Best Management Practices for Wildlife in Maritime Forest Developments

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www.dnr.sc.gov

DNR

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Front cover photos from top to bottom: Edge of a maritime forest at Hunting Island, by George Steele; Painted bunting, by Steve Pittman; Home nestled in trees, by David Whitaker; Sweetgrass meadow on coastal hammock, by John W. McCord

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David Whitaker

Home built to minimize impacts on nature at Lake Tallavanna, Florida

Purpose of this Report

Biologists and nature lovers have a special affinity for the outdoors and wildlife. Ask them what they think about urban development, particularly as it encroaches into and alters natural woodlands, and they will tell you that they would prefer no new development and that all natural areas should be preserved. Yet the reality is that a growing population and the attractiveness and marketability of remote, nonurban areas will result in new development in our existing natural areas.

This report is written with the understanding that development, at a pace we hope is wise and measured, is going to occur. Not only is this happening throughout much of South Carolina, it is occurring at faster rates along the coast. With this coastal development come the inescapable impacts to coastal forests and the wildlife that live in or adjacent to those forests. Although cluster developments surrounded by larger, intact natural areas are being promoted by many as perhaps the preferred mode of development, construction of individual homes within remote areas or traditional developments continues to be the common practice. This report should assist builders of such homes as well as those who own those homes.

This project was guided by a single question: if coastal or maritime forests are going to be developed, what advice can the S.C. Department of Natural Resources provide to minimize development impacts on wildlife and their habitats? To answer this question, this report will first provide a general description of the maritime forest's biological community, including some of its typical plants and animals, as well as coastal species that are rare and possibly declining. Understanding the interrelationships between fauna and the flora they depend upon is important when making decisions that alter habitats and landscapes. This document provides information on the dominant habitats within, and adjacent to, maritime forest and some of the ecological relationships between plants and animals. To illustrate some of the conservation concepts suggested in the report we provide real world examples of how home sites can be developed to minimize impacts to wildlife. And finally, the report provides guidelines on how to minimize impacts on wildlife while building a home in a wooded area. We believe these guidelines will be of interest to a variety of stakeholders, from individual homeowners to neighborhood and community planners.

For this report, we use a rather broad definition of maritime forest and include all dominant forests in the coastal zone, not only those in the nearshore areas that are affected by salt spray and ocean winds. This, then, includes the forests on the beachfront barrier islands, the larger sea islands, the small hammock islands and the mainland forests generally within 10 to 20 miles of the coast (primarily east of U.S. Highway 17).

David Whitaker

Home nestled in woodlands at Lake Tallavana, Florida

Why Is Plant Diversity Important?

If a parcel of land is to keep its maximum ecological value, the natural diversity of its plant species should be retained as much as possible. While protecting only the larger trees may be appealing, this practice greatly limits ecological function. Of major importance is the fact that animal diversity positively correlates with plant diversity. Plant and animal species evolved together over millions of years and provide reciprocal benefits. Plants provide food and structure for shelter, nesting, perching and cover for animals, while animals provide seed dispersal mechanisms, pollination, nutrient recycling, pruning and other functions for plants. Many plant and animal species have "species-specific" relationships, such as butterflies and other insects that rely solely upon certain plant species, usually for food. Many bird species utilize particular plants for food as well as for materials for nest construction. Various species of birds and mammals may require low growing plants, mid-canopy plants, or tall shrubs and trees, *i.e.*, different heights and structure of habitat. Herbs can be valuable components of the ground cover, serving as food during spring when young herbivorous mammals are in rapid growth phases.

Maintaining a diversity of understory plants helps to retain and protect a reserve seed bank that allows quick responses to local or larger-scale disturbances such as fires, throw-downs, freezes, floods and other natural or man-made events that may temporarily alter landscapes. These protected seed reserves ensure that plant communities retain their long-term characteristics. Also, retaining a relatively large quantity of plants in various age-classes increases potential biological diversity and the probability that some individuals will be resistant to diseases and pests. Plants are also important for soil generation and maintenance (including the prevention of erosion) and recycling of nutrients and waste products.

John W. McCord

Maritime forest adjacent to a saltmarsh

Appendix A presents many of the most valuable wildlife plants and their specific benefits that occur in the coastal zone. Many additional plant species that occur less commonly in the coastal zone also provide wildlife value. References listed in this document can be used to determine wildlife value for other species. Also, all native plants have wildlife and habitat value as parts of natural plant communities and ecosystems. Accordingly, retention of the highest practical biological diversity of native plants and the greatest diversity of age-classes for each species ensures function and resiliency of plant communities, habitats and ecosystems.

Maritime Forest

A maritime forest is classically defined as a climax community on southeastern United States barrier islands that is dominated by live oak, cabbage palmetto, Southern magnolia, red bay, yaupon, American holly, sparkleberry, wax myrtle, saw palmetto and other flora. NatureServe, a network of natural heritage programs (*http://www.natureserve.org/index.isp*), reports that a maritime forest "includes vegetation whose structure and composition are influenced by salt spray, extreme disturbance events, and the distinctive climate of the immediate coast." The classical maritime forest is predominantly very near the coast, slowly transitioning into more typical southern upland forests (*e.g.*, inland maritime, oak-hickory, bottom hardwoods and pine-flatwoods) with increasing distance from the coastline. Some of the best remaining examples of the climax maritime forest are on smaller barrier islands and the undisturbed coastal hummock or hammock islands (simply hammocks throughout the remainder of this report) that are scattered throughout the tidal marshes fringing the mainland. While this report concentrates on the maritime forest, we believe that it is generally applicable to most of the forests east of U.S. Highway 17 in South Carolina. This outer portion of the coastal plain is designated as the coastal zone and is so identified throughout this document.

We have found that on hammocks and the larger barrier islands near the ocean a large variety of divergent plant communities exist within or adjacent to the classical maritime forest habitats. Although natural factors, including hurricanes, floods, fires, disease and tornadoes, have altered maritime forests, human activities such as shell deposition (primarily by Native Americans), phosphate mining, dredged sediment disposal, agriculture (including silviculture and animal husbandry), logging, wetlands drainage, Civil War earthworks and game management have altered forests. The production of Sea Island cotton was one of the earliest forms of agriculture established on coastal islands in South Carolina, and by the late 1790s cotton was produced on both the sea islands and many hammocks. Remnants of furrows, presumably from antebellum agriculture, continue to be evident within mature forests in the coastal zone. Combinations of these natural and anthropogenic causes have resulted in an array of variant plant communities embedded within the traditionally defined maritime forest.

John W. McCord

Remnants of sea island cotton furrows on a hammock island

Indeed, all coastal forests have been impacted by the activities of humans of European descent over the past three centuries. Accordingly, no examples of classic virgin maritime forest remain. Most virgin forests of the coastal zone were harvested and cleared during the first century of European colonization for lumber or ship building or for crop-land (Sea Island cotton, indigo, rice, etc.). Few ancient live oaks remain,

and most trees in coastal forests are under 200 years old. Silviculture or forest management has produced dramatic impacts on the primary composition and dominance of canopy species in coastal forests and forests throughout the Southeast. Loblolly pine production has resulted in the transformation of many coastal forests from hardwood-dominated to pine-dominated, including many areas that likely previously supported classic maritime forests.

Most of the South Carolina coastal zone is a mosaic of fragmented uplands, rendered by inlets, sounds and bays, estuaries and tidal waterways. Forests of these uplands were likely once dominated by hardwoods and evergreen shrubs since natural fire was undoubtedly rare relative to the frequent fires generated by lightning strikes in contiguous forests of the inner coastal plain. Longleaf pine was once king of these expansive coastal forests, with hardwoods dominating floodplain forests of rivers and bottomlands. Forests of the South Carolina Grand Strand from central Georgetown County through Horry County were once similarly dominated by fire-dependent longleaf pine savannas because of minimal protection from estuaries and tidal waterways. Because of human development and the need for fire control, fire-dependent coastal forests of today represent a small percentage of such historical forest coverage.

The introduction of non-native plants, primarily for landscaping, has also caused substantial changes in coastal and other plant communities. Non-native plants become invasive when they outcompete or displace native species. Invasive plants such as Japanese honeysuckle and Chinese privet are now so widespread that they are considered naturalized. Other species, including trees, most notably Chinese tallow-tree, have become severe threats to native plant communities. Chinese tallow-tree particularly damages isolated wetlands where it suppresses native plants through competition and shading and causes dewatering from its high demand for water during the growing season. In some disturbed habitats, non-native plants may increase plant diversity, but generally, non-natives negatively impact natural biological diversity.

Non-native mammals often cause significant damage to native plant communities and habitats. Rooting and wallowing by feral hogs cause extensive damage by uprooting vegetation, by consumption of invertebrates and vertebrates and also by causing or exacerbating erosion of sediments into marshes, other wetlands and waterways. Feral goats cause extensive and drastic loss of plant community complexity and plant diversity by over-browsing. Secondary impacts of habitat damage by these large mammals often include colonization by invasive plants such as Chinese tallow-tree.

John W. McCord

Maritime forest

Free-roaming domestic cats (whether feral or allowed to roam by owners) and, to a lesser extent, feral hogs and dogs include many small species of native wildlife in their diet. Coyotes have also recently colonized much of the coastal zone, after years of illegal importation as well as natural immigration and expansion of their range. Such non-native predators cause mortality in addition to that of native predators, and this additive source of mortality may be particularly problematic for species already suffering from habitat loss or other population-limiting factors. Feral hogs also deplete hard mast which is essential to numerous native wildlife species like wild turkey, white-tailed deer, squirrels and the Eastern wood rat.

Some variant plant communities appear to provide advantages to wildlife – particularly with respect to increasing species diversity for fauna and providing high-quality foraging habitat in the form of open areas or forest edges. Some of these communities, particularly high-calcium sites, also harbor rare plant species that are not typically found in a climax maritime forest. However, human-induced impacts on historically natural plant communities have likely dramatically influenced the natural distribution of many species of plants and animals and most likely have negatively influenced natural habitat distribution and connectivity, thereby reducing the natural resiliency and biological diversity of native species.

Some of the more significant communities within the coastal zone forests include: **Oyster Shell/High Calcium Communities** – these communities may contain canopy-forming trees such as Carolina basswood, sugarberry, or Southern sugar maple. Subcanopy species may include Carolina buckthorn, red buckeye, tough bumelia and red bay. Rare species associated with these communities include Godfrey's privet, shellmound buckthorn, leafless swallow-wort, bluff oak, large-tuber morning-glory, widow sedge, Florida privet and midden prickly pear (when shell deposits occur on non-shaded uplands).

Salt Shrub Thickets are located immediately above the usual high tide line of estuaries or salt marshes and typically are comprised primarily of sea ox-eye and marsh elder. Many additional species, including herbs such as big cordgrass, spear orach, Juda's bush and maritime pokeweed and trees and shrubs like Southern red cedar and groundsel tree often occur along the outer slope of uplands at the interface between salt shrub thickets and maritime forests. Such shrubby upland edges provide valuable habitat for many wildlife species, including nesting and foraging birds.

Evergreen Shrub Thickets are often found as a community within a maritime forest and these thickets vary depending upon soil characteristics. Major components are typically yaupon, red bay, wax myrtle, wild olive, Carolina

Megan Gidney

"Spanish Mount" shell mound at Edisto Beach State Park

laurel cherry, sparkleberry, various greenbriers and other shrubs and vines. On barrier islands and the Grand Strand, the maritime shrub thicket naturally occurs near and within interdune swales between maritime forests and Atlantic Ocean beaches. The maritime shrub thicket is also dominated by evergreen species such as wax myrtle, yaupon, red bay and greenbriers. Poison ivy is also frequently common in such thickets. The maritime shrub thicket is often cleared for construction of buildings or lots on barrier islands nearest the ocean. This plant community is also frequently removed or trimmed to enhance visibility of the ocean and beach.

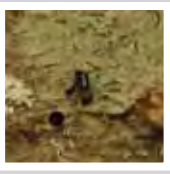
Depending upon the location and extent of canopy cover, **Small Isolated Wetlands** within coastal forests may contain grasses and sedges such as marsh fimbry, redroot flatsedge, and beaksedges, pennyworts, marsh fleabane and late-flowering thoroughwort. The flora associated with such wetlands depend upon various factors – including sun exposure and salinity. The button-bush is a common shrub found in open, low salinity wetlands. Isolated wetlands, and especially those with low salinity, are particularly important as critical habitat for amphibians and reptiles and a water source for mammals. Specialized fish and aquatic insect populations (*e.g.* dragonflies and damselflies) are often associated with isolated wetlands that have seasonal or permanent inundation, with species assemblages primarily determined by salinity.

Threat to Red Bay Trees

Non-native, invasive insects also have the potential to negatively influence and transform coastal forests. Maritime forests and other coastal forests of South Carolina, Georgia and north Florida are suffering significant damage from a fungus carried by the red bay ambrosia beetle. Both the beetle and the fungus it carries are native to Asia and are thought to have been accidentally introduced through the port of Savannah, Georgia, in the early 2000s. The fungus is revealed as laurel wilt disease (LWD), a rapid wilting and dying of foliage nearly simultaneously throughout an infected plant. Maritime forests of many coastal islands and other well-drained forests of the lower coastal plain of South Carolina are suffering extensive mortality of red bays. Concurrently, damp forests within the State's coastal plain have been afflicted by die-off of swamp bays, a close relative of the red bay. The beetle and disease indiscriminately attack plants in the laurel family (Lauraceae), and mortality of the sassafras tree has also been recorded in coastal South Carolina. LWD has caused significant loss of mature red bays in most maritime forests in Jasper, Beaufort, Colleton and southern Charleston counties through June 2009. The long-term impacts of this disease have not yet been determined, but significant changes in forest structure have been noted, particularly at Hunting Island State Park near Beaufort. Effective control for either the beetle or the disease has yet to be determined for a broad landscape or forest application. Potential long-term impacts of LWD may include increased colonization of coastal forests by invasive plants as die-off of red bays and related species provides openings for such aggressive plants.

Phillip Jones

State champion Red bay tree in Charleston County

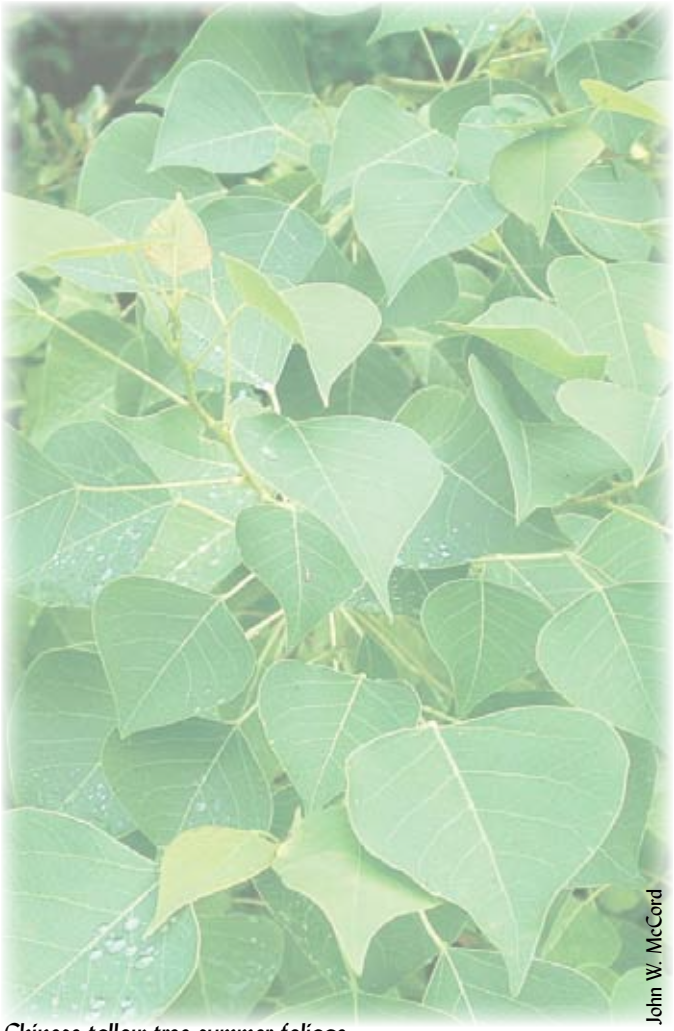


Phillip Jones

Ambrosia beetle

John W. McCord

Dead red bay tree



John W. McCord

Chinese tallow-tree summer foliage

The Invasive Chinese Tallow-tree

Invasive species are non-native species that have the potential to adversely affect ecological health or economic activity. Invasives that flourish in natural habitats often compete with or displace native species, potentially reducing biological diversity and quality of wildlife habitat. Invasive plant species are typically introduced through landscaping.

Among the more aggressive and difficult to control invasives is the Chinese tallow-tree (also known as the popcorn tree). This species, which can grow to 30-40 feet, is native to eastern Asia, but was introduced to the United States in the 1700's as an ornamental tree and for seed oil production. It has been popular in landscaping because of its natural pest resistance, fast growth and attractive fall colors. As the seed capsules fall away in late fall, a cluster of waxy white seeds that resemble popcorn is exposed. Cuttings with seeds attached are used in Christmas decorations.

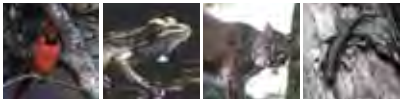
The Chinese tallow-tree is highly aggressive and can easily out-compete and displace native species. A single large tree may produce 100,000 seeds that can be spread over a broad area by birds. Cutting is not an effective control method since this plant readily sprouts from stumps and roots. This species can dominate woodlands and dewater isolated wetlands, to the detriment of wildlife. It should not be used in landscaping and should be eradicated where present with an appropriate herbicide. A colorful alternative to Chinese tallow-tree is the Eastern redbud.

Phillip Jones

Chinese tallow-tree fruit

Phillip Jones

Chinese tallow-tree with fall foliage



Animals of the Maritime Forest

Hundreds of species of resident and transient animals are found within South Carolina's maritime forests. This section provides a brief review of habitats and food habits for some of the more common and representative animals of healthy coastal woodlands. If these species are present, chances are the habitat is functional for most species that may inhabit a typical maritime forest.

Birds

For the purposes of this publication, we established seven groups or guilds of birds that represent the more characteristic species that can be found in coastal forests. These groups include not only resident species, but also seasonal residents and transients that depend upon these coastal woodlands as temporary stopovers during migration or to complete a portion of their life cycle. Some bird species do not fit neatly into a single category or guild since a relatively small percentage of the entire lifecycle may be representative of other guilds. For this document, species are categorized within the guild that is most representative of each species within the South Carolina coastal zone. Shorebirds (plovers, sandpipers and American oystercatchers), seabirds (terns, gulls and brown pelicans), and marsh birds (rails, bitterns, etc.) use open habitats and are not associated with coastal forests and shrub thickets.

Resident Landbirds

Birds in this guild are those that can typically be found in maritime forests and other coastal forests throughout the year using the habitat for all parts of their lifecycle. Our estimate of the number of species that best fit this guild for the coastal zone is 40. Birds that represent this guild include the Carolina chickadee, Carolina wren, Northern cardinal, Eastern towhee and red-bellied woodpecker.

The **Carolina chickadee** can be found in deciduous and mixed deciduous/coniferous woodlands, swamps, riparian areas, open pine woods, oak hammocks, along edges of cypress swamps, palmetto thickets and parks. This bird is found in fringe habitats as well as in forested interior areas. Carolina chickadees will nest in natural cavities, such as abandoned woodpecker holes and rotten branches, but occasionally they will also dig their own holes in trees or branches if the wood is soft, usually from decay or insect damage. Some of the trees they are most likely to use for nesting cavities are oaks, maples and black willows and other "soft" hardwoods. Carolina chickadees also readily nest in bird houses, including those designed to attract Eastern bluebirds. The bottom of the cavity is typically lined with fur, feathers, grasses, thistledown, moss and other plant materials.

Steve Pittman

Carolina chickadee

The diet of the Carolina chickadee is primarily animal matter in the warm seasons, including moths, caterpillars, other insects such as aphids, treehoppers, ants and bees, their eggs and larvae, as well as small spiders. Adults primarily feed nestlings insects and other high protein items. Particularly in fall and winter, they will also feed upon fleshy fruits, berries and seeds such as those of ragweed and pine, acorns and especially sunflower seeds and suet at bird feeding stations.

The **Carolina wren**, the state bird of South Carolina, is found in a wide range of habitats, from swamps to forests and residential areas. The species is generally found in moist woodland thickets and swamps with moderately dense shrub or brushy cover, ravines, rocky slopes, suburbs, gardens, tangles and brush piles. A brushy, thicket-like understory is a key habitat characteristic for this species. The nest is a domed cup with a side entrance that may be placed in a tree or stump cavity, vine tangle, dense branches, along banks of streams, among the roots of an upturned tree, an old hornet's nest or an artificial site such as a mailbox or a hanging basket. Most nest sites are at very low elevations, seldom as much as 10 feet above ground, even in trees.

The Carolina wren feeds primarily on insects and spiders, but will occasionally feed on snails, fruits and berries, some seeds and even small lizards and frogs. Insect prey may include various beetles, ants, leafhoppers, true bugs, scale insects, bees and wasps, grasshoppers, crickets, cockroaches, caterpillars and moths. Of the vegetable food, fruit pulp has been found in a few stomachs, along with seeds of wax myrtle, sweetgum, poison ivy, sumacs, pines and oaks. In other words, Carolina wrens are omnivores, and will sometimes visit suet and seed feeders.

Phillip Jones

Carolina wren

The **Northern cardinal** is common in areas with shrubs and small trees, including forest edges, hedgerows, brushy swamps and vegetation around houses. The Northern cardinal forages in practically any habitat near cover vegetation. This species is a habitat generalist but needs a degree of shrubs and scrub for cover.

