreach programs put on for the public; and the number of positive/negative comments received from the public.

#### **BOX 5-6: SCDNR PRIVATE LAND PROGRAMS**

- **Wildlife Program:** SCDNR Wildlife Biologists conduct site visits and formal consultations with landowners and assist with management plan preparation and technical guidance for all species found therein.
- **Conservation District Program:** SCDNR personnel provide technical assistance and cost-share for farmland improvements, including water quality and erosion management as well as wildlife habitat improvement.
- **Red-cockaded Woodpecker Safe Harbor Program:** This program allows for the formal enrollment of qualifying private lands in a management program to enhance red-cockaded woodpecker populations.
- **Farm Bill Technical Support Program:** As an official member of the NRCS State Technical Committee, SCDNR participates in policy development and Farm Bill program priority setting. Additionally, SCDNR Wildlife Biologists provide technical guidance on Farm Bill program plans.
- **Landowner Incentive Program:** SCDNR directs federal cost share funds to qualifying lands for management practices benefiting red-cockaded woodpeckers and other “species at risk.”
- **US Fish and Wildlife Service Partners for Fish and Wildlife Program:** SCDNR works with this federal program on various habitat restoration projects on private lands (example: Partners for Trout in South Carolina’s Upstate).
- **Focus Area Program:** The purpose of this program is to conduct landscape-level conservation efforts that include private lands conservation. There are 12 habitat conservation focus area task forces in South Carolina which are operated through the Atlantic Coast Joint Venture (example: ACE Basin Project).

### **Specific Conservation Strategies for Private Lands**

- 1) Develop or expand partnerships with other entities to provide landowner assistance programs that focus on the conservation of priority species and their habitats. [Highest priority]

*Currently, SCDNR staff provides consultations with an average of 3,000 private landowners a year. General requests for technical assistance with aquatic and terrestrial habitat recommendations number around 800 per year. The SCDNR partners with NRCS to promote Farm Bill incentive programs to private landowners. Priority habitats that are commonly advocated for include longleaf pine ecosystems and native grasslands.*

- 2) Conduct outreach efforts to private landowners to:
  - a. Explain to the public the ecological importance of protecting natural resources on private lands and the benefits of protecting those resources for all citizens of South Carolina.
  - b. Encourage voluntary participation in natural resource conservation activities.

- c. Encourage natural resource stewardship by utilizing Best Management Practices (BMPs) on private lands.
- d. Explain the mission of the SCDNR and the programs conducted by the department.

[High priority]

*Since its introduction in 1998, the Red-cockaded Woodpecker (RCW) Safe Harbor Program has grown to include 140 enrollees and 299 RCW groups. This program has ensured habitat maintenance and enhancement for nearly 300 groups of Red-cockaded Woodpeckers on private lands. This program has helped facilitate widespread reintroduction of fire to the landscape, thus maintaining and restoring critically imperiled longleaf pine habitat. It has also improved relationships between the private sector and government organizations, producing a cooperative effort toward conservation.*

*In addition, habitat improvement efforts at Wood Storks rookeries (and other priority wading bird rookeries) on private lands has lead to the increase in the number of active rookeries in South Carolina.*

- 3) Develop or modify landowner education and outreach programs to include information about South Carolina's priority species and habitats. [High priority]

*The 2013 Longleaf Pine Alliance meeting featured a presentation on SC's SWAP priority species found in this habitat type.*

*The SCDNR staff has instructed many private landowners and Home Owners Associations (HOAs) on how to better manage rookeries found on site for priority wading birds including Wood Storks.*

## **CONSERVATION ACTION AREA 5: Public Land Management**

Only 7% of the land in South Carolina is in public ownership by federal, state and local governmental agencies (SCFC 2010). Much of that land is not directly managed by the SCDNR; however, these lands provide critical protection for the State's priority species and their habitats. Agencies who manage ecologically important public lands in South Carolina—including the SCDNR; SC Forestry Commission; SC Parks, Recreation and Tourism; US Fish and Wildlife Service; National Park Service; and the US Forest Service—are mandated to conserve native wildlife species and their habitats. Additionally, other public agencies, such as the US Department of Defense, US Department of Energy, and some city and county park facilities manage ecologically important lands for the protection of wildlife and their habitats.

The SCDNR has an excellent working relationship with other public land managers throughout the State. The conservation goals of these separate agencies may differ slightly, resulting in different conservation strategies and efforts. In order to provide the most efficient management of our priority species and their habitats, it is important to continue and enhance partnerships between the SCDNR and other agencies. Future measures of success may include: the number of

education efforts, number of recommendations implemented on public lands, number of partnerships formed, number of in-kind services conducted by partners on public lands, number of recommendations implemented on SCDNR lands, and the number of management plans influenced.