The Northern cardinal nest is an open bowl of weed stems or small twigs, filled with leaves and grapevine bark, rootlets, and lined with grass. It may contain paper or plastic in the outer layer. Nests are often in evergreens of many varieties, including privet hedges and other landscaping shrubs, and may be placed in a thick tangle of vines including rose and honeysuckle. The key characteristic of nest sites is that the nest is not easily visible. The nests may also be placed in low tree branches or saplings, but regardless of cover type they are usually at ten feet or less above the ground.

The diet consists largely of weed seeds, corn, rice, oats, wheat and numerous species of wild fruits from a large variety of trees, shrubs and vines.

The **Eastern towhee** prefers dense thickets and tangles of vegetation from near ground to several feet high that provide habitat for foraging, nesting and shelter or escape. The Eastern towhee seldom strays far from cover, and apparently is reluctant to move across open marshlands. Studies of hammocks in South Carolina strongly suggest that the species rarely occurs on hammocks in areas where the mainland, barrier islands and sea islands offer nearby forests, specifically including dense evergreen shrub thickets. The Eastern towhee is among the first resident bird species displaced by removal of shrub thickets from human land development. It is uncommon or absent from many urban and suburban areas, and hammock studies indicate that it is much more likely to occur on hammocks surrounded by development than on small islands within coastal regions with minimal development pressure.

Eastern towhees generally glean a mixture of seeds, fruits and small invertebrates by scratching in leaf litter. As with many birds, the diet becomes more vegetarian in winter than during warmer periods when invertebrates are active and high protein sources are needed for nestlings.

Nests are similar in structure and composition to those of the Northern cardinal. Nests are hidden in dense thickets and are seldom over five feet above ground.

The **red-bellied woodpecker** occurs in a variety of dry or damp forests (deciduous or pine) and in suburban areas. It is often found in heavily timbered bottom lands or swampy woods; open deciduous or mixed pine woodlands with very large trees; heavy woods of oak and elm along river and creek bottoms; and shade trees and dead trees in urban areas. It is also equally abundant in flat, low pine woods as in the oak hammocks. Like other woodpeckers, the red-bellied woodpecker

Phillip Jones

Red-bellied woodpecker

nests in cavities, usually of its own making. Cavities are typically found in decaying tree-tops and snags and often near an outer forest border. Deciduous trees, especially soft hardwoods, such as red maple and yellow poplar, are preferred to the harder species like hickories and oaks. Nesting cavities are frequently made in dead pines, often with several excavations in the same tree. Nests may be 5 to 70 feet from the ground (usually greater than 40 feet). In maritime forests, dead cabbage palmettos are frequently used for nest cavities. Nesting cavities vacated by the red-bellied woodpecker are often used by Eastern bluebirds, Carolina wrens, Carolina chickadees and tufted titmice. The red-bellied woodpecker is often evicted from nest holes by the European starling. Red-bellied woodpeckers feed mostly on reproductive plant parts, including fruits, nuts and some seeds. Common dietary items in the coastal zone include pine seeds, berries or fruit of

Southern red cedar, cabbage and dwarf palmetto, black gum, red mulberry, elderberry, wax myrtle, Virginia creeper, dogwoods and poison ivy. It will also eat nuts such as acorns and pecans. The diet is supplemented with insects and other invertebrates, and occasionally with vertebrates such as lizards, treefrogs, small fish and eggs and nestling birds. In winter, the red-bellied woodpecker's diet is mostly seeds and nuts, and it is a frequent visitor to feeding stations where it is fond of sunflower seeds and suet.

Other resident landbirds that frequently occur in coastal forests and other coastal habitats are brown thrashers, Northern mockingbirds, tufted titmice, blue jays, American crows, downy woodpeckers and pileated woodpeckers. The Northern mockingbird is common in urban and suburban areas as long as insects and fruit-producing plants occur. The tufted titmouse has habits much like the Carolina chickadee, and the two species are often seen together.

Basic Needs of Resident Landbirds

Resident species as illustrated by the above examples require a diversity of habitats. These include woodlands, open spaces and edge habitat. Of primary importance is habitat comprised of mixed deciduous/coniferous woodlands with native species such as oaks, hickories, Southern magnolia, sweet gum, black gum, sugarberry, yellow poplar, red maple, Southern red cedar and pines. Dead trees, particularly pines and cabbage palmettos, are important for woodpeckers and other birds that utilize cavities. In addition to canopy trees, it is important to have understory brush, shrubs and saplings, including wax myrtle, yaupon, red bay and others. Thickets of low shrubs and vines, including fruit producers such as Virginia creeper, poison ivy, grapes and greenbriers, provide important nesting and foraging habitat for small birds. Although large contiguous woodlands are ideal for many species, particularly the larger predatory birds, open spaces and forest edges are very important for feeding. Grasses, sedges and other herbs are most abundant in openings or clearings that are naturally provided through "blow-downs" or dismembered dead trees. High, dense canopies of live oak, Darlington oak, other "evergreen" hardwoods and pines also create clearings at ground-level that accommodate some herbs. The availability of open water or wetlands is very beneficial for most resident birds.

Domestic Cat Predation

- More than 90 million domestic cats live in the US; 65% of which live at least partially outdoors.
- Free-roaming cats kill hundreds of millions of birds, small mammals, reptiles and amphibians each year, including endangered species.
- Scientists now list invasive species, including cats, as the second most serious threat to bird populations worldwide.
- Even though cat predation of rodents might seem beneficial, native small mammals are important to maintaining biologically diverse ecosystems and are an important food source for birds like hawks and owls.
- Cats prey on wildlife whether or not they are hungry.
- Studies show that bells on collars are not effective in preventing cats from killing wildlife. Wild animals do not necessarily associate the sound of a bell with danger, and bells offer no protection for nestlings and fledglings.
- Wildlife rehabilitation centers report that most small animals injured by cats die. Even if they appear to escape, they often die later because of injury or infection.

<u>Recommendations:</u>

- Keep cats indoors!
- Spay or neuter cats at a young age.
- Do not feed stray cats and never abandon a cat you can no longer care for.

Nearctic-Neotropical Migratory Landbirds

Birds in the nearctic-neotropical migrant guild are those that breed during spring and summer primarily in North America, and migrate south to spend winters in subtropical and tropical areas south of the United States. Although most nearctic-neotropical migrants leave the United States in winter, some species winter in the southern United States, including South Carolina. Before migrating south for the winter, migrant birds must increase their body weight and store enough fat for the migration flight. When they migrate back in spring, many return to the region of their birth. Over half of the songbird species in the United States, about 340 species, fall into this category. Approximately 75 of these species use the South Carolina coastal zone as a migration corridor. Some species in this group breed in coastal South Carolina, while many others are typically only seen while in transitory or migratory mode. Nearctic-neotropical migrants are categorized as summer residents during their stay if they are here during the breeding season. Species that are only present during their migration are called transients. Accordingly, this large group of migratory birds can be divided into two guilds for any given geographical area as determined by whether or not such species do (summer residents) or do not (transients) use an area for breeding.

Megan Gibney

Great nesting area for blue-gray gnatcatcher

Examples of summer residents that breed in the coastal zone of South Carolina are the blue-gray gnatcatcher, the Northern parula, the purple martin and the chuck-will's-widow. Twenty-three species best fit this guild for the South Carolina coastal zone.

Summer Residents

The **blue-gray gnatcatcher** has a wide summer range spanning most of the eastern half of the United States. They winter in the very southern United States (a few birds can be found in coastal South Carolina) and southward to Mexico, Central America and Cuba. Blue-gray gnatcatchers use a variety of wooded deciduous habitats, ranging from shrub land to mature forests, which may include maritime forest. This species is frequently associated with forests with a nearby water source. The blue-gray gnatcatcher typically uses forest edges and the upper portion of the canopy.

As the name suggests, the blue-gray gnatcatcher feeds nearly exclusively on insects and other small invertebrates. They eat the adult insects as well as their eggs and larvae. Foraging strategy includes catching prey in flight or gleaning them from branches by moving through the foliage, constantly shifting the tail to flush the insects.

Nesting is in the mid-story or canopy, and in habitats that are more shrubby than open. For example, they can often be found nesting at forest edges or in woodlands along rivers or streams. Nests are built on branches or branch forks, far from the tree trunk. They construct open cup nests with high walls made from a

variety of materials like spider webbing, bark, lichens, grass, stems, feathers, hair and any other fine materials. Live oaks (abundant in the coastal zone) provide excellent nesting and foraging habitat for this species.

The **Northern parula** is a small warbler found in the eastern half of the United States during the summer breeding season. They overwinter primarily in southern Mexico, Central America and the West Indies, migrating along the Atlantic Coast across the Gulf of Mexico. They can be found in a variety of habitats including conifer, hardwood and mixed forests or woodlands, old fields and shrub lands. They are almost always found near water. Populations in South Carolina are generally associated with bottomland forests, often in riparian areas, but they also use maritime forests with abundant oaks and Spanish moss.

One of their key habitat requirements is Spanish moss which they use for nesting. The Northern parula builds its nests within clumps of hanging moss, incorporating moss or lichen fibers, hair, fine grass, pine needles or plant down. Interestingly, they are one of only a few bird species to use hanging moss exclusively for nesting.

Northern parulas are largely insectivorous, feeding in the mid and upper canopy by gleaning insects from tree branches. They feed more often on the outer branches than near the trunk. Their diet during the breeding season includes insects, spiders and caterpillars. At the wintering grounds, they also include plant material like seeds, berries and nectar.

The **purple martin** is a relatively large swallow which spends the spring and summer in the eastern part of the United States, with scattered populations in the Southwest and the Pacific. Winter is spent in the Amazon basin

Ted Borg

Purple martín

of South America, east of the Andes. Purple martins migrate mostly along the coastline, with most birds departing breeding areas by mid-summer. Males are among the earliest Nearctic-Neotropicals to arrive on breeding grounds and often do so by mid-February.

Purple martins are perhaps best-known for the distinctive man-made houses in which they nest. Prior to the popularity of artificial nesting structures, the species used natural cavities in trees in open woodlands or on forest edges. However, for the last century, the eastern population has nested almost exclusively in man-made houses, while the western population continues to nest in natural cavities like old woodpecker holes. They use twigs, plant stems, mud and grass as nest-building material.

Martins feed aerially, snatching insects from the air while in flight, often over fields, marshes, or water bodies. They eat a variety of flying insects including beetles, flies, dragonflies, midges, mayflies, bees, stink bugs, cicadas, flying ants,

damselflies, butterflies, moths, grasshoppers and wasps. Contrary to popular belief, their diet does not include many mosquitoes. Martins also consume water while in flight, skimming along the surface of a water body and scooping water with their lower bill.

The **chuck-will's-widow** is a species of nightjar or goatsucker that nests in the southeastern United States, and winters in southern Florida, Central America, the Caribbean and northwestern South America. They are nocturnal, and are rarely seen during the day but can often be heard repeating their name at dusk and into the night.

Typically, they are found in mixed woods with pine and/or hardwoods and a light to moderate understory. They are also often found near clearings, which they use for feeding by flying low to the ground in search of insects. The diet of chuck-will's-widows includes beetles, moths, cicadas, winged ants and other medium- to large-sized insects. On occasion, they will eat small birds and bats by swallowing them whole.

The chuck-will's-widow does not build a nest structure, rather it simply lays eggs on the bare ground or on fallen leaves. Eggs are highly camouflaged and are often deposited under dense cover and near old roads or forest edges. The nesting period in our area is April – June.

Basic Needs of Summer Resident or Breeding Nearctic-Neotropical Migrants

Studies have shown that in the last 20-30 years many species of nearctic-neotropical migrants are in decline. While not fully understood, the cause of this decline can likely be attributed to a combination of factors including loss of suitable habitat at both breeding and wintering grounds, and along the migration route.

Of particular concern in our area is protection of breeding habitats which vary widely but include mixed woodlands and forests, maritime forests, bottomland hardwood forests, shrub lands, open grassy habitats and edge habitat. Not only do different species utilize different habitats, but individuals of a single species may require a variety of habitats. Perhaps for birds of this guild, it is more important to protect a diversity of habitats than to concentrate on specific habitats. This is especially true since neotropical migrants are largely insect-eaters and require specific habitats more for breeding purposes than for food.

Transient Landbirds

This guild includes nearctic-neotropical migratory species that are primarily found in maritime forests and on coastal islands (including small hammocks) as they utilize the areas for refueling and resting during migration. Forty-three species fit most appropriately in this guild as based upon their prevailing behavior within the coastal zone. Representative species within this group include the prairie warbler, black-throated blue warbler, yellow warbler, yellow-billed cuckoo and tree swallow.

Prairie warblers breed in much of South Carolina and prefer young thickets of pine and/or saplings. It is an uncommon breeder in the

U.S. Fish and Wildlife Service

Prairie warbler

coastal zone, but utilizes this area during spring and fall migration for resting and refueling. Typically, the species avoids thick woods in favor of forest edge habitats, pine-barrens, low pine-cedar thickets and shrubby second-growth woodlands. Food consists of insects, spiders and other small invertebrates.

During migration, the **black-throated blue warbler** is found in a variety of habitats, including forest, forest edges, parks and gardens. Food consists of insects and some small fruits. This warbler forages mostly in lower to mid-levels of forests, taking insects mostly from the underside of leaves. They forage actively in low vegetation, sometimes hovering or catching insects in flight. They will often forage in one area for a while before moving on to the next. These birds mainly eat insects – including caterpillars, beetles, adult flies and also spiders. Seeds, berries and fruit may be added to their diets during winter. It is primarily an interior forest specialist on the breeding grounds.

The **yellow warbler** is most often seen during migration in small groups as they forage along forest edges and through the canopy. Yellow warblers feed almost entirely upon insects. When caterpillars are plentiful, they may represent a majority of its food. This species is also adept at capturing weevils, beetles, flies, small wasps, grasshoppers and spiders.

Yellow-billed cuckoos are commonly found in open woodlands with clearings and dense scrubby vegetation, often along water. They are often found near streams, rivers or lakes and in abandoned farmland, old fruit orchards, successional shrub land and dense thickets. In winter, the yellow-billed cuckoo occurs in tropical habitats with similar structure, such as scrub forest and mangroves.

This bird feeds primarily on large insects, including caterpillars (especially tent caterpillars), katydids, grasshoppers, crickets and dragonflies. It may also consume small frogs, lizards, bird eggs and snails. Particularly during migration, the diet is supplemented with fruits such as blackberries, wild grapes and elderberries.

Yellow-billed cuckoos are fairly common breeders in the interior coastal plain of South Carolina, particularly in expansive hardwood-dominated forests and bottomland forests. It is infrequently found as a breeding species in the coastal zone.

The **tree swallow** is found most often in open areas near water. Frequently-used habitats include fields, marshes, meadows, beaver ponds, and especially wooded swamps and shorelines. Tree swallows are cavity nesters and make use of woodpecker excavations in standing dead trees. They also opportunistically use small openings in buildings or under eaves, as well as constructed nest boxes.

Like other swallows, tree swallows are highly acrobatic and forage mostly in flight, often swooping low over open water or fields to capture prey in flight, sometimes skimming food items from the water's surface. Important food sources include flying insects such as flies, beetles, winged ants, dragonflies, wasps, stoneflies, mayflies, caddisflies and grasshoppers. Plant materials consumed include seeds from bulrushes, smartweed and sedges, grains, nuts and various berries. During fall and winter (the tree swallow does winter along the Southeast coast, but in low numbers relative to the migrant population), tree swallows often rely heavily on wax myrtle fruit.

Basic Needs of Transient Landbirds

Maritime forests and other forest and shrub habitats on the near-coast mainland and on coastal islands provide essential refueling and

resting stations for migratory birds. As such, it is important to maintain the proper habitats that provide ample quantities of food. Many migratory species also utilize open areas or edge habitats, often near water. Important foods include insects (including caterpillars) and spiders, and some birds prey upon small vertebrates such as lizards and frogs. Seeds and fruits are also important to many migratory birds. Healthy maritime forests, shrub thickets and edges provide a complexity of habitats that sponsor a broad diversity of potential food resources as well as cover that provides protection from adverse weather and predators.

Winter Resident Landbirds

Thirty-eight bird species are considered winter residents in the State's coastal zone. These species, some of which also belong to the nearctic-neotropical migratory group, spend the cold weather season in the southern United States and areas farther south and move north in spring to breeding regions that are typically distant from South Carolina. Common winter resident species include the yellow-rumped warbler, yellow-bellied sapsucker, palm warbler and Eastern phoebe.

The **yellow-rumped warbler** spends winters in the southern United States and as far south as Panama. It breeds during summer in the northern portion of the continent in mature coniferous and mixed coniferous-deciduous woodlands. Winter habitats can be relatively general, including open areas along woodland edges, brushy areas, gardens, orchards and residential areas. It has been suggested that the species migrates along the coast where it heavily utilizes wax myrtles for food and cover. In fact, it was once called "myrtle warbler."

Yellow-rumped warblers feed on insects and fruit, the fat-filled fruits of the wax myrtle being particularly important during winter. The warblers are thought to be one of the few vertebrates that can digest wax – a major constituent of wax myrtle and other bayberries. This ability to consume wax myrtle fruit may allow it to winter farther north than most members of the family. Yellow-rumped warblers also use many other fruits during migration and winter, including those of cedars, Virginia creeper, viburnums, honeysuckles, poison ivy, dogwoods and palmettos.

The **yellow-bellied sapsucker** winters in a variety of forests, especially semi-open woods. During migration, it may visit parks, yards and gardens. Sapsuckers drill neat rows of sap wells in the bark of living hardwood trees, allowing the sap to exude and flow down the trunk. The birds consume the oozing sap as well as attracted insects. Trees most often utilized include sweetgum, American holly, magnolias, hackberries and oaks, although many other species of trees and vines are used. Other fauna that may use the sap wells include butterflies, ruby-crowned kinglets, orange-crowned warblers, yellow-rumped warblers, ruby-throated hummingbirds and blue-gray gnatcatchers. Along with sap, its diet consists of mast, insects (mostly ants and beetles) and fruit.

U.S. Fish and Wildlife Service

Yellow-rumped warbler

Among the fruits they consume are hackberries, hollies, dogwoods, cedars, black gums and Virginia creeper. This species breeds along the Appalachian Mountains and into Canada.

The **palm warbler** breeds primarily on edges of boreal-forest bogs across Canada and the northeastern United States. These birds migrate to the southeastern United States, Mexico and the Caribbean where they actively forage in cone-bearing trees and on the ground. During migration they are usually found in hedgerows, edges of thickets and other edge habitats along the coast. Outside of the breeding season, especially during migration, palm warblers may join mixed species flocks where they are usually found fairly low in the understory or on the ground. The palm warbler may also be found in open places, including the margins of marshes, weedy fields, lawns and golf courses. Palm warblers forage actively in pines and on the ground, sometimes flying to catch insects. These birds mainly eat insects and small fruits or berries.

During the breeding season, the **Eastern phoebe** needs woods, water and rocky outcrops, or artificial structures such as barns, houses, bridges, or utility buildings. Outside the breeding period, it moves into a wide variety of brushy habitats, thick weeds and woods near water, including small ponds, rivers or streams, wet open woodlands, or woodland edges.

During summer months, the Eastern phoebe mostly eats flying insects like bees, wasps, ants, beetles and flies, but it also captures spiders, grasshoppers, ticks, water bugs and even small fish from shallow water. Berries and other fruits supplement the phoebe's diet in cool weather. Along the coast, it is typically seen perched along marsh edges and shorelines as it scans for cold-hardy flying insects.

Basic Needs of Winter Resident Landbirds

Birds of this guild have a wide range of feeding habits and habitat needs. The smaller birds consume insects, but because insects are not as plentiful during the winter months, they also rely heavily on fruits or berries of plants such as wax myrtle, Southern red cedar, dogwoods, hollies and Virginia creeper. The larger predatory winter residents prey on a wide range of smaller birds, small mammals and reptiles and amphibians if available in cool weather. Again, related to the diversity of this guild, habitats vary from understory, thick shrub habitats to woodland edges where food is more abundant. Predatory birds require adequately sized hardwood and pine forests as well as relatively open edge habitats.

Phillip Jones

Prothonotary warbler

Birds of Prey

Birds of prey include raptors (eagles, osprey, hawks, falcons and kites), owls and vultures. This diverse group also includes both resident and migratory species. These species feed only on animal matter, and most birds of prey capture live prey. While vultures are scavengers and feed nearly exclusively on dead animals, some raptors such as the bald eagle and red-tailed hawk

supplement their diet with dead, and usually road-killed, animals. Eighteen species of birds of prey are considered members of the characteristic bird fauna of the State's coastal zone during at least part of each calendar year. Typical coastal zone birds of prey are the bald eagle, osprey, red-tailed hawk, Cooper's hawk, sharp-shinned hawk, turkey vulture, black vulture, great horned owl and Eastern screech-owl.

The **bald eagle** is the largest bird of prey typically occurring in eastern North America, and the eastern population has increased dramatically over the past several decades. Bald eagles are essentially a permanent resident in the coastal zone though most individuals depart breeding territories and move inland and/or farther north by the onset of summer.

Bald eagles usually nest at least 50 feet above ground in live pines that are near water. Eagle nests or aeries are immense, usually at least 5 feet across for a first-season nest. Eagles typically have strong pair-bonds and often mate until one bird dies. Pairs also usually use the same nest for years and add additional dead limbs and branches each nesting season, with some nests reaching nearly 10 feet in diameter and weighing more than a ton. This may largely explain why live, large trees are used. Bald eagle nests are not uncommon on coastal islands which provide tall pines in close proximity to water.

Bald eagles, like other birds of prey, only eat animal matter. They may rely heavily upon fish but will also take small mammals and other birds, particularly waterfowl. Unlike osprey, bald eagles are not expert fishers, and often grab injured or dead fish from the water surface or scavenge dead fish on shores. Some bald eagles become adept at robbing fish from ospreys. Bald eagles will also supplement their diet with road-killed animals or carcasses at landfills.

The **osprey** is referred to by some as the "fish eagle." Although the osprey may be seen throughout the year in the coastal zone, it is actually a migratory species. Individuals that breed during late winter through late spring in South Carolina typically move south in fall and winter, and ospreys present in the State during winter are likely from breeding populations much farther north.

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Osprey

Only during migration is the osprey seen more than a short distance from open water. It is most common near estuaries, sounds and bays, and the Atlantic Ocean shoreline, but is also abundant near inland lakes and rivers. Nests are frequently placed in dead, but sturdy, trees and often 40 or more feet above ground, but they are not particular and will nest in live trees, on power-line poles, channel markers and intentionally placed platforms. The osprey feeds entirely on fish, which it usually captures live in its talons as it plunges feet-first from as high as 30 feet or more. The talons are designed to lock into prey, and occasionally an osprey will drown after attempting to capture a fish that is too large or strong for the bird to lift from the water.

The **red-tailed hawk** is a large resident raptor that occurs throughout South Carolina. It prefers forest edges, grasslands, agricultural fields, road shoulders and marsh edges where it can scan for potential prey from perches or

while soaring. As is the case for most birds of prey, an influx of migrants moves into South Carolina from northern breeding populations during fall and winter. The red-shouldered hawk, a close relative of the red-tailed hawk, is slightly smaller and generally replaces red-tailed hawks in interior forests.

Red-tailed hawks nest in deciduous hardwood forests, mixed hardwood-pine forests, as well as maritime forests. Nests are typically made of sticks and are concealed near the main stem of hardwoods or pines within the canopy. The red-shouldered hawk usually nests in or near bottomland forests or swamp forests.

Although the red-tailed hawk preys primarily on small mammals, and especially rodents, it will also take snakes and occasionally birds, lizards and other small animals. Particularly when live prey is scarce, red-tailed hawks will opportunistically scavenge road-killed animals.

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Red-tailed hawk

The **Cooper's hawk** breeds in deciduous, mixed and pine forests but is becoming more common in suburban and urban areas. Cooper's hawks are closely associated with deciduous and mixed forests and open woodland habitats such as woodlots, riparian woodlands and areas where woodlands occur in patches, including maritime shrub thickets. This bird will build nests in pines as well as deciduous trees, but favors hardwoods, with nests typically 35-45 feet above ground.

The diet of the Cooper's hawk consists primarily of medium-sized birds and lesser quantities of small mammals such as rodents and Eastern gray squirrels. Birds typically taken by the Cooper's hawk include the American robin, blue jay, woodpeckers, European starling, gray catbird, brown thrasher, thrushes and doves. In urban and suburban areas, it frequently relies heavily upon the non-native rock pigeon. Small reptiles and amphibians may occasionally be taken.

The **sharp-shinned hawk** breeds in the boreal and northernmost forests in the Northern Hemisphere, but it also breeds to a lesser extent as far south as the Appalachian Mountains. When nesting, this hawk most commonly uses medium-sized pines found in dense groves with heights of nests varying from 10 to 60 feet off the ground. Otherwise, its general habitat includes large, remote, young forests where they may be found hunting in forest interiors or edges.

Sharp-shinned hawks, like many birds of prey, migrate southward in fall and hundreds can be observed passing over coastal areas of South Carolina during peak migration in September and October. It is a common winter resident throughout South Carolina, and it uses practically any forested cover that supports populations of small birds. Birds ranging in size from small sparrows and warblers to American

robins, mourning doves or Northern bobwhite quail make up to 90% of the sharp-shinned hawk's diet, but it will also take small mammals (rodents), frogs, lizards and large insects. The sharp-shinned hawk, as well as the Cooper's hawk, often establishes winter territories near bird feeding stations where they prey on small birds that are drawn out of cover.

The **turkey vulture** is common throughout South Carolina year-around. However, local breeders are generally replaced by migrants during fall and winter. Turkey vultures do not build nests, but deposit eggs on the ground beneath shrubs or in hollow logs in various upland forests, including maritime forest. In mountainous regions, it may use cliffs or caves for "nesting."

Turkey vultures are generalists with regard to habitat choice as they soar looking for food. This vulture nearly effortlessly soars and sails over forests, marshes, shorelines and highway corridors as it searches for carrion using its exceptional vision and a sense of smell far more acute than that of most birds. The diet is nearly completely carrion, though it will rarely prey on live small animals such as rodents. Outside of breeding season, the turkey vulture only relies on forests for roosting sites, which are typically dead trees.

Black vultures are similar to turkey vultures in all aspects of their life history. However, the black vulture compares poorly to the turkey vulture in soaring skills and flight efficiency, although it has better vision than the turkey. Black vultures hunt visually and may be found mixed with turkey vultures. This species is found over all habitat types and is more abundant near the coast than interior.

The **great horned owl** has adapted to many different habitats and climates from sea level to 11,000-feet elevation. Preferred habitats include dense forests, deserts, plains and city parks. This species appears to be most common in mature deciduous woodlands with scattered conifers for maximum roosting concealment and it prefers to be near water. It can also be found in open and secondary-growth woodlands and agricultural areas. These birds become very much attached to certain localities and seldom wander far from them.

The great horned owl uses the abandoned nests of other birds in either deciduous trees or pines, including nests of red-tailed hawks, crows, herons and other larger birds. Most abandoned

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Great horned owl

nests are from previous years, but it will also take over active nests, including those of large raptors such as ospreys. They occasionally nest in tree holes, stumps, or caves. Nests are usually 30 to 70 feet above the ground.

The great horned owl is an opportunistic generalist and an efficient predator, taking advantage of whatever prey is available. A nocturnal feeder, it hunts by perching on snags and poles and watching for prey, or by gliding slowly above ground. Great horned owls may take prey 2 to 3 times heavier than itself. They also hunt by walking on the ground to capture small prey or wading into water to snatch frogs and fish. Among mammals, the list of prey items includes all available species of rodents, mink, raccoons, nine-banded armadillos, rabbits, squirrels, domestic cats and dogs, shrews, Virginia opossum, moles and bats. Bird prey includes other owls, woodpeckers, crows, turkeys, rock pigeons, red-tailed hawks, bitterns, herons, ducks, swans, gulls, blue jays, crows and many others. Reptilian prey includes snakes, turtles, lizards and young American alligators. Amphibians in the diet include frogs, toads and salamanders. Other foods include fish, large insects, centipedes, crayfish, worms, spiders and road-killed animals.

The **Eastern screech-owl** is the smallest owl occurring in the Southeast. Like most owls, it is largely non-migratory and occupies a home range or territory year-around. Like other owls, it is rather reclusive during day, typically "roosting" in dense cover, hollows in trees or cavities (including nesting boxes). Eastern screech-owls are most common in open forests and woodlands where they can more easily scan for prey during night. They are relatively common in suburban areas where large trees provide cover and nesting habitat. The Eastern

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Eastern screech-owl

screech-owl nests in preexisting cavities such as those excavated by woodpeckers. It will also readily use artificial nest boxes and frequently uses boxes designed for wood ducks or other large cavity-nesting birds.

It feeds by perching and dropping to the ground on small animals, including small rodents, reptiles, amphibians, birds, insects and other invertebrates. It will also glean small animals from limbs and foliage.

Basic Needs of Birds of Prey

Birds of prey require a diversity of habitats for nesting and foraging. Most birds of prey require relatively old growth forests with large trees for nesting. Bald eagles prefer large pines near water, and they generally are not receptive to human disturbance. Ospreys typically use large, dead trees near marshes and waterways. Other birds of prey nest primarily in interior forests where nests are easily concealed in the canopy, or on the ground in the case of vultures. The eastern screech-owl requires natural or manmade cavities for nesting. Natural

forests supply a mixture of healthy, weak and dead trees, thereby providing diverse habitat to accommodate assorted nesting strategies. Mature forests also provide a high diversity of potential prey. Forest edges are used extensively for perches needed by birds of prey as they scan for prey in grasslands, clearings, marshes, ponds and waterways.

Colonial Nesting Wading Birds

Wading birds are a diverse group, but may be generally described as long-legged, long-billed birds associated with wetland habitats. They are often found in coastal areas, but some species are also found further inland along rivers and in wetlands. Those considered to be in the wading bird guild for this report use maritime forests and embedded habitats for resting, roosting, or nesting. Wading birds typically forage in marshes, shallow wetlands and along borders of ponds and waterways. Included in this guild are the **snowy egret**, **great egret**, **great blue heron**, **tricolored heron**, **green heron**, **black-crowned night heron**, **yellow-crowned night heron**, **white ibis**, **glossy ibis** and **wood stork**.

George Steele

White ibis

As their name implies, colonial nesting wading birds typically nest in colonies, called rookeries. Often, they nest on islands that provide protection from mammalian predators. Islands within ponds with American alligators may provide additional protection from mammals such as raccoons. These birds also nest in trees along pond edges if islands are not available. In coastal areas, great blue herons nest primarily in mature pines on hammocks, along the marsh-upland edge, or in areas alongside streams. The wood stork typically nests well above ground in cypresses or other trees in isolated forested wetlands or swamp forests. The yellow-crowned night heron, little blue heron, tricolored heron, snowy egret, great egret and ibises generally nest in shrubby habitat nearer to the ground than does the great blue heron and wood stork. Nests are in trees, shrubs, or on the ground, and often consist of a platform constructed of sticks.

These species feed by wading in relatively shallow water in a variety of aquatic habitats. Prey for all of the wading bird species includes crustaceans, small fish and amphibians and other aquatic invertebrates. The white ibis and glossy ibis feed by using their specially designed bills to probe in the mud. Wood storks, the largest of the wading birds, also feed by probing, sometimes in cooperative groups. Often they are attracted to areas with falling water because prey, particularly fish, are more concentrated in such places. Great blue herons and great egrets, also relatively large wading birds, are able to feed in deeper water than other similar species because of their longer legs. These two

species are also "lie-in-wait" predators, meaning they stalk their prey as opposed to actively chasing or stirring up bottom sediments. Snowy egrets are more active feeders, often chasing prey or shuffling their feet to stir up sediment and expose potential prey. Yellow-crowned and black-crowned night herons can sometimes be seen feeding during the day, but are normally active at twilight or night.

Basic Needs of Colonial Nesting Wading Birds

Colonial wading birds require isolated habitats for nesting and resting. These habitats should be secure from mammals, both wild and domestic. Most wading birds are shy, and particularly so while nesting, resting and roosting. Accordingly, these birds often prefer habitats with limited or no human disturbance. Remote islands are particularly important in providing safe nesting and resting habitat. Wading birds may form rookeries and colonial roosts in relatively close proximity to human development. These birds also require access to shallow water foraging habitat where they capture primarily small crustaceans, fish and amphibians (freshwater only).

Waterfowl or Waterbirds

Waterfowl typically is used as a catch-all for ducks, geese and swans, but here includes other waterbirds such as pied-billed grebe and common moorhen. Most waterfowl only occur (at least as naturally occurring populations) in the South Carolina coastal zone as migrants or winter residents. Most species primarily use open marshlands and expansive freshwater habitat such as lakes, rivers and impoundments and large tidal waterways. Nonmigratory populations of Canada geese, mallards and other species are present as the result of human influence and are not discussed in this publication. This document

Phillip Jones

Female wood duck and ducklings

only addresses the wood duck, pied-billed grebe and common moorhen, species that use coastal forests and embedded habitats.

The **wood duck** is the only truly native resident species of waterfowl in the coastal zone. In fall and winter, an influx of wood ducks arrive from northern breeding populations, and most individuals that breed in or were produced in South Carolina move farther south for winter.

Wood ducks are cavity nesters and often use old woodpecker cavities, particularly those constructed by the large pileated woodpecker. The nest is simple and is constructed of wood chips from the cavity wall and down feathers from the female. Cavities may be 20 feet or higher above ground, and nests are sometimes well away from water. Unlike most hatchling birds, ducklings leave the nesting cavity within a day of hatching and plunge from the cavity to follow the mother to the nearest wetland or water source. Wood ducks are very receptive to manmade nesting boxes and may nest along the borders of manmade ponds as well as within or near natural isolated wetlands, marshes and waterways. Although it prefers freshwater habitats, the wood duck will occasionally use natural cavities or boxes near brackish or

estuarine habitats. Survival of ducklings is undoubtedly greatest in freshwater wetlands and swamps with abundant vegetation for cover.

Adult wood ducks are primarily vegetarians, particularly in winter when they rely heavily on acorns and various seeds. During the warm season they supplement their diet with more animal matter (primarily insects). Ducklings eat primarily insects and other invertebrates.

The **common moorhen** is present year-around in coastal South Carolina, but like the wood duck, some birds migrate during winter, particularly individuals from more northern latitudes. The common moorhen prefers fresh and brackish marshes and ponds with abundant emergent vegetation for cover and nesting. It may occur in interdune ponds of barrier islands and along the Grand Strand in tidal marshes or open, isolated wetlands and man-made ponds.

Nests are made of marsh vegetation and are constructed within standing emergent plants such as cat-tails and rushes. Like ducklings, hatchlings are active quickly and accompany the mother for foraging.

Both adults and young feed on plant parts, including seeds, foliage and roots, as well as small invertebrates. Common moorhens will forage while swimming, walking on mudflats or shorelines, or while walking on floating leaves such as lily-pads.

The **pied-billed grebe** is typically only found in the coastal zone as a winter resident. It is an uncommon breeding species anywhere in South Carolina, and nesting habits are similar to those of the common moorhen.

Pied-billed grebes prefer fresh and brackish water, but they also use estuarine creeks in winter. The species feeds in open water where it dives to feed on small animals including aquatic insects, fish, crustaceans and other invertebrates. It rarely consumes vegetable matter. Fairly common during winter in ponds and waterways near or within maritime forests, it may also use interdune ponds with open water.

Basic Needs of Waterfowl

Waterfowl require ponds and wetlands with a mix of open-water and marsh or forested wetland habitats. Particularly during breeding season, these habitats should be secure from mammals, both wild and domestic. For example, wood duck hatchlings are highly vulnerable to domestic cats and other predators when they first leave nesting cavities. Emergent marsh vegetation provides cover for nesting and foraging habitat for many species of waterfowl. Natural and/or man-made nesting cavities near high quality foraging habitat are essential for wood ducks to successfully breed.

Amphibians

Maritime forests, despite their proximity to saline habitats, potentially harbor a number of amphibians, including frogs, toads, newts and salamanders. These animals are usually closely tied to freshwater habitats either as adults or juveniles. Eggs are typically laid in small, isolated wetlands that are devoid of most aquatic

Steve Bennett

Green tree frog

predators. Since most amphibians depend upon the presence of nearby freshwater wetlands for breeding or for primary habitat, the protection of small wetlands is particularly important to insure the long-term health and even presence of amphibian populations.

Among frogs most likely to occur in a maritime forest are the **green treefrog** and **squirrel treefrog**. Both species are typically found near borders of lakes, ponds, marshes, swamps, on floating vegetation, in trees and thickets near water, in Spanish moss and under bark on trees. The squirrel treefrog may move some distance from freshwater and often uses damp cover provided by humans, such as exposed PVC pipe, the underside of air-conditioner units, and damp nooks in boats. Treefrogs eat insects including crickets, moths and flies as well as other small invertebrates.

Steve Bennett

Southern leopard frog

The **Southern leopard frog** is likewise found near shallow freshwater habitats such as streams, ponds and lakes where vegetation is heavy. It also occurs in low-salinity brackish marshes along the coast. Southern leopard frogs, while tied to wetlands for reproduction, are adaptable – provided both cover and moisture are available. During rainy periods, Southern leopard frogs may be found at relatively large distances away from water. Prey items include almost any small insects, as well as crayfish, earthworms, spiders and centipedes.

The **Southern toad** is also a common amphibian in the maritime forest and other coastal forests, provided freshwater sources are available for breeding. Adults of this species can be found in a variety of terrestrial habitats including fields, pine-barrens, hammocks and maritime forests. Because this toad burrows, it is particularly suited to sandy soils. They may also be found under logs or other debris during the day. Breeding habitats range from shallow waters around lake margins, cypress ponds and wooded Carolina bays to ephemeral pools. Southern toads breed in both temporary and permanent aquatic habitats, but because the tadpoles are toxic or distasteful to many potential predators, they are apparently less vulnerable to predation than are many amphibians. The Southern toad consumes a variety of insects and invertebrates including beetles, earwigs, ants, cockroaches, mole crickets, earthworms and snails.

The **Eastern narrowmouth toad** is widely distributed in the coastal zone. This small frog (it is not a true toad and has relatively smooth, damp skin) burrows and is typically found beneath decaying hardwood or cabbage palmetto logs. Like many amphibians, it is most active during and immediately following torrential rain events when water for breeding becomes available. This toad may breed in various seasonal or ephemeral wetlands, including interdune swales and bowl-shaped depressions resulting from blown-down trees. The Eastern narrowmouth toad feeds nearly exclusively on ants, but it also takes other small invertebrates.

The **slimy salamander** is the most broadly distributed salamander in the South Carolina coastal zone and is one of the few salamanders

found in the maritime forest. In the coastal zone, slimy salamanders are usually found beneath decaying logs, bark, or leaf litter in mixed or deciduous forests, and often near wetlands where soils are moist. It generally moves about underground using animal and insect burrows. This salamander deposits eggs under bark of rotting trees or under decaying logs. Juveniles have no aquatic stage and develop directly to adulthood. Prey consists primarily of ants, but beetles, isopods, earthworms and other invertebrates are consumed.

Basic Needs of Amphibians

Most amphibians require immediate access to isolated water bodies, wetlands or forests with ample, moist cover. For reproductive purposes, almost all require isolated water bodies that are devoid of predatory fishes, or, if in open waters, dense aquatic vegetation to provide cover. Since many adult amphibians often move some distance from wetlands when they are not breeding, adequate natural buffers around water bodies that supply a variety of damp cover or microhabitats are essential to sustain populations. In many coastal forests, particularly on hammocks, small bowl-like depressions resulting from blown-down trees and inter-ridge or interdune depressions may afford the only breeding habitats for amphibians. By most standards, such microhabitats are not recognized as wetlands, and these depressions may only sporadically retain surface water to allow amphibians to breed successfully. Remarkably, adults of some coastal zone amphibians, including the Southern toad, Eastern narrowmouth toad, squirrel treefrog and green treefrog, can survive by burrowing or hiding in moist microhabitats for long periods, likely several years, until torrential rain fills small depressions for breeding. Such isolated amphibian populations likely undergo population booms and busts as determined primarily by sufficient rainfall to accommodate breeding.

Reptiles

At least 38 reptilian species, including skinks, lizards, snakes and turtles, are known to inhabit healthy maritime forests and associated habitats such as ponds, depressions and isolated wetlands. However, many of these species are uncommon or require specific types of habitat. The following are representative species.

The **broadhead skink** is the largest legged lizard in South Carolina, with adult males reaching just over a foot in length. An active forager, it spends much of its time in trees where it searches for food, sleeps, avoids predators and broods eggs. They also forage on ground, but are usually very near a tree, stump or hollow log that affords quick escape. This species is typically found in older-growth deciduous forests with abundant hollows. In maritime forests, broadhead skinks are usually observed near live oaks and Darlington oaks where cover is provided by hollows in large trees, logs and leafy debris. Although broadhead skinks occur throughout much of the eastern United States, their population density is relatively low.

John W. McCord

Southeastern five-lined skink

However, they can be relatively abundant on coastal barrier islands. This species eats a wide range of small invertebrates and will occasionally consume fruit such as blackberries and grapes. Its broad head and relatively wide gape allow it to infrequently take smaller lizards and very small mammals.

The **ground skink** is a diminutive, largely terrestrial species that is most often found in forests with moist, loose soil and abundant leaf litter. It will hide and forage beneath logs, boards and other debris, but it is typically observed as it scurries over and beneath leaf litter. Its bronze back provides excellent camouflage on a forest floor carpeted with dead leaves. Ground skinks prey upon tiny insects, spiders and other invertebrates.

The **Southeastern five-lined skink** is relatively common in maritime forests as well as other forests throughout the coastal portion of the State. This species can be found on the ground as well as in trees. It occupies a great variety of habitats, but is most common in wooded areas where it is typically seen in association with fallen trees and stumps. Southeastern five-lined skinks consume a variety of insects (including cockroaches), spiders and other invertebrates.

The **green anole** is one of the most common tree climbing lizards in the southern United States, although it is absent at higher elevations in the Appalachian Mountains. Preferred natural habitats are moist or wet forests with brushy clearings and forest edges with an established shrub layer. It is commonly seen on or around homes and other buildings or structures, taking advantage of exposed elevated surfaces on which to bask and forage for food. Like most terrestrial and climbing reptiles, the green anole spends winter under tree bark, litter, logs or other cover on the ground. Its diet includes a variety of insects including moths, crickets, beetles, flies, grasshoppers and butterflies. They occasionally eat pollen and nectar, but they more often forage near flowers to ambush visiting insects.

The **Eastern glass lizard** is a common legless lizard of the coastal zone and is equally at home in damp, sandy soils of open coastal forests (including maritime forests), grassy shorelines of fresh, brackish or estuarine wetlands and suburban yards with landscaping that include surface mulch or leaf litter. Eastern glass lizards spend much of the day in burrows or beneath groundcover such as leaf litter, logs, boards or other debris. They often bask during day but are quick to retreat to nearby cover when disturbed. The Eastern glass lizard and other glass lizards are often misidentified as snakes and accordingly often killed or injured by misguided humans who consider any serpentine animal as dangerous. Glass lizards eat a wide variety of insects, spiders and other invertebrates as well as smaller reptiles and probably young rodents.