### **Specific Conservation Strategies for Public Lands**

- 1) Provide key information about management requirements for priority species and habitats in South Carolina to partners responsible for public land management. [Highest priority]

*A statewide Conservation Plan for the Gopher Tortoise in South Carolina was developed to help aid land managers with giving conservation considerations to this priority species. In addition, a management plan for 3 rare burrowing crayfish was also developed.*

*The SCDNR is in regular communication with partners such as SC Audubon, Ducks Unlimited, The Nature Conservancy (TNC), various land trusts, the Lowcountry Biodiversity Foundation, and the USFWS regarding proper management techniques on sensitive habitats (e.g. hammock islands). For example, SCDNR staff assisted TNC and the USFWS in writing the shorebird monitoring protocol for oyster reef restoration.*

*For our partners in the private sector, SCDNR produces brochures on new regulations and habitat protection recommendations to hand out to patrons. For example, kayak companies conducting ecotours near barrier islands receive the latest on shorebird nestings. Boat ramps and marinas are also targeted for outreach efforts.*

- 2) Continue to work with partners to manage and protect priority species and their habitats in South Carolina through other agencies' funding programs. [Highest priority]

*SCDNR has partnered with several parks to address protecting bat roosts from disturbance. In addition, SCDNR partners with the USFWS in shorebird/seabird surveys and the associated data sharing for over 25 miles of shoreline in the Cape Romain NWR area.*

- 3) Ensure that priority species and their habitats on SCDNR lands are managed in accordance with the conservation actions provided in the SWAP. [Highest priority]

*For example, in the Wood Stork species account in the Supplemental Volume of this SWAP, it discusses the need to apply herbicides to control aquatic vegetation that is degrading the open-water habitat under the rookeries. In response, 40 acres of rookery habitat was sprayed, including 2 tracts on private land.*

*In accordance with action items put forth in the various aquatic species' accounts, 6 miles of mountain streams were restored/improved and the faunal response is under different levels of evaluation. Isolated wetlands along the coast have also been restored*

*by damming old drainage ditches (e.g. North Williman Island and Old Combahee Island, Beaufort County).*

## **CONSERVATION ACTION AREA 6: Regulatory Actions**

Within South Carolina, there are several state and federal entities with regulatory authority over certain aspects of wildlife and habitat conservation. State and federal regulations in South Carolina govern the conservation of rare, threatened, and endangered species; protection of natural areas and specific natural habitats; take of game and nongame wildlife species; monitoring and protection of water and air quality; review and permitting of mining, dam construction, surface water discharge, and groundwater withdrawal; dock and pier construction; and other project developments.

As SCDNR biologists and other experts prepared species accounts, they identified areas where existing laws and regulations may need to be changed in order to protect priority species and habitats. They also identified areas for which no laws or regulatory authority exists to protect these species. Future measures of success may include: the number of calls/responses to priority species concerns; number of proposed recommendations implemented; number of plans developed; number of regulation change proposals; number of regulation changes that enhance or protect wildlife or habitat; number of species protected from unregulated use or impact; and the amount of habitat protected/affected.

In addition, our Law Enforcement Division undergoes basic wildlife management training as it relates to their job. Course instruction covers: upland game and fish rules and regulations as well as non-game regulatory authority; wildlife diseases; snake, tree, and grain identification; depredation permitting; trapper education; marine regulations (i.e. TEDs for shrimp trawl nets); and why certain practices are illegal as well as the biological basis behind our Title 50 laws. In 2013, a new class of recruits was briefed on the importance of the SWAP to the people of South Carolina and how law enforcement actions help protect these priority species as well as traditional game species.

### **Specific Conservation Strategies for Regulatory Actions**

- 1) Enhance SCDNR Law Enforcement capability to address priority wildlife species law enforcement needs. [Highest priority]

*In 2006, Act 84 was passed which dealt with the regulation of non-hunting violations on leased WMA properties and SCDNR owned properties.*

- 2) Continue to develop State of the Resource Reports for marine species that are not currently targeted in commercial or recreational fisheries and for species that are targeted, but for which no plan currently exists. [Highest priority]

*As of 2013, 17 finfish species and 3 invertebrates have undergone a stock assessment and a State of the Resource Report generated for each. These reports give an index of abundance that shows population trends over time. Modifications of management*

*strategies can be made quickly and efficiently as new data dictates. SWAP priority species, in particular, that are now being tracked in more detail include the mummichog, weakfish, sheepshead, king mackerel, Spanish mackerel, southern flounder, spot, Southern kingfish, black drum, blue crab, and Eastern oyster. In addition, a moratorium on the retention of saltwater catfish was instated.*