The **Eastern kingsnake** is a dominantly terrestrial species that can be found in open fields, forests and abandoned home sites, but it also occurs near the margins of streams, marshes

David Whitaker

Eastern glass lizard

and swamps where it preys upon water snakes and turtle eggs. It uses practically any habitat that provides cover such as shrub thickets, logs and stump-holes. Eastern kingsnakes forage during day, but become more nocturnal during the heat of summer. They are opportunistic predators that kill prey by constriction. They feed on other snakes, small mammals (rodents), lizards, birds, turtle eggs and frogs. They include venomous snakes in their diet.

The **corn snake** is another relatively widespread and common snake of the coastal zone. It may be found in assorted habitats, including mature upland pine-dominated forests, maritime forests, hardwood hammocks, swamps and residential areas. Corn snakes are often found near water sources and forage in open fields and along forest edges. It often burrows in stump holes, rodent holes, sand or under debris. This snake is a constrictor that is capable of climbing, but it primarily remains on the ground. Adults prey upon mice, rats, fledgling birds and bats, while younger snakes often consume lizards and treefrogs. The name is very well-suited since this species frequents barns and grain storage areas with corn and other grains that attract rodents.

The **Southern black racer** is the "black snake" most often observed throughout the South Carolina coastal plain. This snake is active only during daytime, and it hunts by sight. The Southern black racer is very quick and is among the most agile of snakes in the Southeast. Oftentimes, only a glimpse of this species is made as the snake rapidly retreats to cover. It consumes a variety of small animals including insects, lizards, snakes, birds, rodents and amphibians. At night and during cool weather, racers take refuge in burrows or under cover such as boards or tin. Racers will also climb into small trees or shrubs to search for food (including bird eggs), to bask, or to sleep at night. This snake is most abundant in edge habitats such as forest edges, old fields and wetland edges. They are also often found in moderately disturbed or agricultural habitats.

John W. McCord

Corn snake

Rat snakes occur throughout the eastern United States, with various subspecies distributed regionally. The **yellow rat snake** is the rat snake of the coastal plain and coastal zone. It occupies a wide variety of habitats including hardwood forests, river floodplains, swamp margins and assorted upland forests, including maritime forests and hammocks. It is likely the most common snake in coastal South Carolina. Rat snakes are excellent climbers and frequently occur in abandoned buildings and barns, as well as well above ground in trees. Juvenile rat snakes are very slender and, because of their propensity to climb, are the most likely snakes to accidentally enter buildings occupied by humans.

The yellow rat snake is a constrictor and primarily eats mice, rats, squirrels and small birds. It also consumes bird eggs, and though it is largely beneficial to humans because most individuals consume primarily rodents, it may become a nuisance on poultry farms or at nesting boxes for birds. Yellow rat snakes also

swim well, and it is a common predator on wood duck eggs. Juveniles eat mostly small frogs, lizards and small rodents.

The **Eastern cottonmouth**, often called "water moccasin," is the most widely distributed and most common venomous snake in the coastal zone. Although this species is typically associated with forested wetlands, including swamp forests, Carolina bays and depressions, it may also occur in forests with thick herbs and shrubs that afford habitat for rodents. It is present on many undeveloped barrier islands and large hammocks. It is relatively uncommon in areas of highest human population density, as is the case for many other snake species (exceptions — rat snakes, garter snakes and brown snakes). The Eastern cottonmouth is an ambush predator, and its markings provide camouflage that make it difficult to see even when it is basking (typically on logs). This snake has a diverse diet, including frogs, lizards, young American alligators, other snakes, small mammals (particularly rodents), birds and fish.

The **banded water snake** is the most common snake encountered in ponds, freshwater marshes, ditches and streams in the coastal zone. However, the redbelly water snake may also be locally common, particularly in ponds and ditches with abundant cover, and, unlike other water snakes, can be found at some distance from water. The true water snakes are non-venomous and most rarely move far from water. Water snakes frequently bask in or near water on logs, weed-beds and overhanging branches. Water snakes feed primarily on aquatic and semi-aquatic animals, primarily on frogs, crawfish and fish.

Although once listed as an Endangered Species, the **American alligator** is now very common in South Carolina with the population estimated at about 100,000 and with the vast majority of the population within the coastal plain. Alligators generally stay close to their birth place for two or three years before establishing home ranges. Females generally have relatively small home ranges, but males may range up to two square miles. The American alligator occupies a variety of natural habitats including marshes, swamps, rivers and lakes, but they may also use farm ponds, ditches, neighborhood retention ponds, drainage canals, golf course ponds and even swimming pools. Nearly any body of water in the Lowcountry has the potential to harbor alligators.

Phillip Jones

American alligator

The alligator is a carnivore and scavenger and will eat almost any animal it captures or carcass it finds. Young alligators consume snails, crayfish, frogs, insects and other invertebrates. As they become larger, they prey upon fish, turtles, snakes, waterbirds, raccoons, beavers and otters. Given the opportunity, they may also capture pets, especially dogs swimming in the water.

Basic Needs for Reptiles

Many reptiles are primarily terrestrial, but others are adapted to living in shrubs or trees. In either case, most reptiles require natural habitats with ample cover – either as fallen logs, stumps or ground cover, or understory brush and tangles. Subterranean refuge sites, such as stump-holes and abandoned rodent burrows, are very important to many reptiles, in particular some of the large snake species. Old-growth

forests provide high quality habitat because of the presence of tree hollows, standing snags, fallen trees and decaying logs and leaf litter. Most skinks and lizards feed upon insects, and often use the more productive edge habitats at the perimeter of forests. Snakes more often feed upon vertebrates such as fish, toads, frogs, lizards and other snakes. Accordingly, snakes are frequently associated with water bodies or wetlands or areas with abundant cover used by potential prey.

Mammals

Most mammals that are common in healthy maritime forests in South Carolina also occur throughout much of the State. Among some of the common mammals of maritime forests are white-tailed deer, bobcats, raccoons, Virginia opossums, Eastern grey squirrels, Eastern fox squirrels, Southern flying squirrels, marsh rabbits, Eastern cottontails, Northern river otters, minks, bats and a number of small rodents and insectivores. Insectivores include moles and shrews. Although some mammals can be particularly bothersome for homeowners, they are important components of the ecosystem and have a rightful and important place in the landscape.

The **white-tailed deer** typically inhabits wooded areas although it will roam into developed areas where it occasionally forages on ornamental shrubs or garden plants. White-tailed deer habitats range from large woodlands and forests to farmlands, suburban developments and hammocks. Ideal habitat contains dense thickets (in which to hide and move about) and edges (which furnish food). Deer are exclusively herbivores, feeding primarily from dusk through dawn. Their diet changes with the season and is comprised of green plants, including aquatic ones, in spring and summer. Vegetation may include greenbriers, grape and other vines, seedlings and saplings of many trees, herbs, fruit, mushrooms, algae and mosses. During fall, they typically rely heavily upon acorns, but they are also fond of corn and other nuts and grains. Winter food includes buds and twigs of woody plants including those of many shrubs, hardwoods and conifers. Because of hunting restrictions in some areas and a lack of natural predators, local deer populations can grow out of control and over-browsing can negatively impact plants and plant diversity. This can lead to secondary impacts of habitat damage including colonization by invasive plants.

Bobcats are most common in dense, thick brush in bottomland forests of the coastal plain. Such forests provide cover and abundant prey, as well as limited human disturbance, and likely present nearly ideal conditions for rearing young. Bobcats prefer complex forests with thickets and large trees as reclusive retreats during day, but they will use marginal habitat such as pine plantations, agricultural fields and hedgerows during night-time foraging. Though bobcats generally avoid areas of human habitation, they are relatively common on some of South Carolina's developed barrier islands and hammocks, particularly those islands with

Phillip Jones

Bobcat

areas of dense forest and shrub thickets. As indicated by tracking studies at Kiawah Island, bobcats are not averse to swimming relatively broad tidal creeks. The bobcat is exclusively an opportunistic carnivore and preys upon rabbits, rodents, Virginia opossums, raccoons, white-tailed deer (particularly fawns and injured animals), birds, reptiles and amphibians.

The **American black bear** is the only bear that occurs in South Carolina and is becoming more common in coastal forests, particularly in Horry and Georgetown counties. The typical male bear may have a territorial range of up to 10 miles and females up to 4-5 miles. As a result of this large range, bear sightings are usually of animals passing through an area. However, reliable food sources, including human-produced garbage, may result in the habitual use of a specific area. American black bears have well-developed senses of smell, and bears are good at locating food resources. They feed primarily on plants, berries and nuts, but will also consume insects and meat. Breeding season is June to August (another reason bears may be seen roaming in unusual areas) with cubs born seven months later.

Raccoons inhabit most of the United States, including all of South Carolina, with population densities highest near the coast. They are usually most common near wetlands, including tidal marshes and swamps, where favored food resources are plentiful, and particularly when den sites such as hollows in hardwood trees, blown-down trees and hollow logs are abundant. Mature forests, including maritime forests and bottomland hardwood forests, provide ideal habitat since both cover and wetlands are readily available. Raccoons have presumably benefited from human development because they opportunistically use human garbage, wild bird food and pet food in their diet and will readily take up residence in buildings or other shelter.

Phillip Jones

Raccoon

The raccoon is omnivorous and opportunistic, and will take advantage of the most readily available food resources. They typically eat mostly vegetable material, and commonly consume items including fruits such as persimmons, grapes, berries of pokeweed and blackberries, acorns and other nuts and corn. A frequently used resource in the maritime forest during late summer and fall is the cabbage palmetto fruit. Animal foods include crayfish, crabs (including fiddlers), clams, mussels, reptiles and eggs (both bird and reptile). Raccoons can be very adept at finding and excavating buried eggs of loggerhead sea turtles and diamondback terrapins. In areas of high raccoon population density, reproduction success of nesting turtles may be limited.

The **Virginia opossum** is a solitary, nocturnal animal that lives in virtually all areas, but is most common in deciduous forests and open

woodlands. It seems to be most attracted to wet areas like marshes, swamps and streams. Hollow trees and fallen logs provide den sites, but opossums will den in woodpiles, rock piles, crevices in cliffs, under buildings, in attics and in underground burrows. Since they are not adept at digging burrows for themselves, they use those excavated by other mammals. The Virginia opossum is omnivorous – eating mostly insects (grasshoppers, crickets, beetles, bugs and ants), fruit, berries, grains, small vertebrates (rats, mice, frogs, tadpoles, young rabbits, birds, lizards, snakes and carrion), eggs, crayfish and shellfish. It is relatively common and widespread on the coastal zone mainland, sea islands and barrier islands, but it is generally absent from hammocks unless such small islands are connected to larger landmasses by a causeway.

The **Eastern gray squirrel** is extremely common throughout most of the South Carolina coastal plain, particularly in mainland and sea island forests that have nut-producing hardwoods such as oaks and hickories. It is often rare or absent on isolated barrier islands and hammocks despite the usual presence of mast-producing trees. Although the Eastern gray squirrel often constructs nests from leaves and twigs, it also uses natural tree cavities as dens. It is most successful when old-growth hardwoods are present since such trees provide mast and nesting and/or den sites. This species has adjusted well to development and is often common in suburban and urban areas when sufficient oaks or other mast-producers are present.

Eastern gray squirrels have a varied diet with mast crops (acorns, walnuts, pecans, hickory nuts, etc.) comprising the majority of the fall and winter diet. They also consume plant material including seeds, buds, roots, fruits of trees (*e.g.* mulberries, cherries, dogwoods and black gums)

SCDNR staff photo

Eastern gray squirrel

and flowers from maples. Seeds of pines are also important in the diet, as well as insects, fungi, occasional bird eggs and bird nestlings. Squirrels may rarely display cannibalism by consuming young from another squirrel's nest.

Like most rodents, squirrels have a high reproductive potential capable of supporting rather high mortality within a population. In most residential areas, many more squirrels are likely lost to the combined impacts of predation by free-roaming domestic cats and road-kill than to combined predation from native species.

The **Southern flying squirrel** is distributed over much of the eastern United States and throughout South Carolina. However, it is completely nocturnal and is rarely seen by humans. It is most common in mature forests with abundant hardwoods, particularly oaks and hickories, which provide both abundant mast for food and natural cavities for nesting and den sites. It will occasionally use bird nesting boxes within forests or near forest edges as den and nest sites. In addition to acorns and hickory nuts, other dietary items of the Southern flying squirrel include insects, small fruits and berries, fungi, tree sap and occasionally bird eggs and

nestling birds. This secretive species is most easily documented by its high pitched nocturnal squeaks than by sightings.

The **marsh rabbit** is primarily a coastal plain species ranging from southeastern Virginia through southern Alabama. It is seldom found far from water and is abundant in thick shrubs or grasses near marshes (fresh, brackish and estuarine) and bottomlands associated with river floodplains or isolated wetlands. It is widely distributed in the coastal zone on practically any upland with low, dense cover near water, including hammocks.

Marsh rabbits are active at night and feed on a variety of plant material including grasses, broadleaf herbaceous plants, leaves of deciduous trees and shrubs, greenbriers, pennyworts, rushes and even woody stems when more desirable foods are not available.

The **Eastern cottontail** prefers disturbed habitats, occurring most commonly in brushy areas, old fields, cut-over woods, cultivated areas, thickets of blackberries and vines, fence and hedge rows and brush piles. Habitats with heavy cover are needed for rest and escape from predators. Grass-lined nests are usually well concealed in thickets, along logs, or in dense grass. Within the coastal zone, the Eastern cottontail is generally restricted to agricultural lands.

Food is not usually a limiting factor for rabbits since they consume a wide variety of plant parts. During spring and summer, grasses and other herbs, leaves, shoots, fruits, branch tips, buds and bark are consumed. During winter, rabbits consume primarily woody plant material such as bark from dogwoods, sumacs, maples and oaks. Grains such as corn and soybeans also provide a source of high-energy food in agricultural areas.

The **Northern river otter** occurs throughout much of North America including the Atlantic coastal zone. An adaptable species, it inhabits a variety of aquatic habitats including ponds, rivers, swamps and estuaries. In South Carolina, the Northern river otter is apparently fairly widespread in waterways and adjacent marshes of the coastal plain.

Northern river otters are social animals that typically establish habitually used latrines or "camp" sites (resting, grooming and sleeping locations). Otter camps typically occur on uplands adjacent to creeks or streams where the bank slopes gradually. Latrines on shores of large water bodies and rivers are often on points of land or isthmuses or at mouths of permanent streams. Points of land provide elevated, conspicuous locations for scent marking and allow for rapid retreat to waterways. Surveys of South Carolina hammocks revealed a heavy reliance by otters upon small islands for camps. Of the many camps discovered to date, the vast majority are located immediately upland of salt shrub thickets and just within the forest, often near or beneath Southern red cedars. Camps are typically located on islands isolated from human disturbance and are most frequently near small tidal creeks that abut the upland near forest

SCDNR staff photo

River otter

cover. Small depressions (presumably used for dusting, resting or sleeping) are typical as are small piles of Spanish moss or leaf litter topped with scat.

Female otters usually give birth to two to four kits in dens located in hollow trees or logs or in or under some other types of shelter. The maritime forests on hammocks and other landmasses near tidal creeks likely provide isolated den sites within the coastal zone.

The Northern river otter is carnivorous and feeds mainly on fish, especially slow-moving species. Crayfish, crabs, amphibians and other aquatic animals may also be taken when available. Birds make up a relatively small portion of the diet, but otters will occasionally take marsh birds such as rails and waterfowl that are crippled or lost by hunters. Cursory observation of scat deposits at latrines or camps on South Carolina hammocks indicates that fish is the dietary staple in estuaries.

Common bat species of the coastal zone include the **free-tailed bat**, **evening bat**, **big brown bat**, **tri-colored bat** (also known as the eastern pipistrelle), **red and Seminole bats** and the migratory **hoary** and **silver-haired bats**. The free-tailed, evening, big brown and tri-colored bats are colonial cavity roosting species. That means they form groups or colonies, preferring to aggregate together in the summer and winter months. These bats use hollow trees, sheltered bridge structures, crevices such as those formed by loose bark, old cisterns and buildings. Only colonial cavity roosting species and sometimes silver-haired bats will use bat boxes.

Red, seminole and hoary bats are solitary foliage roosting species that hang under live or dead foliage, and under clumps of Spanish moss.

Mary Bunch

Big brown bat

None of the solitary, foliage roosting species are pests to homeowners. In winter, red and Seminole bats will sometimes shelter under leaf litter on the ground. Silver-haired bats are often found alone or in small groups. They prefer small cavities or crevices for roosting, including loose bark and stacks of firewood. Silver-haired and hoary bats are winter residents that migrate north for the summer. Although red bats are also migratory, they can be found year round in South Carolina.

All of South Carolina's bat species are nocturnal and eat only insects, therefore they are beneficial to humans because they reduce biting insects and agricultural pests. All bats have a low reproductive rate and populations are slow to recover from losses.

South Carolina has two species of fox, the **gray fox** and the **red fox**. The gray fox appears to be more common although both species are

found statewide. The gray fox is considered primarily a woodland inhabitant, although it benefits from an interspersion of forests and fields. The red fox is more abundant in areas of mixed, small wood lots and hedgerows. Foxes are generally secretive, nocturnal animals that avoid humans and play a beneficial role in the control of rats. Grey foxes appear to have become a more frequent visitor to developed areas, some even being spotted in downtown Charleston. There is a good chance that foxes will be found near homes situated in natural settings. Both species feed upon similar prey, including small mammals such as rabbits and rodents, as well as birds, insects, fruits and berries. Grays are known to eat persimmons, grapes and acorns. Both species will feed upon carrion.

A number of mice and rats inhabit maritime forests and associated habitats, including the **cotton rat**, **marsh rice rat**, **Eastern wood rat** and others (golden mouse, cotton mouse, eastern harvest mouse and pine vole). Mice and rats may be found in old fields, heavy vegetation at the edges of forests, ditches, marshes, thick grasses and sedges, burrows, thickets adjacent to beaches, beach dunes (particularly at night) and numerous other habitats. Nests are commonly placed under fallen logs, in crevices and in hollow logs or cavities of trees. Food consists of a wide variety including grasses, sedges, herbs, greens, corn, apples, potatoes, sugar cane, wild seeds, bird eggs, insects, baby birds and turtles, fiddler crabs, snails, clams, small fishes and carcasses. Rodents play an important ecological role because of their diverse food habits and because they are important prey for many mammals, birds and reptiles.

Cotton rats and marsh rice rats are the most abundant native small rodents in the coastal zone. The cotton rat typically occurs

Megan Gibney

Marsh rice rat

in hedge-rows, brushy fields, forest edges and maritime shrub thickets on barrier islands. It usually has a network of well-used trails and small burrows. Marsh rice rats are semi-aquatic, often entering shallow water to escape predators, and are rarely found far from grassy wetland edges. It frequently nests under logs and boards near the marsh and salt shrub thicket edges. It will also nest under logs and cover within the outer slopes of the maritime forest. Marsh rice rats are abundant and widespread in the coastal zone and are likely mainstays in the diet of many predators, including birds of prey, bobcats, minks and snakes.

The **black rat**, **Norway rat** and **house mouse** are non-native rodents frequently found in the maritime forest and throughout much of the State. These non-native, invasive rodents are typically the species that enter human buildings and thereby reach pest status.

Basic Needs for Mammals

Although many mammals, notably rodents and raccoons, have adapted to and exploited human development, most mammals remain secretive and generally avoid human activity. As a general rule, the larger the mammal, the more

buffer to development it requires. Mammals benefit from having access to dense forests with thick understories for cover dens, but forest edges and open habitats are equally valuable for many species, and particularly as primary foraging habitat.

Species of Concern

Populations of several species that use maritime forests and associated habitats are declining in abundance and are of special concern to resource managers.

The **painted bunting** is a nearctic-neotropical migratory species that occurs in the coastal zone as both a summer resident and transient. Until several decades ago, the painted bunting was very rare in most of the Southeast inland of the coastal zone. It is thought to have predominately used coastal islands and the near-coast mainland for breeding. Habitat loss from coastal development, perhaps in concert with fragmentation of forested areas of the inner coastal plain, is presumed to have sponsored the relatively recent range extension of this species into the interior coastal plain.

Steve Pittman

Painted bunting

Painted buntings nest in shrub thickets and tangles of vines, with nests usually 3-6 feet off the ground. Nests are occasionally placed at greater height in outer tree branches, and particularly in branches with Spanish moss. Preferred nesting habitat in the coastal zone includes shrub thickets on the outer edges of maritime forests and evergreen shrub thickets within maritime forest.

Ideal habitats for the painted bunting are complex forested areas with substantial edge, interior and perimeter shrub thickets and high canopies with grassy forest openings scattered beneath. Edges of coastal uplands near tidal marshes provide good nesting and foraging habitat. Transitional habitats between tidal marshes and maritime forests, such as salt flats, salt shrub thickets, grasslands and chaparral-like mixes of stunted trees and shrubs with interspersed clearings with grasses, provide excellent foraging areas for adults and young.

Painted buntings forage mostly on the ground or in low brush. Their diet consists of seeds and insects, with insects dominating during the breeding season. Seeds include wild grasses, sedges and herbs. Prey includes beetles, grasshoppers, crickets, caterpillars and other insects. On hammocks, females have been observed collecting grasshoppers in transitional habitats between tidal marshes and maritime forests. These were fed to young, and fledged juveniles have been frequently seen capturing grasshoppers. Painted buntings will supplement their diet by visiting bird feeders, particularly feeders containing white millet seeds.

The **common ground-dove** is a resident species and was historically restricted primarily to the South Carolina coastal zone, where it

was most common on barrier islands that provided a patchwork of maritime shrub thickets and maritime grasslands between maritime forests and primary sand-dunes of ocean beaches. Like the painted bunting, the common ground-dove's range has expanded inland to agricultural areas with open fields, hedge-rows and early successional scrub habitat as occurs in laid-out agricultural fields. This species is now generally absent or rare on intensively developed barrier islands.

The common ground-dove nests primarily in low shrubs adjacent to or within grasslands. Nests are occasionally placed in low grasses. It feeds mostly on seeds of grasses and herbs. In agricultural areas, it also eats waste cereal grains, such as corn, wheat, rye and millet and sunflower seeds. In areas with local populations, it may visit feeding stations where millet seed, cracked corn and/or sunflower seed are scattered directly on the ground or offered on a low platform feeder.

The **brown-headed nuthatch** is a resident landbird that is endemic to mature, open, pine-dominated forests of the coastal plain. The decline in abundance of this species over the last several decades is believed to be related to the steady loss of old-stand natural pine forests. It was likely most abundant centuries ago when the longleaf pine savanna was a primary landcover over much of the interior coastal plain of the Southeast.

Brown-headed nuthatches nest in cavities vacated by woodpeckers, but more often made in soft wood of dead pines or pine snags. This species is highly dependent upon pines for food. It gleans insects, particularly beetles and spiders, from dead and living pines during warm seasons and relies heavily upon pine seeds that it extracts from cones during fall and winter.

The brown-headed nuthatch is most often seen in the coastal zone in association with dead pines, which are frequently most abundant near the edge of the maritime forest and pine-dominated forests adjacent to estuarine marshes. This species does best in areas managed for old-growth longleaf pine.

John W. McCord

Eastern fox squirrel

The **Eastern fox squirrel** is considered to be in decline in the coastal zone of South Carolina. This squirrel is most common in mature pine-hardwood forests that have a relatively open understory. Food includes nuts, seeds, buds and flowers of pines and hardwoods. Green pinecones are a mainstay of the summer diet, and it is particularly fond of mushrooms or other fungi. The mushrooms on which it feeds occur primarily in areas of relatively open forest floor.

Like the Eastern gray squirrel, the Eastern fox squirrel uses both tree cavities and leaf nests for dens and for birthing young. It is generally replaced by the Eastern gray squirrel in dense forests with interior shrub thickets. Mature maritime forests with a closed canopy and areas of open understory will sponsor the Eastern fox squirrel. It is also present in similar forests on the sea islands and has been documented on a few large hammocks in Beaufort County.

The **Northern yellow bat** occurs primarily in the coastal zone of the southeastern United States. This species is considered imperiled primarily due to habitat loss from land development, but its regional population status is generally unknown.

The Northern yellow bat is believed to most commonly occur in pine-hardwood forests with permanent water sources nearby. Maritime forests and similar forests on large coastal islands and hammocks provide such habitat. The Northern yellow bat roosts by day, hanging under leaves and branches, and particularly under palm fronds and in Spanish moss clumps. At night, it forages over open areas like fields, marshes, pastures and lake and forest edges. The diet includes practically any flying insect, including mosquitoes. Of consideration in the protection of habitat for this species is retention of Spanish moss and old, dead cabbage palmetto fronds (which are typically removed by many property owners).

The **Eastern woodrat** occurs in much of the Southeast, but within the Atlantic coastal zone, is primarily restricted to South Carolina, Georgia and Florida. This small rodent is not a problem or nuisance to humans since it does not typically enter human buildings. A secretive species, it usually inhabits dense thickets in damp forests or near wetlands. The Eastern woodrat builds nests or lodges of sticks and leaves that are usually in holes in the ground, cavities at the base of trees, or in hollow logs. In the maritime forest it often uses hollow cabbage palmettos (standing dead trees or logs) as well as dense maritime shrub thickets. It eats mostly green vegetation, but will also consume fruits, nuts, fungi and seeds.

The **diamondback terrapin** occurs only in the estuarine waters of the coastal zone. It is largely aquatic but will bask on exposed banks of tidal creeks. Females nest on sandy beaches and in relict dunes or open, sandy grasslands associated with maritime forests of barrier islands and hammocks. Adults of this species have high site fidelity, rarely leaving their home creek. Diamondback terrapins are typically found in relatively small, shallow water creeks (less than 15 ft) and rarely venture into large waterways. Little is known about the habits of the juveniles. This species is threatened by multiple human activities including loss of nesting habitat to development, general estuarine habitat deterioration from siltation and pollution caused by runoff and other sources of chemicals and mortality from crab traps and road-kill. Additionally, nests are routinely destroyed by wild and domesticated mammals. The raccoon is likely the primary nest predator. The diamondback terrapin feeds principally upon marsh periwinkle or grass snails, fiddler crabs and small fish, but it occasionally eats carrion as evidenced by its attraction to baited crab traps.

The **Southern hognose snake's** range is primarily the coastal plain of the Southeast. It typically occurs in sandy areas commonly found in maritime forests and other coastal habitats. The Eastern hognose is a close relative with a

John W. McCord

Southern hognose snake

much broader distribution. Hognose snakes are undoubtedly killed by humans because the snakes are mistakenly identified as dangerous. The population of the Southern hognose snake has declined over the past several decades, likely from mortality inflicted by humans, pets and road-kill and because of habitat loss from coastal development.

This snake is active strictly by day and is most often seen on warm mornings during spring and fall. This species burrows and often seeks refuge underground. Hognose snakes feed almost exclusively on toads, although they will occasionally consume other prey such as lizards and frogs.

The **island glass lizard** is a rare species that is found only in the coastal zone of South Carolina and Georgia and through much of Florida. It only occurs where soil is sandy, such as in maritime forest and associated habitats of coastal islands. This lizard is secretive and is possibly largely nocturnal, presumably remaining hidden in sandy soil or under surface cover such as washed up, dead tidal marsh grass wrack on coastal shorelines during daylight. Little is known about its food habits, but it probably feeds primarily on insects, spiders and other invertebrates. Habitat loss and increased mortality from unnatural causes such as road-kill and predation by domestic cats are likely contributors to the current status of this legless lizard.

Box turtle

Copperhead snake

Bull frog

American alligator

Yellow rat snake

All photos by John W. McCord

How to Attract Wildlife

Any homeowner who has access to open space around his or her home can attract wildlife and play a role in sustaining natural resources. Most citizens, particularly those in urban settings, will likely prefer to limit wildlife attraction to birds and butterflies. Good wildlife habitat provides for the four basic life requirements: food, fresh water, cover or shelter and sufficient area to carry out life functions, particularly courtship and breeding. These basic requirements can be provided for at least some species in almost any yard, park or other area. Because each species has its own requirements, the widest variety of habitat types will result in the greatest number of species attracted. One should start small and gradually expand the habitat to attract a wider variety of species. An excellent starting point is planting and otherwise designing a garden to attract butterflies and birds. Because of their mobility, at least some species occur in even the largest metropolitan areas.

Butterflies

Planting for butterflies should include many varieties of flowering plants since different species may be attracted best to different types of flowers depending on color, size and shape of the blooms. Larger species generally visit larger and deeper throated flowers than do smaller species. Providing an assortment of flowering trees, shrubs, perennials and annuals will allow for the most diversity of available blooms from spring through fall when the adult butterflies are most active. Of course, planting for butterflies includes the use of many flowering plants that can easily be incorporated into any landscaping plan and add beauty and value to one's property.

John W. McCord

Monarch butterfly

Caterpillars or larvae of butterflies are even more selective than the adults about the plants on which they will feed. Many feed only on the foliage or other plant parts of just a few species or closely related group of plants. Including larval food-plants can improve one's chances of attracting desired species to the garden area, particularly those adults that rarely if ever feed at flowers.

Xeriscaping, the use of native and drought-tolerant species to promote water conservation, can provide excellent butterfly and other wildlife habitat as well. Lantana, for instance, is very drought-tolerant and is an excellent plant for butterflies and seed-eating birds and mammals. The use of native plants also reduces or eliminates the need for pesticides, which should be used sparingly, if at all, in any wildlife garden and certainly when attempting to attract butterflies and other insects. Some plants that are preferred food-plants for caterpillars and adults include: Hercules club, black cherry, sassafras, fennel, red bay, passion-flower, milkweed, pawpaw, violets, loquat, Carolina laurel cherry, daylilies, Salvia, rosemary, asters, marigolds and honeysuckle.

Birds

You can enjoy wildlife gardening by providing winter feeding stations and nesting boxes for birds. Feeding wintering birds is the most common

Steve Pittman

Cardinal

practice, but many different species of seed-eaters will use seed provided during the warmer months. High-energy foods such as suet (beef fat) and peanut butter mixed with seeds and hung in open mesh bags are more important for winter birds when energy demands are highest. These foods tend to become rancid during warm and hot periods in the South if they are not eaten quickly. Suggested foods for bird feeders include sunflower, niger, proso millet and cracked corn.

Providing cover and breeding habitat will attract birds to your garden. Many species prefer shrub thickets or trees nearby for rapid escapes from danger. Food, cover and breeding habitat can be provided by the same plantings if seed, fruit and nut-producing plants are used in the garden layout. Oaks, dogwood, hollies and fig are some excellent choices of trees. Wax myrtle, American beauty-berry, blueberries and Lantana are excellent shrubs providing cover and food. Evergreens such as pines and cedar should also be incorporated into the garden for winter cover. A mixture of deciduous and evergreen plants should be used to produce year-round cover and food. If you desire to attract hummingbirds, use feeders with four parts water and one part sugar – boiled for several minutes – being sure to replace the liquid every 3 to 7 days. Plants for hummingbirds include mimosa, red buckeye, red bee balm, cardinal flower, red four o'clock, trumpet vine, red petunias, coral honeysuckle, cross vine and cypress vine.

Nesting boxes will also attract birds. Allowing partially dead or dead standing trees or "snags" and dead limbs in living trees to remain on one's property will improve the area's attractiveness to woodpeckers and other insect-eating birds and can provide natural nesting cavities. Such dead wood should be removed if it could cause damage or injury if it were to fall.

Bird baths provide sufficient water sources for birds. Shallow bird baths with wet sand or clay are also good water sources for insects. Baths with misters or fountains are more attractive for birds, many of which seem to enjoy taking showers during particularly hot weather. Bird baths with flow-through water also do not require frequent cleanings as do those with static water, which can become stagnant and algae-filled. Diseases can easily be passed from bird to bird in static water containers if they are not cleaned with 10 percent chlorine bleach at least three times per year and filled regularly. Flow-through baths also provide permanent moisture at ground level that is attractive to a wide variety of wildlife, particularly insects and other invertebrates and amphibians.

To learn more about attracting wildlife and the SC Wildlife Federation's Backyard Wildlife Habitat™ Program, see: *http://www.scwf.org/index.php/education-programs/habitats/bwh*.

Gary Johnson

South Carolina Wildlife Federation certified wildlife habitat at the home of Karen and Gary Johnson

The following Best Management Practices (BMPs) are intended primarily to assist citizens who currently live in or plan to build a home(s) in South Carolina's coastal woodlands. Many of the suggestions are also applicable to homeowners or builders in almost any setting including cities or traditional urban developments. These BMPs should help citizens live in better harmony with wildlife, hopefully improving the quality of life for both the homeowners and the animals. Where appropriate, Web sites with more detailed information are provided. Additionally, we list "**References Used**" at the end of the text to assist readers who wish to learn more about a particular topic. It is not the purpose of this document to thoroughly address water quality BMPs, although a few are included because water quality is important for fish and aquatic invertebrates, as well as semi-terrestrial mammals and birds, particularly wading birds, diving birds and waterfowl.

Best Management Practices for the Community

These BMPs are suggested for planning or implementation at the community level in the form of local ordinances or community-wide guidelines.

- Encourage self-sustaining communities where homes, jobs and amenities are nearby (walking or biking distances). These communities foster healthier, safer lifestyles and help reduce the negative impacts of commuting.
- Ideally, home lots should be surveyed by someone well versed in local biota, who can identify rare native plants, particularly plants that serve important wildlife functions, and who can identify critical wildlife habitat that should be preserved. If possible, this should include mapping and/or photography of the parcel to assist in placement of the home. The survey should also include topography marked in one-foot contours. Members of the South Carolina Native Plants Society can provide assistance or names of experts (*http://www.scnps.org/*). Items to be marked include:
  - All trees and unusual or rare plant species (the "grand tree" concept of preserving only larger trees is contradictory to maintaining highest practical biological diversity).
  - Thickets, grassy swales or other areas that provide high quality habitat for nesting or foraging.
  - Low lying areas, including wetlands and depressions, that may retain surface water, even temporarily or seasonally.
  - Wildlife dens, nests and pathways.
  - Soils: erodible, fragile and fertile areas.
  - Links or connections with other important wildlife habitats.
- Encourage "cluster" development – Consider small, closely-spaced residential lots and large communal areas of green space, including undisturbed native habitat. The developed area should be examined closely to avoid loss of rare or significant habitat or plants. In clustered developments, avoid creating islands of isolated natural space by protecting travel corridors between

undeveloped natural spaces. See: *http://www.epa.gov/smartgrowth/index.htm* or *http://www.plannersweb.com*

- Build relatively narrow roads, unpaved if practical. Adopt traffic calming techniques such as street trees and prominently marked pedestrian crosswalks. Studies show that larger roads and wider lanes promote faster speeds and more accidents. Faster road speeds are correlated with higher fatality rates for humans and presumably would be the same for wildlife.
- An arborist's report should be obtained prior to selecting sites for any buildings, drives, or other footprints for constructed features in order to maximize protection of native trees and other plants. The arborist's report should address the health and structural stability of trees and should be a key factor in determining the locations of buildings and driveways.
- Require restoration of any construction-related disturbance to natural areas. If a home's construction must include temporary crossing of a wetland, temporary bridges, planks, mats or removable structures with gravel should be used. Construction runoff must be prevented from entering wetlands or at least filtered through straw bales, sediment fencing and other standard methods. See: *http://www.scdhec.gov/environment/ocrm/pubs/docs/swmanual.pdf*.
- Impervious surfaces should be minimized to the fullest extent feasible to encourage water percolation into the ground. This includes minimizing the size of roofs for homes and outbuildings and all paved surfaces including roadways and walks. Water quality and ecological health of nearby water bodies have

Cluster Development

Cluster development, or open space design, is a residential site design and zoning technique used to protect natural features of the landscape while allowing new development. New development is clustered on one portion of a property, leaving a large tract of environmentally sensitive or scenic land intact on the remainder of the parcel. Cluster developments promote both plant and animal diversity and also provide residents with opportunities for natural resource education. While this technique may significantly lower the impact on the natural landscape, it may also be more economical.

Economic benefits of open space development:

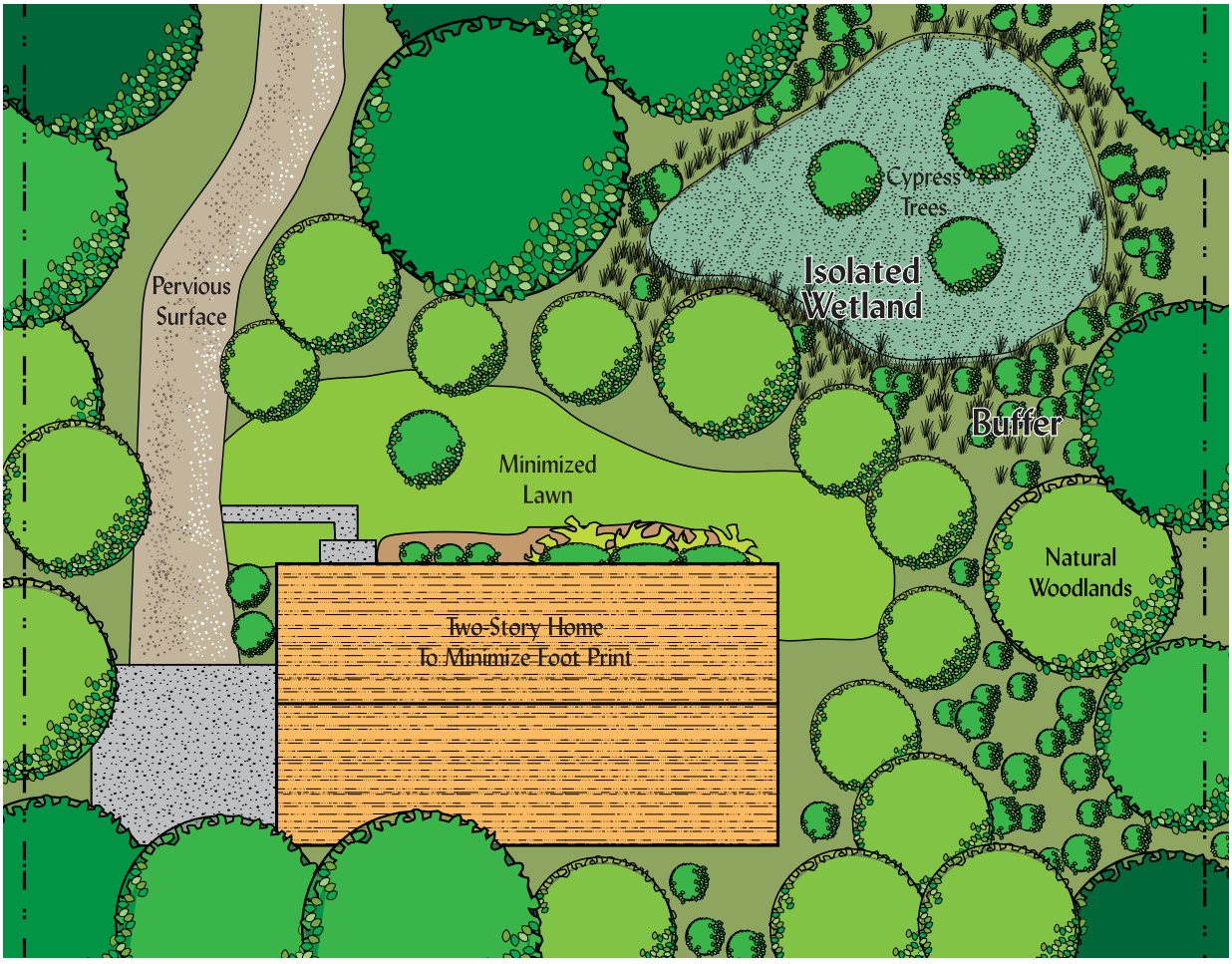
- Lowers initial land clearing and grading costs.
- Lowers infrastructure construction and maintenance costs.
- Lowers cost of storm water management.
- Minimizes costly and harmful wetland crossings.
- Preserves the maximum amount of land.
- Views and the ability to use preserved land are proven marketing strategies. Homes with these features sell for more than those without.
- Homes in these types of subdivisions tend to appreciate faster than those in conventional developments.

David Whitaker

House with garden path

been shown to be impaired when impervious surfaces exceed 10-20% of the total area of the community or neighborhood. See: *http://crd.dnr.state.ga.us/assets/documents/jrgcrddnr/ImperviousLitReview_Final.pdf*

- Roadway underpasses can be constructed for wildlife. Size and location depend upon the species that may regularly utilize the roadway crossing. See: *http://www.wildlifeandroads.org/decisionguide/2_1_6.cfm*
- Establish and enforce natural vegetative buffers around wetlands and water bodies. Adequate buffers (as large as practically possible) around wetlands provide habitat for reptiles, amphibians and birds. They also function to filter stormwater runoff into wetlands. Even ephemeral (temporary) wetlands serve ecological functions by providing habitat and reducing flooding by retaining rainfall runoff. Water retained in wetlands slowly recharges groundwater and does not contribute to runoff and associated erosion or introduction of contaminants into tidal marshes and creeks.



Mark Conrardy

Home with minimal impact on woodlands and nearby wetland

- "Brashing," the practice of clearing property lines of vegetation to complete surveys, should be avoided through the use of global positioning systems (GPS) that do not require a clear line of sight. If this is not feasible, care should be taken in pruning of trees and shrubs to avoid long-term damage, with special attention to rare or uncommon species.
- Maintain trees. Develop ordinances and/or restrictive covenants restricting tree removal, including a prohibition on removal of limbs greater than 6 inches unless through an approved permit or variance. Ideally, protect all trees regardless of size, because many ecologically important trees never reach "grand tree" status (i.e., large size). Minimally, protect trees over a certain minimal diameter.
- Grading and site disturbance should be limited to those areas within or immediately adjacent to building sites. Grading should follow the natural topography, to the extent possible, blending into the natural landscape.
- Avoid grade changes near trees. Generally do not add or remove more than 6 inches of soil within a tree's drip line (the perimeter of the tree's branch overhang).Tree walls that retain the elevation within the drip line may be built if grading is required. If a tree is necessarily severely impacted (by pruning or grading), it is probably best to remove the tree and replace it with a healthy smaller tree. Severely damaged trees are likely to die.
- Building height should be below the existing tree canopy. This will minimize the potential for bird strikes.
- Plan wildlife corridors. Plan for and allow connectedness of woodlands and other wildlife habitat. Consult with a wildlife biologist to determine likely movement routes between important habitats. See: *http://news.nationalgeographic.com/news/2006/09/060901-plant-corridors.html* and *http://www.conservationeconomy.net/wildlife_corridors.html*
- Encourage or foster open area plantings for birds and insects. (See Table 1)
- Protect and save small coastal islands. These small islands, sometimes referred to as hammocks or hummocks, provide some of the last remaining refuges for wildlife in heavily developed coastal regions. Hammocks are also important stopover stations for refueling and resting for migratory birds. They often serve as safe havens for wading birds, particularly during high tide. Along with providing habitat for animals, many of the small islands support rare plants that warrant protection.
- Retain some open natural areas through periodic cutting or burning (where practical and permissible). Access to open natural areas is important for a number of plant and animal species. See: *http://www.state.sc.us/forest/fire.htm*
- Do not use herbicides with surfactants near amphibian breeding areas (ephemeral or temporary wetlands).

Table 1. Plant species that can be used for open-space planting for insects and birds.