*In 2007, Act 85 was passed which established new finfish bag and size limits. An additional regulation passed in 2013 which reduced the limit of flounder taken in response to a decline in the population seen through surveys, especially for the priority species Southern flounder. Regulations for black drum (bag and size limit) and weakfish (size limit) were also modified.*

- 3) Investigate the need to amend existing SCDNR regulations and/or develop additional SCDNR regulations to address the conservation status of South Carolina's priority species. [High priority]

*Act 251 was passed in 2005 which allowed bonds to be issued for land acquisition guaranteed with Heritage Trust funds. This subsequently allowed SCDNR to purchase 2 tracts of land totaling ~39,000 acres for priority species habitat protection.*

*The SCDNR is also able to offer an endangered species specialty license plate portraying our state reptile, the loggerhead sea turtle, as well as a SWAP priority species—the Painted Bunting. The tag advertises the importance of endangered species conservation in South Carolina, and revenue from the sale of the license plates is used by SCDNR for fish and wildlife management and conservation programs as authorized by SC law.*

*Cormorants have increased in population to the point where they are impacting fisheries in South Carolina. The Cormorant Removal Program on Santee Cooper Lakes will allow for hunting of this species in order to protect sportfish and SWAP priority species. The effects of migrant Double-crested Cormorants that winter on the Santee Cooper Lakes include competition with the resident fish population for clupeid (herrings, shads, menhaden, etc.) forage, direct predation on out-migrating anadromous juvenile shad and herring, direct predation on returning anadromous adults while crowded below the System's dams, and direct predation on juvenile game fish and catfish. In addition, cormorant harassment has been linked to significant winter kills of adult Redear Sunfish too large to swallow. Permanent damage to flooded bald cypress and tupelo trees used for roosts has also been documented. The first year the SCDNR initiated a citizen-lead reduction effort, 11,653 cormorants were removed from the Santee Cooper Lakes.*

- 4) Investigate the need to amend existing SCDNR regulations and/or develop additional SCDNR regulations to address the effects of collecting and/or harvesting South Carolina's priority species. [Moderate priority]

*The "turtle law" that was passed in 2006 protects several priority species of freshwater turtles plus the Eastern box turtle from overharvesting for commercial purposes such as Asian food markets and the pet trade. More laws such as this are being developed.*

## CONSERVATION ACTION AREA 7: Survey and Research Needs

When preparation of South Carolina's first SWAP was initiated, it quickly became apparent that SCDNR and other entities in South Carolina were lacking data for many of the priority species and their habitats. Historically, research and survey activities have focused on managed species, federally or state listed species, and activities funded through grants and private dollars. In order to adequately manage for priority species in South Carolina, it is imperative that baseline research be conducted for these species.

Within this iteration of the SWAP, Chapter 6: South Carolina Comprehensive Monitoring Program specifically addresses survey and research needs as they apply to the priority species. The conservation actions here are presented to illustrate the type of information that needs to be gathered. Future measures of success may include: the number of areas surveyed; number of new survey sites; number of species/populations located; number of new monitoring sites or species protocols; number of new trend estimates; number of species for which population targets can now be assigned; amount of new data on a species compiled; number of genetic analyses conducted; and the number of taxonomic issues resolved.

### Specific Conservation Strategies for Survey and Research Needs

- 1) Conduct surveys to determine the presence and extent of priority species populations and their habitat. [Highest priority]

*The SCDNR, along with its partners and volunteer network, utilizes a variety of methods to survey and monitor priority species including: aerial transect plots (wading birds); helicopter passes to map intertidal oyster reefs and monitor sea turtles; photo identification (cetaceans); trammel netting (fish); electroshocking (fish); drop net sampling (fish, crustaceans); hydrophonic transmitters (Shortnose Sturgeon); pit tagging (rattlesnakes); mist-netting (songbirds); point counts (birds); nest checks (songbirds, Red-cockaded Woodpecker, Bald Eagle); radio telemetry (birds and reptiles); spotlight surveys (deer); camera censuses (deer, gopher tortoise, etc.); rocket/cannon netting (waterfowl and Red Knots); track boards (mink); scent stations (furbearers); scent lures/hair snares (black bear); and butterfly tagging (monarch).*

*The recent Stream Assessment (2006-2011) answered a lot of questions as to the range and population size of many of SC's priority freshwater fish. In addition, a recent SWG grant is cataloging the species of crayfish that were collected at the same time.*

*The marine species known as the weakfish is being tagged to examine its migration. Atlantic blue crabs and gag grouper are undergoing genetic studies to determine the extent of and health of their populations along the South Carolina coast.*

*Heritage Preserves, WMAs, hammock islands, and accreted lands are routinely surveyed by staff and partners to identify potentially new populations of priority species as well as*

*document the occurrence of invasive exotics for removal. These site visits include Carolina Vegetative Survey “pulse” exercises.*

- 2) Monitor the condition of priority species populations and their choice habitat, once discovered. [Highest priority]

*Life history studies have been conducted for at least 4 priority crayfish species. The SCDNR actively monitors many of the State’s priority species through bird banding programs, snake pit tagging, freshwater fish fin clipping and radio telemetry studies, and marine fish tagging.*

*Yearly surveys of over 200 sites and 20 seabird colonies are conducted along the coast for high priority bird species.*

*Addendum 1 to the Interstate Fishery Management Plan, approved in 2012, established a coast-wide sampling program to improve the quality of information available for use in future bluefish stock assessments. The intent of this coast-wide biological sampling program is to address uncertainties existing within the current age-structured assessment model used to monitor the status of the bluefish population. Specifically, the goal is to develop aging techniques that can be used to perform a coast-wide age structure analysis of the bluefish stock in an effort to increase the validity of stock assessment results.*

*A multi-species stock assessment model was developed by the ASMFC to move fisheries management away from individual species assessments to ecosystem-based fishery management. Members of the ASMFC Multispecies Technical Committee and others have worked to develop a multispecies Virtual Population Analysis (MSVPA) model to explore important predator-prey interactions among key ASMFC-managed species, including Atlantic menhaden as the primary forage fish and striped bass, bluefish, and weakfish as predators. The most recent update was in 2012.*

- 3) Determine the impacts of contaminants (including thermal discharges) on South Carolina’s priority species. [Highest priority]
- 4) Conduct research to identify the habitat requirements for South Carolina’s priority species and determine whether existing habitats meet those requirements. [High priority]

*Habitat modeling for 4 priority crayfish species has been done, and statistically significant preferences for specific plant assemblages and habitat features were found. Swainson’s Warbler has undergone extensive habitat evaluation. Several other priority species are currently under review such as McGillivray’s Seaside Sparrow.*

- 5) Determine genetic relationships of new species and those species with questionable taxonomic designations. [Moderate priority]

*A molecular phylogeny study of seepage slope salamanders determined that the Southern dusky salamander does not actually occur in South Carolina. Thus, it was removed from*

*the list of SC's priority species. In addition, a recent crayfish study found that the Edisto crayfish (*Procambarus echinatus*) needs to be re-examined as there may be 2 separate species involved. Multiple distinct genetic populations of Cobia have been discovered along the Southeast coast, thus affecting species management strategies in SC and elsewhere. A new species of shark, the Carolina hammerhead, is being studied to determine how to distinguish it from the scalloped hammerhead.*

- 6) Determine the effects of plant and animal invasive and non-native species (including diseases) on South Carolina's priority species and their habitats. [Moderate priority]

*As previously stated, feral hogs have demonstrated their ability to cause severe predation on sea turtle nests and destroy fragile habitats with their rooting behavior. In addition, coyotes have been having an impact on white-tailed deer fawn recruitment. Armadillos have moved into the State, causing additional alterations to sensitive habitats with their burrowing habits and fondness for ground nesting birds' eggs. Studies addressing the extent of their influence on SC's priority species have yet to be determined. A possible new marine threat includes the recent reports by commercial shrimp fisherman of captures of the invasive Asian tiger shrimp, *Penaeus monodon*. An investigation may be warranted.*

- 7) Determine the effects of hunting/fishing on South Carolina's priority species. [Moderate priority]

*Many of South Carolina's species hold a significant place in our hunting heritage. However, sound science should prevail over culture. Therefore, the SCDNR closely monitors the impact of hunting on both common and priority species. While other states have placed a moratorium on Bobwhite quail hunting, documented harvest rates on quail in SC, based on fall covey count data and harvest data, has ranged from <1% to nearly 30%. It is unclear if hunting has a marked influence on quail numbers. Habitat restoration is thus preferred. Ruffed grouse, another priority species, is rarely hunted in SC and is thus assumed to not be under immediate threat. Waterfowl trend graphs, similarly, show no hunting impact on populations in SC. Black bear, despite increases in hunting pressure, are in fact increasing in number and have become a nuisance in some parts of the State. Public alligator hunts have been allowed since 2008 (private land hunts since 1995) now that the population appears recovered and stable, but a management plan for the species is in progress (Clemson University graduate work) which will help to analyze and guide the long-term effects and direction of the hunting program.*

## **CONSERVATION ACTION AREA 8: Urban and Developing Lands**

Since the 1950s, the United States had experienced a mass migration to the suburbs. Fueled by the proliferation of the automobile, residential and commercial growth has expanded into the far reaches of what once were healthy wetlands, uplands and forestlands. Many have determined that nationally, land consumption has outpaced population growth two to one.