Common Name	Scientific Name	Type
Purple passionflower or maypop	*Passiflora incarnata*	perennial
Turkey tangle fogfruit or capeweed	*Phyla nodiflora*	perennial
Beach blanket-flower	*Gaillardia pulchella var. drummondii*	annual or perennial
Goldenmane tickseed or Texas coreopsis	*Coreopsis basalis*	annual or biennial
Greater tickseed or stiffleaf coreopsis	*Coreopsis major*	perennial
Golden tickseed	*Coreopsis tinctoria*	annual, biennial or perennial
Lanceleaf tickseed	*Coreopsis lanceolata*	perennial
Pinkscale blazing star	*Liatris elegans*	perennial
Shaggy blazing star	*Liatris pilosa*	perennial
Dense blazing star	*Liatris spicata*	perennial
Black-eyed susan	*Rudbeckia hirta*	perennial
Clasping heliotrope	*Heliotropium amplexicaule*	perennial
Nuttall's thistle	*Cirsium nuttallii*	annual or biennial; prefers damp soil
Spotted beebalm	*Monarda punctata*	perennial
Eastern purple Coneflower	*Echinacea pupurea*	perennial
Butterfly milkweed	*Asclepias tuberosa*	perennial
Hairy beggarticks or shepherd's needle	*Bidens pilosa*	annual
Pinkladies or white evening-primrose	*Oenothera speciosa*	perennial
Garden cosmos	*Cosmos bipinnatus*	annual
Garden zinnia	*Zinnia violacea*	annual

Best Management Practices for Neighborhoods

These BMPs are intended to provide assistance for homeowners in planned or previously developed neighborhoods who wish to minimize impacts upon native wildlife. These BMPs may be incorporated into restrictive covenants or homeowner association guidelines.

- Form a Property Owners or Homeowners Owners Association (POA or HOA) with wildlife conservation as one of the founding principles. Develop community-wide plans to handle nuisance and damage-causing wildlife, including lethal control, if warranted. In developing such plans, homeowners should consult with a licensed animal control expert before deciding on a course of action for dealing with nuisance wildlife. The mere sight of wildlife is generally not a legitimate reason for removal. POAs should set guidelines and provide this information to prospective property owners before purchasing or developing property. For example, alligators are an integral part of coastal landscapes, yet many homeowners irrationally fear small alligators less than 7-feet long that pose little real threat to residents. Many coastal communities will only remove alligators that pose an immediate threat to their residents or are located in such a place that their removal is warranted. It should be noted that

the American alligator is a protected species in South Carolina, and a depredation permit from the SCDNR is required by law before a "nuisance" alligator can be removed. Depredation permits may also be issued by the SCDNR for the taking of nuisance furbearing animals at any time of year. A depredation permit is not required by the property owner when capturing furbearing animals or squirrels within 100 yards of the owner's home, if the animals are causing damage to the owner's property. Animals captured under this exception may not be relocated and must be released or destroyed.

- Limit the footprint of each home to a small percentage of the lot's area to preserve native vegetation and wildlife habitat, as well as to minimize the extent of impervious surface and, consequently, stormwater run-off. See: *http://www.lowimpactdevelopment.org*.
- Limit the length and width of driveways and other paved surfaces to the extent practicable – 10 feet wide for straight drives and 12 feet for curved drives may be adequate. Avoid root zones of trees, staying 10 feet away from healthy trees that are 6 inches or greater in diameter. Drives and parking areas should ideally be made of pervious materials such as compacted earth or sand, open-celled pavers (turf blocks), granite, cobblestone or native stone, mulch, porous concrete or asphalt, or new technologies such as grass overlaying porous mats.
- For individual homes, minimize the size of lawns and avoid high maintenance turf grasses that require frequent mowing and use of fertilizers and pesticides. Consider a communal, grassy open space that is carefully selected to avoid loss of rare or significant plant habitats. See: *http://www.scwf.org/index.php/education-programs/habitats/fence-garden/34-garden-native*.
- Develop a wildlife management plan with a primary goal of sustaining a diversity of habitats which may include routine clearing or promotion of thick understory. Longleaf pine habitat may require burning.
- Set aside open spaces dedicated to pets (e.g., dog parks), where dispensers with bags for pet waste are prominently displayed. These open fields and associated woodland "edge" habitats can be managed for the benefit of birds and other wildlife. Uncollected pet waste contributes to contamination of nearby waterways.
- Stormwater collection should work with natural drainage systems to the greatest extent possible. Natural swales and native vegetation should be used to absorb and filter runoff and promote infiltration.
- Oyster shell should not be used in construction or driveways. Oyster shell is in short supply for planting as cultch for natural shellfish beds. (See the SCDNR website for a list of shell recycling drop-off locations.)
- Paths to an adjacent water body should utilize native materials such as mulch or porous material and should be sinuous so as to discourage erosion.
- Establish a communal garden and green house for native plant propagation and seed production.
- Prohibit high VOC (Volatile Organic Compounds) paints and varnishes. This reduces potential contamination of groundwater, run-off and landfills, as well as ozone depletion.

- Regarding exterior paint colors, select colors that are subdued and blend in with the natural landscape. Aside from being aesthetically displeasing in scenic vistas, bright colors can be disorienting to wildlife, particularly at night.
- Encourage the use of native plants (particularly those that provide forage and habitat for wildlife) (see Appendix A).
- Discourage the use of invasive or high-maintenance non-native plants through education and restrictive covenants (see Appendix C).
- Remove non-native, invasive plant species (see Appendix C) particularly where they impact wetlands and other important wildlife habitat. If feasible, invasive species should be removed over the entire landscape, concentrating first on wetlands. If an herbicide is used to remove an invasive species, be sure to follow label directions and apply only to species for which the herbicide is approved.
- Utilize plant species and planting patterns that match animal needs. Retain as much native vegetation from pre-development as possible (see Appendix A for suggested native plants). See: *http://www.scwf.org/index.php/education-programs/habitats/fence-garden/34-garden-native*
- Some wildlife species, particularly birds, can be disoriented by lights or their behavior can be negatively affected. Use low-wattage landscape lighting (preferably solar-powered). Do not use flood or spot lights, particularly those that are "up-lighted." Use cutoff lights that prevent upward illumination, glare shields or louvered lights. Consider installing timers and motion detectors to use lights only when needed. Structures (houses, fences, walkways) should be neutral colors that will not upwardly reflect light. Mounting heights for required outdoor lights should be no higher than necessary to achieve lighting objectives.

Why Buffers Matter

Vegetative buffers bordering waterbodies are important to an ecosystem for a variety of reasons. Buffers maintain water quality because they absorb nutrients and trap sediments. Nutrients, in the form of phosphorus and nitrogen, can contribute to excessive algal blooms and water quality deterioration by causing dissolved oxygen levels to drop, potentially killing aquatic animals. Excessive sediments can clog or erode gills of aquatic animals, smother bottom-dwelling animals and block sunlight penetration. Sediments can also contribute to deterioration of organic matter, cause reduced dissolved oxygen and often carry harmful pollutants into the water. Buffers also provide habitat for wildlife, including protected access to wetlands and water. Wide and continuous buffers allow animals to migrate along corridors bordering marshes, waterways and waterbodies. As a general rule, wider buffers accommodate larger animals and greater species diversity. The prevailing belief of the scientific and planning communities is that buffers should be at least 100 feet wide to adequately protect resources.

David Whitaker

Vegetative buffer bordering a waterbody

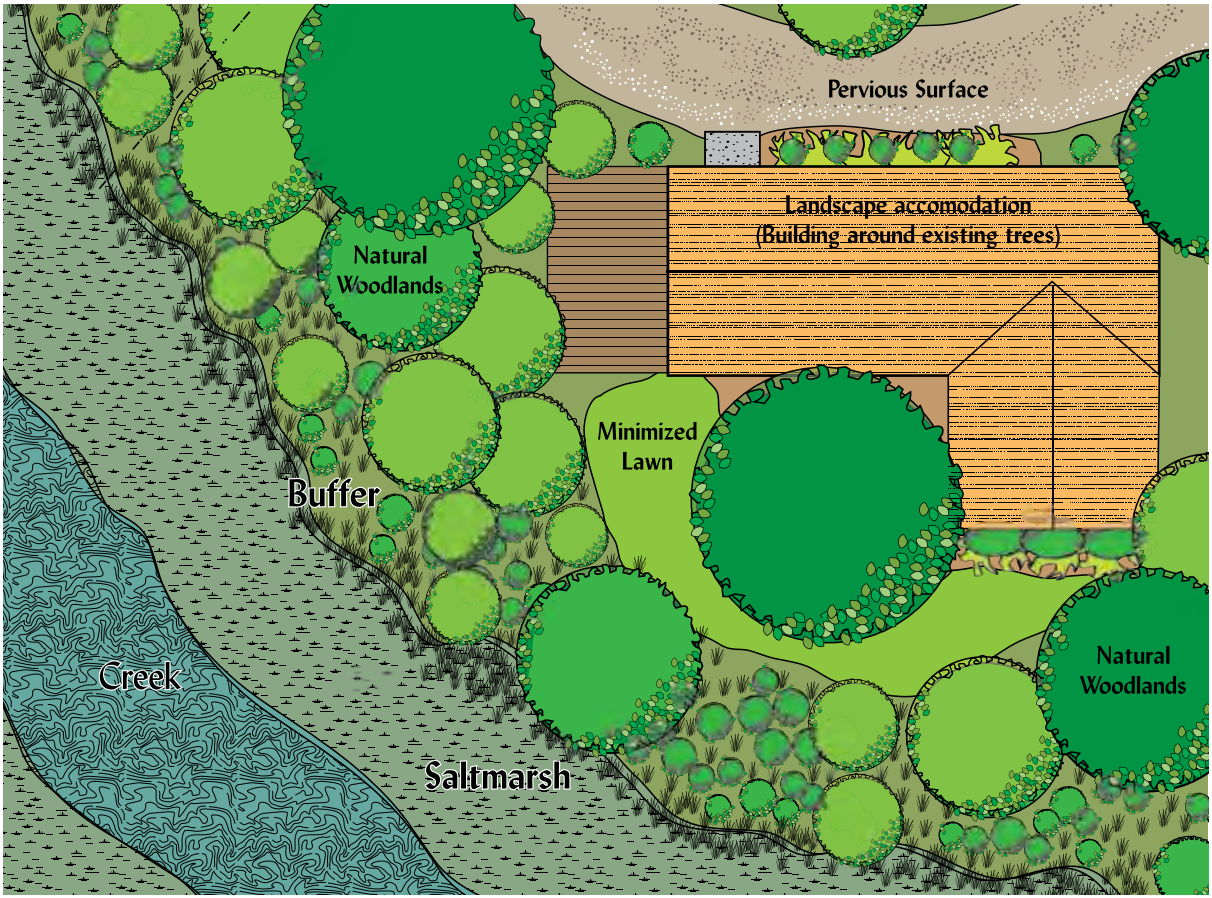
- Establish and maintain butterfly fields or meadows with wildflowers. Such natural areas create habitat diversity and valuable edges.
- In communal or adjacent natural spaces, allow dead trees that are not safety hazards to stand for woodpeckers and other wildlife that use cavities and tree hollows.
- Bird-window strikes resulting in mortalities are staggering and estimates range as high as 100 million birds per year. Large plate-glass windows where the outside habitat is mirrored are problematic, particularly when birds are frightened by predators and dart off without selecting safe escape routes. Feeders are best situated either as far from windows as is practical or very near windows. When feeders are far away, the birds have an opportunity to recognize windows. Smaller windows reduce the chance of impact as do fritted (patterned) and colored glass windows. Keeping homes below the tree canopy level will reduce the potential for strikes by night-flying migratory birds. Habitat reflected in untreated reflective glass should be avoided by applying measures that obscure the reflection. If strikes are a problem, options include exterior shade cloths, plastic film on windows, hawk silhouettes and blocking through-house line of sight to the outdoors. See: *http://www.eartheasy.com/article_birds_windows0704.htm and http://www.toronto.ca/lightsout/pdf/development_guidelines.pdf*

Best Management Practices for Homeowners or Single Home Builders

These BMPs are intended to provide advice to private homebuilders who elect to build a single home within a coastal forest or for homeowners who wish to adapt their present property to be more wildlife-friendly. Many of these BMPs can also be applied at the community or neighborhood level.

- Minimize the footprint of homes and outbuildings – build small to conserve resources, and "up," not "out," to conserve land and reduce the amount of impervious surface. Limit vertical height to that of the largest oak or magnolia, or the mean height of the adjacent forest. Limit total "disturbed area" (including landscaped area).
- Homes should be situated so that they "fit within the natural landscape." This may require non-traditional floor plans and/or placement of homes at angles to property lines or in portions of lots where impacts to trees, wetlands, or desirable plants will be avoided or minimized. Ideally, do not build within 30 feet of any tree greater than 6-inches in diameter (measured 4.5 feet above the ground).
- Home site selection and design should be planned to minimize solar heat gain to the home's interior during summer and maximize it during winter. This can be accomplished through careful orientation of the house with respect to the sun, as well as incorporating solar roof panels, roof overhangs and deciduous shade trees into the design of the house and landscape.
- When building a home, establish a "building envelope" that is the area of the site within which all construction will be contained. This should include the construction area and a carefully limited work zone. Non-native plants (but not invasive species, which should be avoided) and constructed landscape features should be limited to the area within the envelope.

- Homes should be built in a manner that minimizes the need for pesticides (e.g., by incorporating structural controls such as sand barriers and metal shields to provide termite protection around the foundation). See: *http://www.ces.ncsu.edu/depts/ent/notes/Urban/termites/pre-con.htm and http://www.greenbuilder.com/sourcebook/termite.html*
- Maximize the use of efficient, alternative energy sources (e.g., solar, geothermal, wind); energy-efficient lighting and appliances; locally manufactured materials; durable materials like brick and cement/fiber siding; recycled materials such as tiles made from recycled glass, cotton insulation made from recycled fabric; wood from sustainably grown forests and other sustainably grown natural products like cork and bamboo. See: *http://www.buildinggreen.com , http://www.usgbc.org and http://www.greenbuilder.com/sourcebook/DimensionalLumber.html*
- Exterior colors for homes, outbuildings, fences, etc., should be natural, neutral or muted colors – bright whites or other bright colors should be avoided. Aside from being esthetically displeasing in scenic vistas, bright colors can be disorienting to wildlife, particularly at night and in a wooded setting.



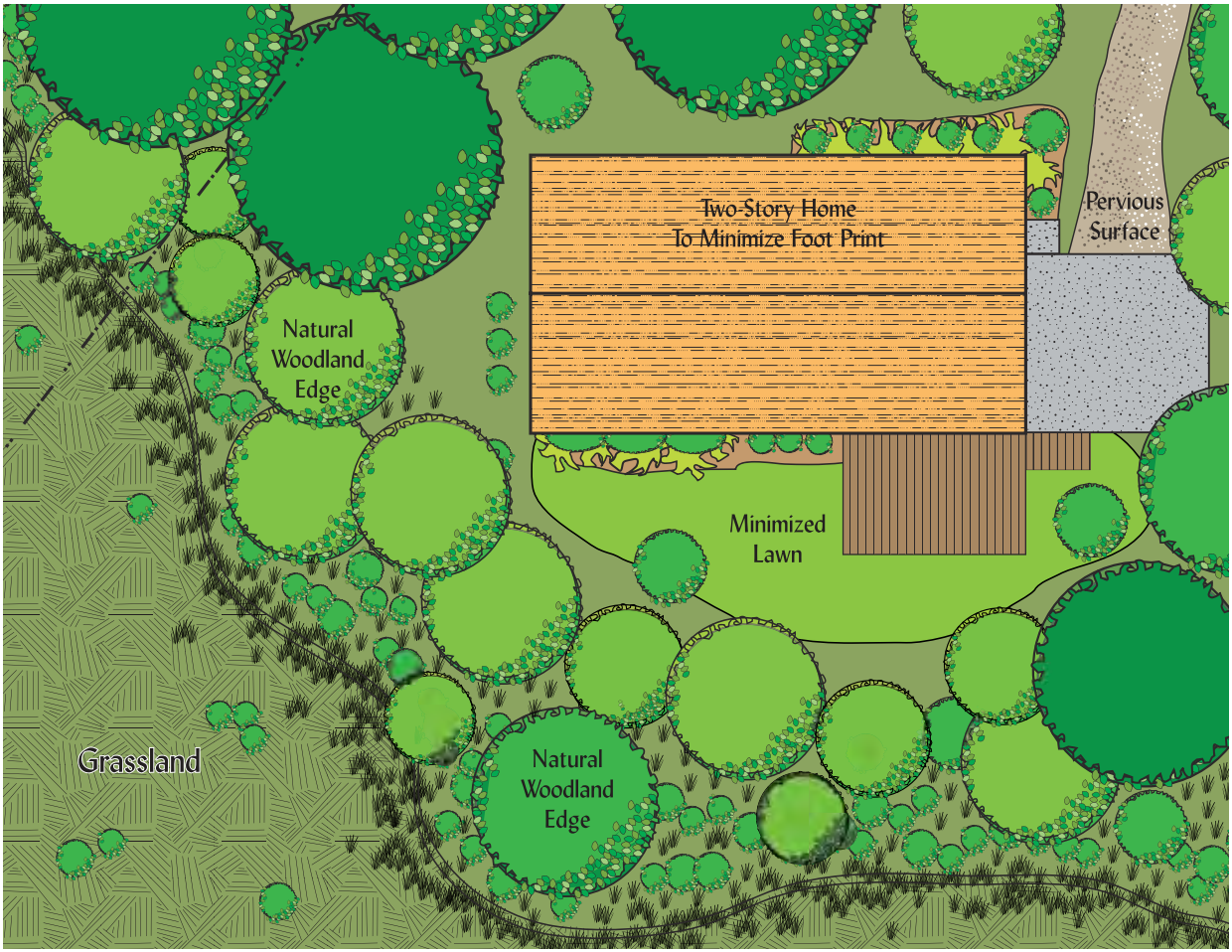
Mark Conrardy

Home with minimal impact on woodlands and saltmarsh

- Fences, walls and other barriers along property lines should allow for the passage of small mammals.
- For homes adjacent to coastal water bodies where docks may be constructed to gain access to water, preferentially select a path to the water that minimizes the length of the dock, as well as the disturbance to vegetated saltmarsh and intertidal shellfish beds. If practical, design the dock to avoid inserting pilings through the bed's shell matrix. Use construction methods that minimize collateral damage to the saltmarsh and mudflats – such as using floating barges instead of heavy machinery on bottom mats. Docks should be as narrow as practical and elevated sufficiently to allow adequate light to reach vegetation under the dock. Docks with inadequate elevation above the marsh are also likely to trap floating saltmarsh grass wrack and debris, which can settle on the bottom at low tide and smother living grass.
- Develop a compost bin for recycling kitchen waste and yard vegetation. Construct it in such a manner that wildlife cannot gain entry. See: *http://www.clemson.edu/extension/hgic/plants/other/compost_mulch/hgic1600.html*
- Consider constructing a rain garden for individual homes, particularly in locations where natural wetlands are absent or have been impacted by overall community development. Constructed wetlands and rain gardens should be designed to collect stormwater run-off from impervious surfaces (e.g., roofs, driveways, patios) and overflow from rain barrels. These landscape features filter pollutants from stormwater and potentially provide useful habitat for amphibians, birds and butterflies. For information on Low Impact Development ("LID") and construction of rain gardens, see: *http://www.lowimpactdevelopment.org/raingarden_design*
- Collect rainwater from roofs in barrels or cisterns for watering plants. Ideally, roofs that are stainless steel, tile, terra cotta, or slate are preferred for collecting clean rainwater. Paints and solder can contain lead and may not be appropriate for some uses. Other surfaces (such as treated wood or asphalt) are not appropriate for drinking water but may be useful for other domestic purposes including watering plants. See: *http://www.clemson.edu/public/carolinaclear/what_you_can_do/raingardens.html*
- Excessive rainwater can be handled by infiltration through slowing water down or holding it, and increasing soil permeability. This includes use of bioswales, natural or created wetlands, or a French drain or "soakaway" (dry well). See: *http://landscaping.about.com/cs/lazylandscaping/ht/French_drains.htm*
- Protect water bodies and wetlands with vegetated buffers, ideally using native plants. The wider the buffer the better, but buffers at least 100-feet wide are recommended adjacent to water bodies and 35-foot buffers around critical areas such as isolated wetlands or rare plant communities. See: *http://www.scdhec.gov/environment/ocrm/pubs/docs/backyard.pdf*
- Use mulch in flower beds to conserve water and minimize use of herbicides to control weeds. See: *http://www.clemson.edu/extension/hgic/plants/other/compost_mulch/hgic1604.html*

- Practice "Integrated Pest Management" (IPM) to minimize the use of pesticides and fertilizers, and follow all label directions carefully. See: *http://www.epa.gov/opp00001/factsheets/ipm.htm*
- Avoid the use of automatic misting systems to control mosquitoes around coastal wetlands and waterbodies.
- Use low-maintenance native plants in landscaping, particularly xerophytic plants. These plants will require less water and pesticide use. See: *http://www.scwf.org/index.php/education-programs/habitats/fence-garden/34-garden-native*
- Maintain a canopy of large native trees – a predevelopment planning map should show all trees greater than 4-inches in diameter.
- Maintain a subcanopy of smaller native trees, shrubs, grasses and other woody and herbaceous plants, while allowing a "view corridor." A "broken view corridor" with alternating clearings and retained native patches of vegetation should provide wildlife corridors and nesting and foraging habitat.
- Retain fallen logs and dead standing trees, if not a danger to home or a safety risk. These provide good feeding habitat and shelter for amphibians, reptiles, birds and mammals. (Logs can be fuel for fires; remove any within 30 ft. of a structure.)
- Retain transitional edge habitats around wooded areas. These areas are important as feeding locations for birds and other wildlife. Install and maintain bird boxes/bird feeders and bat boxes. See: *http://www.batcon.org/index.php/get-involved/install-a-bat-house.html*
- For bat habitat, retain Spanish moss and old palm fronds that are used as shelter by yellow bats.
- Avoid or minimize use of plant fertilizers in natural communities as these can encourage weak and weedy invasive plants. If fertilizer is used, try to rely on compost or organic fertilizers. Composting on-site materials and vegetative kitchen waste helps retain nutrients, thereby reducing the need for fertilizers. When planning to build on a lot, space should be dedicated to composting.
- Do not allow free-ranging pets, except in designated, contained areas. Dogs may dig turtle nests for species like diamondback terrapin. Cats frequently prey upon song birds, amphibians and reptiles. See: *http://audubonmagazine.org/audubonliving/audubonliving0811.html*
- Collect and dispose of pet waste through incineration or in approved septic tank systems or community sewer treatment facilities. Pet waste is known to contribute to contamination and closure of coastal shellfish beds.
- If bears are known to be within several miles, take steps to reduce attractions and to prevent problems. These include: do not put out trash the evening before a pickup; store trash in a secure location or in a bear-resistant container, and frequently clean trash cans; do not burn or bury trash; do not use bird feeders when bears are nearby; do not leave overnight or store food on screened porches; avoid planting fruit-bearing trees; thoroughly clean outdoor grills; and do not leave uneaten pet food outdoors.