Anthony Downs of the Brookings Institute defines sprawl as “a specific form of suburbanization that involves extremely low-density settlement at the far edges of the settled area, spread out far into previously undeveloped land.” Sprawl development began to take place in the last half of the 20<sup>th</sup> Century. However, when it arrived to South Carolina, it proceeded quickly. Land conversion in the State ranked ninth in the nation between 1992 and 1997, with over 539,700 acres converted for development. During this time period, South Carolina’s population increase was 5.3% while the percentage of developed land was 30.2 for almost a six-fold increase. The trend has continued as new projections estimate a statewide population figure of 5 million people by the year 2030 (SCFC 2010). This number may be reached before this date. Chapter 1 of this SWAP further explains South Carolina’s population growth statistics.

South Carolina’s dramatic growth has occurred primarily on the outskirts of the State’s larger metropolitan areas, as well as Charlotte, North Carolina and in the coastal/tourism centers of Hilton Head Island, Charleston, and Myrtle Beach. Much of this growth has come in the form of sprawl development. The impact of sprawl on wildlife has not been measured directly.

As previously natural lands are converted to urban lands, wildlife and habitat are undoubtedly affected as habitat is lost or fragmented in this process. However, the impacts of development on South Carolina’s priority species and their habitats can be mitigated, if efforts are made to do so. Effective planning is imperative in protecting natural resources during development. **Chapter 3** discusses the urban landscape and its potential for wildlife habitat in more detail.

In April 2005, the 7 members of the Urban and Developed Lands Conservation Action Committee met to discuss priority species, their habitats, and the overarching actions that could affect urban and developing lands in South Carolina. Members included municipal leaders, home builders associations, academia, land trusts, and other non-profit conservation organizations. The group identified 5 areas for conservation action opportunities which are presented in Box 5-7. These ideas have been incorporated into the specific conservation strategy list.

#### **BOX 5-7: FIVE AREAS FOR CONSERVATION ACTION OPPORTUNITIES**

- Protection of habitat through acquisition and easements.
- Habitat (corridor and buffer) research and public education.
- Strengthen comprehensive planning through research, enforcement, and public education. Coordinate the development process between the developer and local level stakeholders in a one-stop-shop manner.
- Promote better storm water management regulations and techniques on impervious surfaces. Develop constructive wetlands education and incentives.
- Develop a higher-level coordination and training program for all levels of government and professionals, including appointed and elected officials.

Future measures of success may include: the number of cooperators; number of technical guidance interactions; number of recommendations implemented; number of BMPs developed; measurements of the degree of compliance and the quality thereof; number of site visits

conducted; number of partnerships developed; number of decision-making protocols adopting aquatic conservation priorities; number of acres/miles of wetland/stream positively affected; number of plans/permits commented on; number of collaborative efforts; number of species for which threats are conclusively identified and abated; number of information requests received and responded to; number of mitigation scenarios developed; number of species/habitats affected; number of outreach programs conducted; number of audiences reached and number of participants; number of comprehensive plans prepared; and the number of urban wildlife calls received from the public and handled effectively.

### **Specific Conservation Strategies for Urban and Developing Lands**

- 1) Encourage responsible land use planning throughout South Carolina that ensures the protection of natural resources. To do this, an urban biologist is needed to collaborate with municipalities and communities to reduce the impacts of development. This can be accomplished by assisting local governments in drafting meaningful comprehensive plans, as they relate to the Natural Resources section of local comprehensive plans. Other ideas include:
  - a. Implementation of Best Management Practices
  - b. Planned development communities such as conservation community design principles by Arendt (2003)
  - c. Low impact development; infill
  - d. Passive recreation park design and trail systems, especially with minimal stream crossings
  - e. Greenways and “green space” that also function as wildlife corridors
  - f. Creation of a “green growth” manual for municipalities including natural resource-friendly ordinances and incentives for green growth

[Highest priority]

*Currently, SCDNR averages 50 requests per year for general information near specific locations (i.e. what species are within a mile of a project site), and about 21 requests per year for GIS data (which varies from state- or county-wide to information by species). Usually, an average of 200 community officials and professionals are trained each year by SCDNR personnel while an additional 3,500 receive some sort of technical assistance.*

- 2) Encourage SCDNR staff to provide wildlife/habitat educational information to communities. Inform elected and appointed officials about environmental issues relating to local development and wildlife/habitat issues and disseminate information on the following:
  - a. Support the creation of local habitat protection capabilities.
  - b. Work with local land trusts on the location of priority habitats.
  - c. Promote and educate about transfer of development rights.
  - d. Collaborate with local governments to develop Best Management Practices for storm water run-off: education, incentives, and awards.