- If alligators are found in nearby wetlands or water bodies, the most important rule is leave them alone and do not feed them. Fed alligators will associate humans with food, therefore they lose their natural fear of humans. Remember that although alligators appear slow and awkward, they can move at surprising speeds over short distances. Never disturb a nest or capture a young alligator, even if the mother is not visible. She is often watching and can be defensive of her nest. Keep pets and children away from alligators, and do not swim in areas where alligators are present.



Home with minimal impact on woods and nearby natural grassland

Fire Prevention

Homes built within woodlands can be vulnerable to forest fires. The national "Firewise Communities" program is a multi-agency effort designed to reach beyond the fire service by involving homeowners, community leaders, planners, developers and others in an effort to protect people, property and natural resources from the risk of wildfire – before a fire starts. For more complete information, see the Web sites below or contact the South Carolina Forestry Commission.

Some Firewise recommendations for protecting homes built in natural settings from a wildfire include the following. During the dry season, try to keep the area immediately near the home irrigated. Do not allow dead pine needles, weeds and grasses to accumulate on or near the home. Clean gutters of leaves and pine straw. If mulch is used adjacent to the home, use a less flammable type. Planting beds mulched with pine straw should not be within 3-feet of flammable structural components such as vinyl siding or wood lattice. Do not use highly flammable vegetation in landscaping within 30 feet of the home. Examples include red cedar, pine saplings and wax myrtle. Prune lower limbs of tall trees to prevent ground fires from creeping up and igniting tree canopies. No tree limbs should be within 10 feet of your home. Use native vegetation for landscaping but be careful where it's planted – keeping in mind the flammability characteristics of the plant. Roofs should be constructed of Class A fire resistant materials (Class A asphalt or fiberglass shingles, slate or clay tiles, cement, concrete or metal roofing, or terra-cotta tiles). Use cement, plaster, stucco and concrete masonry such as stone, brick or block for exterior walls. Install metal screens in foundation vents to prevent wind-blown burning material from entering beneath the home and use chimney screens. See: *http://www.firewise.org/resources/homeowner.htm* or *http://www.state.sc.us/forest/wyncwpp.pdf*. Also, *see http://www.itm-info.com/homesc/images/landscape.pdf for a list of fire-resistant landscaping plants.*

David Whitaker

Home built in natural setting with fire prevention kept in mind

Glossary

Aerie – The lofty nest of a bird of prey (such as a hawk or eagle).

Aboreal – Adapted to life in the trees; tree dwelling.

Arborist – A specialist who is trained in the art and science of planting, caring for and maintaining individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care.

Boreal – Referring to northern regions. Specifically, the region south of the Arctic Circle and north of latitude 50 deg. N; the term may also refer to an area dominated by coniferous forests.

Buffer – A zone of land, trees, or vegetation bordering an area, often adjacent to water bodies or wetlands.

Biological diversity – The variety and complexity of life on Earth at all scales. Examples include: genetic, species, ecosystem and landscape.

Bioswales – A bioswale is a landscape element consisting of a low-gradient, open channel possessing a cover of vegetation through which surface runoff is directed in order to improve water quality through removal of silt and pollution.

Brashing – The removal of the lower tree branches for clearing a line of sight.

Canopy – The more or less continuous cover of leaves and branches in a forest, usually formed by the crowns of the dominant and co-dominant trees.

Cistern – A reservoir or tank for holding water, especially for catching and holding rainwater for later use.

Coniferous – Pertaining to conifers which are evergreen trees and shrubs that bear naked seeds in cones. Examples of conifers include pine, fir and spruce trees.

Compost – Substance composed mainly of partly decayed organic material that is applied to fertilize the soil and to increase its humus content. Compost usually is made from plant materials e.g., grass clippings, vegetable tops, garden weeds, hay, tree leaves, sawdust and peat.

Compost bin – The container used to make compost, which is a combination of food waste and brown waste that is being decomposed through aerobic de-composition into a rich black soil.

Cultch – Any substrate laid on the seabed with the purpose of encouraging molluscan larvae (spat) settlement.

Deciduous – Of or pertaining to shrubs or trees which lose their leaves in winter.

Drip line for trees – The area directly located under the outer circumference of the tree branches. This is where the tiny rootlets are located that take up water for the tree.

Dry well – An underground structure that disposes of unwanted water.

Edge habitat – Zone of transition created by adjacent and distinctly different habitats.

Embedded habitats – Smaller distinctive habitats that can be found within a larger, general habitat type (e.g., maritime forest).

Ephemeral wetlands – Depressional wetlands that temporarily hold water in the spring and early summer or after heavy rains. Periodically, these wetlands dry up, often in mid to late summer. They are isolated without a permanent inlet or outlet, but may overflow in times of high water. Ephemeral wetlands are free of fish, which allows for the successful breeding of certain amphibians and invertebrates.

Footprint (for a home) – The entire perimeter edge of a structure; it allows calculation of the square footage of land that is occupied by a building.

French drain – A subterranean drain used to divert excess rainfall runoff. It usually consists of a shallow ditch with a gravel or rock-filled bottom that is overlain with sand. Turf may be added for esthetics. The drain should slope in the desired direction of water flow.

Geothermal heating – Geothermal heating of homes with heat pumps (GHPs) uses the constant temperature of the earth as the exchange medium instead of air. Heat pumps work like a refrigerator that can run in reverse. With ground loop geothermal systems, heat is taken from or deposited to the earth by use of water in a ground loop pipe.

Global Positioning Systems (GPS) – A satellite navigation system designed for and operated by the U.S. military but can be used freely by anyone. Often used by civilians for navigation purposes.

Hammocks (hummocks) – Coastal islands that occur between barrier islands and the mainland. They are surrounded by wetlands or tidally influenced water and are typically less than 1,000 acres in size.

Herbicides – Chemicals used to kill unwanted plants.

Impervious surface – A surface that prevents precipitation from infiltrating soil. They are mainly artificial structures such as pavements (roads, sidewalks, driveways and parking lots) that are covered by impenetrable materials such as asphalt, concrete, brick and stone – and rooftops. Soils compacted by urban development are also highly impervious.

Invasive plants – A non-native plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Integrated pest management – Rationale that combats plant pests while reducing any negative impacts that control methods might have on the environment. The protocols of IPM seek to minimize the use of chemical controls like broad spectrum pesticides by carefully optimizing cultural practices while using a combined pest control approach that includes biological, environmental, mechanical and, as a last resort, chemical methods.

Isolated wetlands – Wetland types that are completely surrounded by uplands; there are no apparent surface water inlets and/or outlets.

Mast – The edible vegetative or reproductive part produced by woody species of plants, i.e. trees and shrubs, that wildlife species and some domestic animals consume. Hard mast comes in the form of acorns, hickory nuts and beechnuts. Examples of soft mast are leaf buds, catkins, true berries, drupes and rose hips.

Mulch – A protective covering that is spread on the ground around plants to inhibit evaporation and weed growth, control soil temperature, enrich the soil, or prevent the dispersal of pathogens.

Native plants – In the western hemisphere, indigenous plants that grew naturally in the area before the arrival of European colonists.

Pervious surface – Surfaces that allow precipitation to infiltrate the soil.

Riparian – Of or relating to or located on the banks of a river or stream; "riparian land."

Salinity – The measure of the amount of salts dissolved in water. Estuaries exhibit a range of salinity as they are places where saline ocean water mixes with fresh water.

Sea Islands – A chain of 100 or more relatively large islands off the coast of South Carolina, Georgia and northern Florida. The ocean side of the islands is generally sandy; the side facing the mainland is marshy. The islands may be bordered by rivers, sounds, bays and the intracoastal waterway.

Scrub – A general term for vegetation dominated by shrubs, i.e. low woody plants, which typically forms an intermediate community between grass and high forest.

Silviculture – The science or practice of growing trees for wood production.

Subcanopy – Shrubs and trees that grow under the canopy.

Surfactants – Wetting agents that lower the surface tension of a liquid, allowing easier spreading, and lower the interfacial tension between two liquids.

Sustainably grown forest products – Products that can be collected in a renewable fashion on a small scale by local peoples. The harvesting of forest products without destroying the forest.

Swale – A wide, shallow depression in the ground to form a channel for water drainage. May serve in the place of curbs and roadway gutters.

Uplighting – The landscaping practice of directing light from ground-placed electric light fixtures up into shrubbery or a tree canopy.

Volatile Organic Compounds (VOC) – Compounds that have a high vapor pressure and low water solubility. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, pharmaceuticals and refrigerants. VOCs typically are industrial solvents, such as trichloroethylene; fuel oxygenates, such as methyl tert-butyl ether (MTBE); or by-products produced by chlorination in water treatment, such as chloroform. VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners and dry cleaning agents. VOCs are common ground-water contaminants.

Wildlife corridors – An area of habitat connecting wildlife populations.

Xerophytic plants – Plants that naturally grow in dry regions and are often structurally modified to withstand dry conditions.

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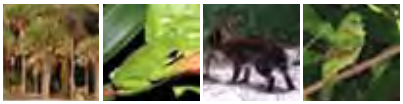

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Appendix A

Native plants of particular importance that should be retained and encouraged for sustaining wildlife. (Also, see *http://www.scwf.org/index.php/education-programs/34-garden-native*)

Plant Species	Wildlife Value
Herbaceous (including grasses & sedges)	
Blackberry/Dewberry (*Rubus* sps.)	Fruit eaten by many birds (particularly Northern mockingbird and brown thrasher), and also by mammals, including raccoons and gray foxes.
Blackseed Speargrass (*Piptochaetium avenaceum*)	Seeds mature in late spring and early summer; consumed by songbirds, including painted buntings and Northern cardinals.
Coral Bean (*Erythrina herbacea*)	Flowers used by ruby-throated hummingbirds. Foliage is caterpillar host for the long-tailed skipper butterfly.
Goldenrods (*Solidago* sps.) Seaside Goldenrod (*S. sempervirens*)	Forest borders and marsh edges. Flowers of seaside goldenrod used heavily by migratory monarchs (butterfly). Seeds (fall & winter) used by small songbirds, particularly American goldfinches and sparrows.
Gulf Croton (*Croton punctatus*)	Occurs in open, sandy areas such as dune grasslands. Seeds used heavily by ground-feeding birds such as the common ground-dove and mourning dove.
Nuttall's Thistle (*Cirsium nuttallii*)	Flowers are valuable nectar source for many butterflies and the ruby-throated hummingbird. Seeds used by many songbirds, including Carolina chickadees.
Panicgrasses (*Panicum* sps.), including: Switchgrass (*P. virgatum*) Bitter Panicgrass (*P. amarum*)	Seeds mature late spring through fall; consumed by songbirds, including painted buntings and Northern cardinals, also by the mourning dove (common ground-dove in dunes) and Northern bobwhite.
Partridge Berry (*Mitchella repens*)	Winter fruit eaten by birds and small mammals.
Partridge Pea (*Chamaecrista fasciculata*)	Seeds – many birds, including the Northern bobwhite. Plant (foliage, buds & blooms) – caterpillar host for cloudless sulphurs and sleepy oranges (both butterflies).
Paspalum grasses (*Paspalum* sps.) Thin Paspalum (*P. setaceum*)	Thin paspalum (*P. setaceum*) fairly common in sandy forest clearings. Seeds eaten by many small birds, including the painted bunting.
Pokeweeds (*Phytolacca* sps.) American (*P. americana*) Maritime (*P. rigida*)	Fruit eaten by many songbirds, particularly brown thrashers, Northern mockingbirds and gray catbirds. Seeds consumed by ground-feeding birds (*e.g.* mourning doves, Northern bobwhites, and sparrows) in winter.

Plant Species	Wildlife Value
Herbaceous (including grasses & sedges)	
Prickly Pear cacti (*Opuntia* sps.) Midden Prickly Pear (*O. stricta*) Dune Prickly Pear (*O. pusilla*) Prickly Pear (*O. humifusa*)	Fruits are persistent and are eaten by Eastern woodrats, Eastern box turtles and raccoons.
Sea Ox-eye (*Borrichia frutescens*)	Blooms used extensively by various butterflies, particularly the American lady, painted lady, common buckeye, Eastern pygmy blue and various skippers. Also provides excellent cover.
Spanish Moss (*Tillandsia usneoides*)	Valuable nesting material, especially for Northern parulas and yellow-throated warblers. Painted buntings and other songbirds sometimes build nests in clumps of Spanish moss.
Swallow-wort (*Seutera angustifolia*)	Nectar source for many butterflies and the ruby-throated hummingbird. Caterpillar host-plant for monarchs and queens.
Sweetgrass (*Muhlenbergia sericea*) Hairgrass (*Muhlenbergia capillaris*)	Excellent cover for birds such as sparrows; also, seed source for similar small birds.
Turkey Tangle Fogfruit; Capeweed (*Phyla nodiflora*)	Groundcover (open areas). Flowers provide nectar for many butterflies. Larval host-plant for the phaon crescent (butterfly).
Witch grasses; Rosette grasses (*Dichanthelium* sps.)	Seeds mature late spring through fall; consumed by songbirds, including painted buntings and Northern cardinals, also by mourning doves and Northern bobwhites.
Yellow Passionflower (*Passiflora lutea*)	Plant used as larval host by several butterflies (Gulf fritillary, variegated fritillary and zebra longwing). Seeds eaten by various birds.
Woody Vines	
Crossvine (*Bignonia capreolata*)	Spring blooms provide nectar for ruby-throated hummingbirds as they migrate north or arrive in breeding areas.
Greenbriers (*Smilax* sps.)	Persistent fruit eaten by birds and small mammals, particularly in winter when more preferred fruits are absent. Tangles provide excellent cover for birds and other wildlife.
Poison Ivy (*Toxicodendron radicans*)	Fruit consumed by many migratory and winter birds; heavily used by the yellow-rumped warbler and woodpeckers in winter.
Trumpet Creeper (*Campsis radicans*)	Blooms (late spring – fall) used by ruby-throated hummingbirds.

Plant Species	Wildlife Value
Woody Vines	
Trumpet Honeysuckle (*Lonicera sempervirens*)	Blooms (spring – fall) excellent for ruby-throated hummingbirds; blooms also pierced at base for nectar access by the orchard oriole.
Virginia Creeper (*Parthenocissus quinquefolia*)	Fruit eaten by many birds in fall and early winter, including migratory thrushes.
Wild Grapes (*Vitis* sps.) Muscadine Grape (*V. rotundifolia*) Summer Grape (*Vitis aestivalis*)	Fleshy fruit eaten by mammals (*e.g.* raccoons, Eastern gray squirrels, Virginia opossums); also, smaller fruit eaten by birds such as American robins and brown thrashers.
Shrubs and Small Trees	
American Beauty Berry (*Callicarpa americana*)	Late summer – fall fruit used by more than 40 bird species, particularly relished by Northern mockingbirds, brown thrashers and gray catbirds. Also used by Eastern towhees and Northern cardinals.
Blueberries (*Vaccinium* sps.)	Summer fruit consumed by many songbirds and mammals. Flowers (mostly spring) used by butterflies and bees.
Button-bush (*Cephalanthus occidentalis*)	Summer blooms used heavily by butterflies and other insects. Seeds valuable for waterfowl (*e.g.* wood duck) and songbirds.
Common Chinquapin (*Castanea pumila*)	Nutlets, which resemble small chestnuts, eaten by wild turkeys and other birds and by raccoons and small mammals, including squirrels. Flowers very attractive to butterflies and bees.
Devil's Walking Stick (*Aralia spinosa*)	Summer flower clusters used by bees and butterflies. Fall fruit valuable for many birds particularly migratory species such as thrushes and gray catbirds.
Dwarf Palmetto (*Sabal minor*)	Summer flowers used by butterflies and bees. Fall fruit eaten by small mammals and raccoons and also by many migratory, resident and winter birds.
Elderberry (*Sambucus canadensis*)	Clusters of fruit ripen in late summer and early fall and provide food to more than 50 species of birds, including many migratory songbirds.
Groundsel Tree; Eastern Baccharis (*Baccharis halimifolia*)	Particularly valuable as nectar sources for fall migratory monarchs and other butterflies. Also attracts many smaller insects that are used as food by many birds, particularly migratory species such as prairie and palm warblers. Seeds eaten by winter sparrows. Excellent nesting habitat for birds.
Hercules Club (*Zanthoxylum clava-herculis*)	Flowers used by many butterflies, particularly in fall by migratory monarchs. Seeds consumed by sparrows and other ground-foraging, seed-eating birds. Plant is native larval food of giant swallowtail, the largest North American butterfly.

Plant Species	Wildlife Value
Shrubs and Small Trees	
Red Buckeye (*Aesculus pavia*)	Spring blooms provide nectar for ruby-throated hummingbirds as birds migrate north or arrive in breeding areas.
Saltwater False Willow (*Baccharis angustifolia*)	Flowers attract butterflies and other insects in late summer and early fall. Smaller insects are used as food by many birds, particularly migratory species such as the prairie and palm warblers. Seeds eaten by winter sparrows. Excellent nesting habitat for birds.
Saw Palmetto (*Serenoa repens*)	Thickets provide dense cover used by many wildlife species. Flowers used heavily by European honey bee and other insects. Fruit eaten by birds and small mammals.
Shellmound Buckthorn (*Sageretia minutiflora*)	Rare plant usually associated with Native American shell deposits; produces abundant small fruit in fall that persist into winter. Fruit eaten by birds. Plants form nearly impenetrable thickets that provide excellent wildlife cover and bird nesting habitat.
Sparkleberry (*Vaccinium arboreum*)	Fruit not as preferred as other soft-fleshed blueberries, but persistent fruit eaten by many birds in winter. Blooms (spring) heavily used by butterflies and bees.
Tough Bumelia (*Sideroxylon tenax*)	Summer blooms used by many insects. Fall, olive-like fruit important for migratory birds, particularly gray catbirds and thrushes.
Wax Myrtle (*Morella cerifera*)	Fruit highly valuable to many birds, fall and winter. Winter fruits are mainstay in diet of wintering tree swallows and yellow-rumped warblers. Shrubs provide cover and are often used for nesting by birds, including painted bunting.
Wild Olive (*Osmanthus americana*)	Summer blooms used by many insects. Fall, olive-like fruit important for migratory and wintering birds.
Winged Sumac (*Rhus copallina*)	Fruit clusters or heads persist through winter and are particularly valuable to winter birds, such as hermit thrush.
Yaupon (*Ilex vomitoria*)	Female plants produce abundant, persistent red fruit used by many birds, including resident and migratory songbirds, fall – early spring.
Trees	
American Beech (*Fagus grandifolia*)	Nuts eaten by wild turkeys, woodpeckers, Eastern towhees and many other birds, as well as by small animals.
American Holly (*Ilex opaca*)	Female plants produce abundant, persistent red fruit used by many birds, including resident and migratory songbirds, fall – early spring.