[Highest priority]

- 3) Develop wildlife/development win-win situations and disseminate information to local governments and the development community. [Highest priority]

*The partnership between local high-rise owners and SCDNR in which gravel rooftops are maintained by these businesses for nesting Least Terns has been a positive one. Signs have brought attention to the businesses as conservation-minded. The next step will be installing cameras to show the public live footage of the terns nesting. The Charleston Aquarium, a conservation partner of the SCDNR, already has used real-time video footage of nesting Brown Pelicans on Crab Bank Seabird Sanctuary to show the public the importance of minimizing human interference during critical stages in a species life cycle.*

- 4) Act as a repository for Best Management Practices relating to natural resources. [Highest priority]

*SCDNR has already helped create or comment on various Best Management Practices documents for specific locations or projects. One that has been previously mentioned in the above Education and Outreach CAA section concerns BMPs for maritime forest communities.*

- 5) Research existing Dept. of Defense, Dept. of Transportation, Dept. of Energy plans, etc. to find ways to coordinate objectives and efforts. [High priority]

- 6) Participate in the environmental review process for development projects throughout South Carolina. [High priority]

*As mentioned previously, SCDNR routinely provides an average of 1,400 comprehensive environmental reviews per year to a variety of entities. These include environmental impact statement reviews, FERC relicensing projects, nuclear projects, mine construction, jetty construction, and beach renourishment and dredging projects. Trend graphs show a steady increase in requests per year. SCDNR also assisted with the completion of the SC State Water Assessment, 2<sup>nd</sup> ed.*

*Also, SCDNR staff provide comment as needed to city/town council on erosion control measures (e.g. dikes and dredge sites), stream buffers, sensitive habitats, and cultural resources.*

- 7) Collaborate with partners to establish appropriate recommendations for riparian buffer widths to assist in the protection of coastal and inland water quality. [High priority]

*In 2008, SCDNR published a booklet on the subject, which is also available online, entitled "Protecting Your Streams: Choices for Conservation".*

- 8) Collaborate with the South Carolina Department of Transportation (SCDOT) to protect priority species and their habitats during and after road construction, bridge replacement, etc. [High priority]

*The SCDOT receives a copy of the SCDNR's Heritage Trust Threatened and Endangered Species database on an annual basis for use in planning purposes. They are also encouraged to report bat colonies on bridges so that mitigation efforts can be made if the bridge needs to be modified or replaced. At the Stevens Creek bridge by the SCDNR Heritage Preserve, a replacement will be constructed that will be I-beam or T-beam in nature (instead of slab) to benefit bats. However, SCDNR needs to create an MOU with SCDOT. Alternate roosts need to become a standard part of bridge replacement requests from the SCDNR.*

- 9) Partner with other state and federal agencies, conservation organizations, industries, and permitting agencies to deter development in important breeding, feeding, and roosting/nesting sites that are important to South Carolina's priority species.  
[Moderate priority]

*SCDNR partnered with a local conservation group on Sullivan's Island and The Nature Conservancy to develop a video on the value of marine ecosystems to native wildlife and why these areas should be protected from development.*

- 10) Discourage development in habitats for South Carolina's priority species; maintain an updated map for municipal partners showing sensitive habitat and focus areas.  
[Moderate priority]

- 11) Provide wildlife/habitat research and demonstration projects. These could include:
- a. A buffer demonstration project that provides a win-win for both developers and the environment.
  - b. Research projects on the impact of buffers and corridors on wildlife and habitat.
  - c. A storm water demonstration project.
- [Moderate priority]

*SCDNR personnel and partners assist schools with the creation of nature trails (e.g. Sullivan's Island Elementary School), butterfly gardens, rain gardens, and how to landscape with native plants (e.g. James Island Elementary School and Stiles Point Elementary School).*

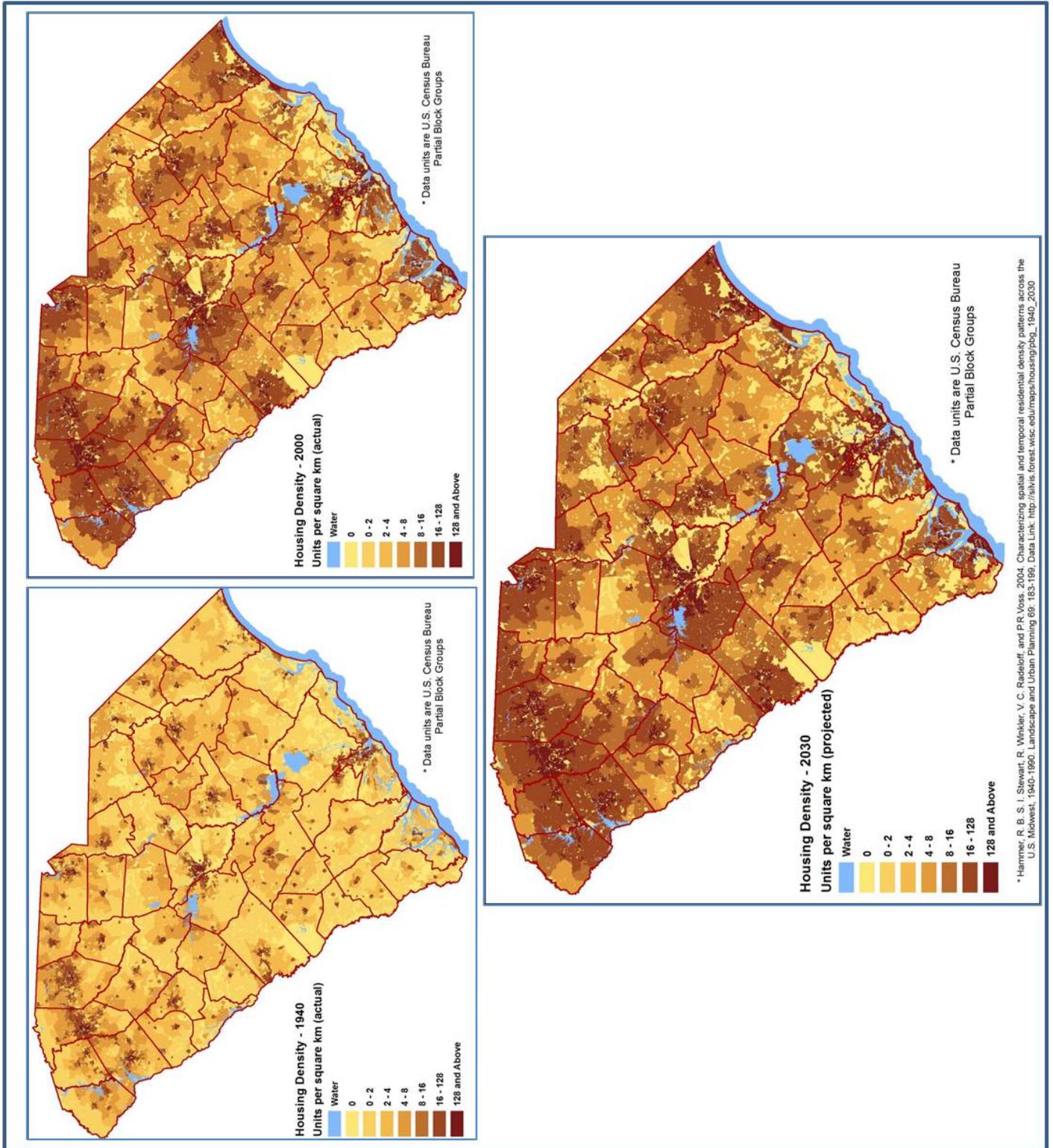


FIGURE 5-1: Housing density changes from 1940-2000 and projection to the year 2030 (Hammer et al. 2003).

## CONSERVATION ACTION AREA 9: Climate Change

Anthropogenic and naturally occurring variability in combination are producing a change in the world's climate which will likely impact South Carolina and our natural environments in some fashion. As climate change issues have surfaced, SCDNR approached the subject proactively by creating the SC Climate Change Technical Committee, which in turn has produced a working document to address climate change issues relating to our natural resources and effective measures to realistically manage them in the face of imminent threats. The SCDNR draft document entitled "Climate Change Impacts to Natural Resources in South Carolina" is a collaboration of experts representing the diversity of the Agency (Perry et al. 2012). Each team member has put thoughtful consideration into their recommendations on how we, as lead agency for our natural resources, should address climate change and react accordingly. Within the current climate change document, the SCDNR has set clearly defined goals and future actions as climate change issues arise. This document was placed on the website for public review in early 2013 and can be viewed at <http://www.dnr.sc.gov/lwc/climatereport.html>.