Plant Species	Wildlife Value
Trees	
Bays (*Persea* sps.) Red (*P. borbonia*) Swamp (*P. palustris*)	Fruits ripen in fall and persist through winter and are consumed by migratory and winter birds and by small mammals. Foliage is the obligate larval food for palamedes swallowtail, one of the largest coastal butterflies.
Black Cherry (*Prunus serotina*)	Summer fruit consumed by resident and summer resident birds and by mammals (*e.g.* raccoon, gray fox and Virginia opossum).
Cabbage Palmetto (*Sabal palmetto*)	Summer flowers used by butterflies and bees. Fall fruit eaten by small mammals and raccoons and also by many migratory and winter birds. Hanging, dead fronds provide important cover for roosting bats and owls and for treefrogs.
Carolina Laurelcherry (*Prunus caroliniana*)	Early spring blooms used by many insects (*e.g.* butterflies & bees). Abundant late summer through winter fruit used by birds, particularly in winter when other fruit sources are sparse.
Flowering Dogwood (*Cornus florida*)	Fall fruit relished by many birds, including American robins, rose-breasted grosbeaks and woodpeckers.
Maples (*Acer* sps.) Red (*A. rubrum*) Southern Sugar (*A. barbatum*)	Late winter – early spring buds eaten by winter birds, particularly American goldfinches and purple finches. Spring, winged seeds eaten by birds and small mammals.
Mockernut Hickory (Carya *alba*)	Nuts are important winter food for the Eastern gray and Eastern fox squirrels, Southern flying squirrel and rodents. Nuts also eaten by woodpeckers. Cavities and crevices in dead or dying wood are used extensively for nesting and dens by many birds, reptiles and mammals.
Oaks (*Quercus* sps.) Cherrybark (*Q. pagoda*), Darlington (*Q. hemisphaerica*), Live (*Q. virginiana*), Southern Red (*Q. falcata*), Water (*Q. nigra*), Willow (*Q. phellos*) and others	Acorns are a sustaining food resource for many wildlife species in winter, including Eastern gray and Eastern fox squirrels, Southern flying squirrels, white-tailed deer, wild turkeys, woodpeckers, blue jays and many other birds. Cavities and crevices in dead or dying wood are used extensively for nesting and protection by many birds, reptiles and mammals.
Persimmon (*Diospyros virginiana*)	Fleshy fall – winter fruit eaten by raccoons, Virginia opossums, gray foxes and birds such as the Northern mockingbird.
Pignut Hickory (*Carya glabra*)	Nuts are important winter food for the Eastern gray and Eastern fox squirrels, Southern flying squirrels and rodents. Nuts also eaten by woodpeckers. Cavities and crevices in dead or dying wood are used extensively for nesting and dens by many birds, reptiles and mammals.
Pines (*Pinus* sps.) Loblolly (*P. taeda*), Longleaf (*P. palustris*), Short-leaf (*P. echinata*), Slash (*P. elliottii*), Spruce (*P. glabra*) and others	Seeds in cones very valuable resource for many birds (*e.g.* brown-headed nuthatch, Carolina chickadee, pine warbler, Northern bobwhite) and squirrels. The Eastern fox squirrel often "eats" green cones. Large pines provide excellent nesting habitat for bald eagles and great blue herons. The red-cockaded woodpecker makes cavities in live longleaf pines. Slash pine is most salt tolerant and was likely once the dominant near-coast pine. Spruce pine in damp or marl forests.

Plant Species	Wildlife Value
Trees	
Red Mulberry (*Morus rubra*)	Summer fruits are highly used by many birds and by raccoons, Virginia opossums, gray foxes and Eastern gray squirrels.
Southern Magnolia (*Magnolia grandiflora*)	Late summer and fall fruit eaten by birds, including vireos and woodpeckers.
Southern Red Cedar (*Juniperus virginiana* variety *silicicola*)	Fruits used heavily fall through early spring by many birds, perhaps most notably by cedar waxwings. Trees and thickets provide excellent year-around cover and bird nesting habitat.
Sugarberry (*Celtis laevigata*)	Fall fruits provide important resource for migratory birds. Foliage is only larval host for three coastal butterflies: hackberry emperor, tawny emperor and American snout.
Sweetgum (*Liquidambar styraciflua*)	"Gum balls" produce abundant, small, winged seeds that are picked from the fruit in fall and winter by birds such as American goldfinches, Carolina chickadees, tufted titmice and downy woodpeckers. Seeds on ground are highly valuable to mourning doves, Northern bobwhites, Northern cardinals, Eastern towhees, winter sparrows and others.
Wild Olive (*Osmanthus americana*)	Fall fruits persist into winter and are used by migratory, resident and winter birds and by small mammals.
Willows (*Salix* sps.) Black (*S. nigra*) Coastal Plain (*S. caroliniana*)	Colonies at wetland borders provide important nesting sites for wadingbirds (herons and egrets).

Appendix B

Rare and uncommon native plants.

Common Name	Species Name	Primary Habitat
Seabeach amaranth	*Amaranthus pumilus*	Beach flats
Spreading sandwort	*Arenaria lanuginosa*	Maritime forest clearings; dunes
Bottlebrush threeawn grass	*Aristida spiciformis*	Wet pinewoods; open, acidic seepages
Terrestrial water-starwort	*Callitriche terrestris*	Ditches; open depressions
Golden canna	*Canna flaccid*	Fresh marsh; ditches; wet savannas
Willdenow's sedge	*Carex basiantha*	Damp forests with calcareous soil
Sandywoods sedge	*Carex dasycarpa*	Maritime forests; dry forests
Pillpod sandmat	*Chamaesyce hirta*	Sandy clearings
Satincurls	*Clematis catesbyana*	Forested shell middens and shell-mounds
Pinebarren sunrose	*Crocanthemum corymbosum*	Maritime forest clearings; relic dunes
Leafless swallow-wort	*Cynanchum scoparium*	Coastal hammocks
Piedmont flatsedge	*Cyperus tetragonus*	Maritime forest; relic dunes
Needleleaf rosette grass	*Dichanthelium aciculare*	Sandy, open forests
Godfrey's privet	*Forestiera godfreyi*	Shell middens and shell-mounds
Southern privet	*Forestiera segregate*	Shell middens and shell-mounds
Beach morning glory	*Ipomoea imperati*	Beach fore-dunes and beach flats
Large-stem morning glory	*Ipomoea macrorhiza*	Open shell middens
Sweetgrass	*Muhlenbergia sericea*	Grasslands near dunes and saltmarsh
Midden prickly pear	*Opuntia stricta*	Open shell middens and dunes
Florida pellitory	*Parietaria floridana*	Coastal clearings, often calcareous soil
Whisk fern	*Psilotum nudum*	Damp forests; marl deposits; foundations
Bluff oak	*Quercus austrina*	Forests with shell or marl
Shellmound buckthorn	*Sageretia minutiflora*	Shell middens and shell-mounds
Fourleaf vetch	*Vicia acutifolia*	Margins of brackish and fresh wetlands

Appendix C

Invasive plants that should be avoided or targeted for eradication in South Carolina's coastal forests. (source: *http://www.se-eppc.org/southcarolina/*)

Trees

- Tree of heaven (*Ailanthus altissima*)*
- Silktree, mimosa (*Albizia julibrissin*)*
- Chinese parasol tree (*Firmiana simplex*)*
- Chinaberry tree (*Melia axedarach*)*
- Chinese tallow-tree (*Triadica sebifera*)*
- Princess tree (*Paulownia tomentosa*)*
- Camphor tree (*Cinnamomum camphora*)
- White mulberry (*Morus alba*)
- White poplar (*Populus alba*)
- Paper mulberry (*Broussonetia papyrifera*)
- Sawtooth oak (*Quercus acutissima*)

Shrubs

- Thorny olive (*Elaeagnus pugens*)*
- Autumn olive (*Elaeagnus umbellata*)*
- Two color bush clover, shrub lespedeza (*Lespedeza bicolor*)*
- Chinese privet (*Ligustrum sinense*)*
- Japanese privet (*Ligustrum japonicum*)*
- Japanese knotweed (*Polygonum cuspidatum*)*
- Multiflora rose (*Rosa multiflora*)*
- Beach vitex (*Vitex rotundifolia*) *
- Scotch broom (*Cytisus scoparius*)
- Leartherleaf mahonia (*Mahonia bealei*)
- Nandina (*Nandina domestica*)
- Trifoliate orange (*Poncirus trifoliata*)

* Severe Threat

- Sweet breath of spring (*Lonicera fragantissima*)
- Saltcedar, tamarisk, French tamarisk (*Tamarix ramosissima, T. parviflora, T. gallica*)

Vines

- English ivy (*Hedera helix*)*
- Japanese climbing fern (*Lygodium japonicum*)*
- Japanese honeysuckle (*Lonicera japonica*)*
- Kudzu (*Pueraria montana*)*
- Japanese wisteria (*Wisteria floribunda*)*
- Chinese wisteria (*Wisteria sinensis*)*
- Bigleaf periwinkle (*Vinca major*)*
- Sweet autumn virgin's bower (*Clematis terniflora*)
- Asian/Oriental bittersweet (*Celastrus orbiculatus*)
- Air potato, Chinese yam (*Dioscorea oppositifolia*)
- Cherokee rose (*Rosa laevigata*)

Grasses/Sedges

- Cogongrass (*Imperata cylindrica*)*
- Tall fescue (*Lolium arundinaceus*)*
- Japanese stilt grass, Nepalese browntop (*Microstegium vimineum*)*
- Chinese silvergrass (*Miscanthus sinensis*)*
- Bahia grass (*Paspalum notatum*)*

Grasses/Sedges continued

- Common reed, phragmites (*Phragmites australis*)*
- Golden bamboo, fishpole bamboo (*Phyllostachys aurea*)*
- Johnson grass (*Sorghum halepense*)*
- Giant reed (*Arundo donax*)
- Pampas grass (*Cortaderia selloana*)
- Dallis grass (*Paspalum dilataum*)
- Vasey's grass (*Paspalum urvillei*)
- Weeping love grass (*Eragrostis curvula*)

Herbs

- Bull thistle (*Cirsium vulgare*)*
- Showy tattlebox (*Crotalaria spectabilis*)*
- Queen Anne's lace/ wild carrot (*Daucus carota*)*

* Severe Threat

- Serecea, Chinese bush clover (*Lespedeza cuneata*)*
- Liriope, monkey grass (*Liriope muscari*)*
- Rattlebox, scarlet wisteria tree, purple sesbania (*Sesbania punicea*)*
- Tropical spiderwort, bengal dayflower (*Commelina bengalensis*)
- Wart removing herb, marsh dewflower (*Murdannia keisak*)
- Tropical soda apple (*Solanum viarum*)
- Elephant's ear, coco yam, taro (*Colocasia esculenta*)
- Smooth rattlebox (*Crotalaria pallida*)
- Mascarene Island leafflower (*Phyllanthus tenellus*)
- Leafflower shatterstone, chamber bitter (*Phyllanthus tenellus*)
- Witchweed (*Striga asiatica*)

Appendix D

Common and scientific names used in the document.

Common Name	Scientific Name
A	
American alligator	*Alligator mississippiensis*
American beauty berry	*Callicarpa Americana*
American crow	*Corvus brachyrhyncos*
American goldfinch	*Carduelis tristis*
American holly	*Ilex opaca*
American lady	*Vanessa virginiensis*
American oystercatcher	*Haematopus palliates*
American pokeweed	*Phytolacca Americana*
American robin	*Turdus migratorius*
American snout	*Libytheana bachmanii*
Atlantic Coast slimy salamander	*Plethodon chlorobryonis*
B	
Bald eagle	*Haliaeetus leucocephalus*
Banded water snake	*Nerodia fasciata*
Barn owl	*Tyto alba*
Big cordgrass	*Spartina cynosuroides*
Bitter panicgrass	*Panicum amarum*
Blackberry/dewberry	*Rubus* sps.
Black cherry	*Prunus serotina*
Black gum	*Nyssa sylvatica*
Black-crowned night heron	*Nycticorax nycticorax*
Blackseed speargrass	*Piptochaetium avenaceum*
Black-throated blue warbler	*Dendroica caerulescens*
Black rat	*Rattus rattus*
Black vulture	*Coragyps atratus*
Black willow	*Salix nigra*
Blueberries	*Vaccinium* sps.
Blue-gray gnatcatcher	*Polioptila caerulea*
Blue jay	*Cyanocitta cristata*

Common Name	Scientific Name
B	
Bluff oak	*Quercus austrina*
Bobcat	*Lynx rufus*
Broadhead skink	*Eumeces laticeps*
Brown-headed nuthatch	*Sitta pusilla*
Brown pelican	*Pelecanus occidentalis*
Brown thrasher	*Toxostoma rufum*
Button-bush	*Cephalanthus occidentalis*
C	
Cabbage palmetto	*Sabal palmetto*
Canada goose	*Branta Canadensis*
Carolina basswood	*Tilia americana var.caroliniana),*
Carolina buckthorn	*Frangula caroliniana*
Carolina chickadee	*Poecile carolinensis*
Carolina laurelcherry	*Prunus caroliniana*
Carolina wren	*Thryothorus ludovicianus*
Cedar waxwing	*Bombycilla cedrorum*
Cherrybark oak	*Quercus pagoda*
Chickasaw plum	*Prunus angustifolia*
Chinese privet	*Ligustrum sinense*
Chinese tallow-tree	*Triadica sebifera*
Chuck-will's widow	*Caprimulgus carolinensis*
Cloudless sulphur	*Phoebis sennae eubule*
Coastal plain willow	*Salix caroliniana*
Common buckeye	*Junonia coenia*
Common chinquapin	*Castanea pumila*
Common ground-dove	*Columbina passerine*
Common moorhen	*Gallinula chloropus*
Cooper's hawk	*Accipiter cooperii*
Coral bean	*Erythrina herbacea*
Corn snake	*Elaphe guttata*
Cotton rat	*Sigmodon hispidus*
Coyote	*Canis latrans*
Crossvine	*Bignonia capreolata*

Common Name	Scientific Name
D	
Darlington oak	*Quercus hemisphaerica*
Devil's walking stick	*Aralia spinosa*
Diamondback terrapin	*Malaclemys terrapin centrata*
Domestic cat	*Felis catus*
Downy woodpecker	*Picoides pubescens*
Dune prickly pear	*Opuntia pusilla*
Dwarf palmetto	*Sabal minor*
E	
Eastern bluebird	*Sialia sialis*
Eastern box turtle	*Terrapine Carolina*
Eastern cottonmouth	*Agkistrodon piscivorus*
Eastern cottontail	*Sylvilagus floridanus*
Eastern fox squirrel	*Sciurus niger*
Eastern glass lizard	*Ophisaurus ventralis*
Eastern gray squirrel	*Sciurus carolinensis*
Eastern kingsnake	*Lampropeltis getula getula*
Eastern narrowmouth toad	*Gastrophryne carolinensis*
Eastern phoebe	*Sayornis phoebe*
Eastern pygmy blue	*Brephidium isophthalma*
Eastern screech-owl	*Otus asio*
Eastern towhee	*Pipilo erythrophthalmus*
Eastern wood rat	*Neotoma floridana*
Elderberry	*Sambucus Canadensis*
European honey bee	*Apis mellifera*
European starling	*Sturnus vulgaris*
F	
Flatwoods plum	*Prunus umbellate*
Florida privet	*Forestiera segregate*
Flowering dogwood	*Cornus florida*
G	
Giant swallowtail	*Heraclides cresphontes*
Glossy ibis	*Plegadis falcinellus*

Common Name	Scientific Name
G	
Godfrey's privet	*Forestiera godfreyi*
Goldenrods	*Solidago* sps.
Grape	*Vitis* sps.
Gray catbird	*Dumetella carolinensis*
Great blue heron	*Ardea Herodias*
Great egret	*Ardea alba*
Great horned owl	*Bubo virginianus*
Green anole	*Anolis carolinensis*
Greenbriers	*Smilax* sps.
Green heron	*Butorides virescens*
Green treefrog	*Hyla cinerea*
Groundsel tree; Eastern baccharis	*Baccharis halimifolia*
Ground skink	*Scincella lateralis*
Gulf croton	*Croton punctatus*
Gulf fritillary	*Agraulis vanillae nigrior*
H	
Hackberry emperor	*Asterocampa celtis*
Hercules club	*Zanthoxylum clava-herculis*
Hermit thrush	*Catharus guttatus*
House mouse	*Mus musculus*
I	
Island glass lizard	*Ophisaurus compressus*
J	
Japanese honeysuckle	*Lonicera japonica*
Juda's bush	*Iresine rhizomatosa*
K	
L	
Large-tuber morning-glory	*Ipomoea pandurata*
Late-flowering thoroughwort	*Eupatorium serotinum*
Leafless swallow-wort	*Cynanchum scoparium*
Little blue heron	*Egretta caerulea*
Live oak	*Quercus virginiana*

Common Name	Scientific Name
L	
Loblolly pine	*Pinus taeda*
Loggerhead turtle	*Caretta caretta*
Longleaf pine	*Pinus palustris*
Long-tailed skipper	*Urbanus proteus*
M	
Mallard	*Anas platyrhynchos*
Maritime pokeweed	*Phytolacca rigida*
Marsh elder	*Iva frutescens*
Marsh fimbry	*Fimbristylis castanea*
Marsh rabbit	*Sylvilagus palustris*
Marsh rice rat	*Oryzomys palustris*
Midden prickly pear	*Opuntia stricta*
Mink	*Mustela vison*
Mockernut hickory	*Carya alba*
Monarch	*Danaus plexippus*
Mourning dove	*Zenaida macroura*
Muscadine grape	*Vitis rotundifolia*
N	
Nine-banded armadillo	*Dasypus novemcinctus*
Northern bobwhite	*Colinus virginianus*
Northern cardinal	*Cardinalis cardinalis*
Northern mockingbird	*Mimus polyglottos*
Northern parula	*Parula Americana*
Northern river otter	*Lutra Canadensis*
Norway rat	*Rattus norvegicus,*
Northern yellow bat	*Lasiurus intermedius*
Nuttall's thistle	*Cirsium nuttallii*
O	
Orchard oriole	*Icterus spurious*
Orange-crowned warbler	*Vermivora celata*
Osprey	*Pandion haliaetus*
P	
Painted bunting	*Passerina ciris*

Common Name	Scientific Name
P	
Painted lady	*Vanessa cardui*
Palamedes swallowtail	*Pterourus palamedes*
Palm warbler	*Dendroica palmarum*
Panicgrasses	*Panicum* sps.
Partridge berry	*Michella repens*
Paspalum grasses	*Paspalum* sps.
Persimmon	*Dispyros virginiana*
Pied-billed grebe	*Podilymbus podiceps*
Pignut hickory	*Carya glabra*
Pileated woodpecker	*Dryocopus pileatus*
Pine warbler	*Dendroica pinus*
Poison ivy	*Toxicodendron radicans*
Pond pine	*Pinus serotina*
Post oak	*Quecus stellata*
Prairie warbler	*Dendroica discolor*
Prickly pear	*Opuntia humifusa*
Purple finch	*Carpodacus purpureus*
Purple martin	*Progne subis*
Q	
Queen	*Danaus gilippus*
R	
Raccoon	*Procyon lotor*
Red bay	*Persea borbonia*
Redbay ambrosia beetle	*Xyleborus glabratus*
Red-bellied woodpecker	*Melanerpes carolinus*
Red-cockaded woodpecker	*Picoides borealis*
Redbelly water snake	*Nerodia erythrogaster*
Red buckeye	*Aesculus pavia*
Red maple	*Acer rubrum*
Red mulberry	*Morus rubra*
Redroot flatsedge	*Cyperus erythrorhizos*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*

Common Name	Scientific Name
R	
Rock pigeon	*Columba livia*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Ruby-crowned kinglet	*Regulus calendula*
Ruby-throated hummingbird	*Archilochus colubris*
S	
Saltwater false willow sassafras	*Sassafras albidum*
Saw palmetto	*Serenoa repens*
Sea ox-eye	*Borrichia frutescens*
Seaside goldenrod	*Solidago sempervirens*
Sharp-shinned hawk	*Accipiter striatus*
Shellmound buckthorn	*Sageretia minutiflora*
Short-leaf pine	*Pinus echinata*
Slash pine	*Pinus elliottii*
Sleeping plant; partridge pea	*Chamaesyce fasciculate*
Sleepy orange	*Eurema nicippe*
South Carolina slimy salamander	*Plethodon variolatus*
Snowy egret	*Egretta thula*
Southeastern five-lined skink	*Eumeces inexpectatus*
Southern black racer	*Coluber constrictor priapus*
Southern flying squirrel	*Glacomys volans*
Southern hognose snake	*Heterdon simus*
Southern leopard frog	*Rana utricularia*
Southern magnolia	*Magnolia grandiflora*
Southern red cedar	*Juniperus virginiana* variety *silicicola*
Southern red oak	*Quercus falcate*
Southern sugar maple	*Acer barbatum*
Southern toad	*Bufo terrestris*
Spanish moss	*Tillandsia usneoides*
Sparkleberry	*Vaccinium arboretum*
Spear orach	*Atriplex patula*
Spruce pine	*Pinus glabra*
Squirrel treefrog	*Hyla squirella*
Sugarberry	*Celtis laevigata*

Common Name	Scientific Name
S	
Summer grape	*Vitis aestivalis*
Swallow-wort	*Seutera angustifolia*
Swamp bay	*Persea palustris*
Swamp gum	*Nyssa biflora*
Sweetgrass	*Muhlenbergia sericea*
Sweetgum	*Liquidambar styraciflua*
Sweet scent	*Pluchea odorata*
Switchgrass	*Panicum virgatum*
T	
Tawny emperor	*Asterocampa clyton*
Thin paspalum	*Paspalum setaceum*
Tough bumelia	*Sideroxylon tenax*
Tree swallow	*Tachycineta bicolor*
Tricolored heron	*Egretta tricolor*
Trumpet creeper	*Campsis radicans*
Trumpet honeysuckle	*Lonicera sempervirens*
Tufted titmouse	*Baeolophus bicolor*
Turkey tangle fogfruit; capeweed	*Phyla nodiflora*
Turkey vulture	*Cathartes aura*
U	
V	
Variegated fritillary	*Euptoieta Claudia*
Virginia creeper	*Parthenocissus quinquefolia*
Virginia opossum	*Didelphis virginiana*
W	
Water oak	*Quercus nigra*
Wax myrtle	*Morella cerifera*
White ibis	*Eudocimus albus*
White-tailed deer	*Odocoileus virginianus*
Widow's sedge	*Carex distenta*
Wild olive	*Osmanthus Americana*
Wild turkey	*Meleagris gallopavo*

Common Name	Scientific Name
W	
Willow oak	*Quercus phellos*
Winged sumac	*Rhus copallina*
Witch grasses; rosette grasses	*Dichanthelium* sps.
Wood duck	*Aix sponsa*
Wood stork	*Mycteria Americana*
X	
Y	
Yaupon	*Ilex vomitoria*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Yellow-billed cuckoo	*Coccyzus americanus*
Yellow-crowned night heron	*Nyctanassa violacea*
Yellow passionflower	*Passiflora lutea*
Yellow poplar	*Liriodendron tulipifera*
Yellow rat snake	*Elaphe obsoleta quadrivittata*
Yellow-rumped warbler	*Dendroica coronate*
Yellow warbler	*Dendroica petechia*
Z	
Zebra longwing	*Heliconius charitonius*

DNR

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