Impacts of climate change can include the gradual warming of air and water temperatures, alteration of atmospheric water vapor, increases or decreases in annual rainfall, and rises in sea level (Perry et al. 2012). Many of these factors will directly or indirectly affect the priority species listed in this strategy. Some species will be directly impacted by a change in their habitat preferences in response to rising temperatures and changes in rainfall. Seasonal habitats available to SGCN will change in response to climate change. It is likely that climate change will have the greatest impact on high elevation species as their mobility or ability to re-colonize and adapt is limited. It may also increase the devastating effects of invasive species on species of greatest conservation need (priority species). For example, more temperate-loving invasive species have not migrated northward because they cannot tolerate the lower winter extremes. As climate change occurs, warmer average winter temperatures may open a door for further migration, which will have a greater impact on native species through direct and indirect competition for resources.

Management efforts need to be on a regional scale. Connectivity of important landscape features should be a priority, as the ability to re-colonize or re-locate becomes a factor in a species' ability to adapt to changes. It would be wise to develop land-use GIS maps to help prioritize areas of conservation in the face of climate change. Likewise, partnerships with other state and federal agencies, industry, NGO's, land trusts, and other conservation-based organizations will need to be strengthened as climate change issues are tackled. This Plan could utilize our existing partnerships to foster future talks and the development of statewide contingency plans. Climate change will also be an important consideration for collaboration between neighboring states as species populations' boundaries react to the change.

We will also need to constantly re-evaluate South Carolina's priority species list as species may be added or removed as they adapt/react to climate changes. Taxa chairs and their committees were charged with reviewing and updating the current priority species lists. During this review process, they considered climate change as a possible challenge to their species and listed these threats as applicable. Known climate change threats and issues, as considered by the committees, are addressed in Chapter 3 and in the species accounts found in the Supplemental Volume.

Although climate change discussion is not a required element within this document, we felt it was imperative that we include it for future considerations in management and protection of our priority species and habitats. The SCDNR is by law charged with the protection of our natural resources, as well as their sound management and enrichment. We need to be prepared to respond proactively by gathering and monitoring population status and habitat conditions so that we can then react more quickly to assist species in need. Whether climate change is considered a new or exacerbating threat to SGCN, monitoring species should be continued and a priority for our agency. As part of that monitoring effort, modeling should be conducted so that “tipping points” (thresholds) can be determined for species under various scenarios (Glazer 2013). Then strategies or actions developed for each possible outcome can be initiated if or when that scenario begins to occur. It will be crucial that we consult our internal climate change document, mentioned above, as a guideline for handling climate change issues as they arise.

The South Carolina State Climatology Office produced “The Climate Connection Workshop Series: Climate Variability and Impacts to South Carolina’s Natural Resources” in 2012. Details are discussed in Chapter 7. Needs and challenges that came out of this public input process—plus additional comments from agency staff, and the climate report previously referenced—resulted in the following list of specific conservation strategies to respond to climate change issues.

Future measures of success may include: the amount of new data collected; number of models run or created; number of priority areas for conservation identified; number of multi-state partnerships created and projects implemented; and the number of relevant workshops attended.

### **Specific Conservation Strategies for Addressing Climate Change**

- 1) Finalize the document, “Climate Change Impacts to Natural Resources in South Carolina” and begin implementing suggestions therein. [Highest priority]
- 2) Identify ways to collect data that tracks local effects and impacts (downscaling of global climate models). [Highest priority].

*The new (2013) Decision Support Tools program, developed for the Freshwater Fisheries Section of the SCDNR, is being used to model potential consequences of urban development, deforestation, and—potentially—climate change for streams in the State.*

- 3) Identify monetary and staff resources for addressing management needs as they relate to climate variability. [High priority]
- 4) Create a centralized information area with data and tools to support decision making. [High priority]

*See Chapter 6 on SC’s Monitoring Program for more discussions on database creation.*

- 5) Prioritize areas for conservation actions using updated mapping capabilities. For example, conduct SLAMM modeling (Sea Levels Affecting Marsh Migration) of the State's coastline as needed to identify potential conservation focus areas for marsh migration inland (predictive impact modeling). [Moderate priority]
- 6) Conduct scenario planning for landscape changes in South Carolina. [Moderate priority]
- 7) Develop a map of new priority areas to target for conservation as old habitats dwindle or shift. [Moderate priority]
- 8) Conduct climate-related monitoring of species and habitats as needed. Run species- or habitat-based vulnerability index assessments as needed for priority species as it is a standardized data collection program with proven methods. [Moderate priority]
- 9) Collaborate with neighboring states to address species/habitat range shifts due to climate change. [Moderate priority]
- 10) Continue to participate in national workshops and meetings that discuss adaptive management techniques as it relates to our changing world. [Moderate priority]
- 11) Foster partnerships within the State and nationwide to address climate change in South Carolina. [Moderate priority]