CHAPTER 3: SOUTH CAROLINA'S TERRESTRIAL AND AQUATIC HABITATS BY ECOREGION

South Carolina is divided into five ecoregions as one moves from the northwest corner of the State to the southeast: Blue Ridge (Mountains), Piedmont, Sandhills, Coastal Plain, and Coastal Zone. Other sub-zones often demarcated in the State include the Fall Line (where the rolling hills of the Piedmont "fall away" into the flatter Coastal Plain) and the Slate Belt (running southwest from Lancaster County through Saluda County). Likewise, the five ecoregions are sometimes further divided into upper, lower, inner, or outer. This chapter summarizes the State's habitats that are found in each ecoregion, first beginning at a course scale and then discussing finer scale habitats that may be categorized under each or embedded within. Some may themselves contain microhabitats which various plant and animal Species of Greatest Conservation Need (SGCN) rely upon. It is important to the overall diversity of the State, and the greater Southeastern Region, that representative examples of all native habitats be a part of South Carolina's portfolio of protected lands. These priority habitats may be at either the course or the fine scale or even be the ecotones between habitat types. The South Carolina Department of Natural Resources (SCDNR) strives to follow the conservation biology principles of resiliency, redundancy, and representation (collectively known as the "3Rs") when conserving habitats and the species therein across the State so that all native habitat types are a priority for conservation. This chapter also discusses more "unnatural" habitat types like pine plantations and man-made structures utilized by wildlife as they too are present on the landscape although not prioritized for conservation. Figure 3-1 visualizes the main basins overlaid on the ecoregions to create the ecobasins map referenced in aquatic habitats.

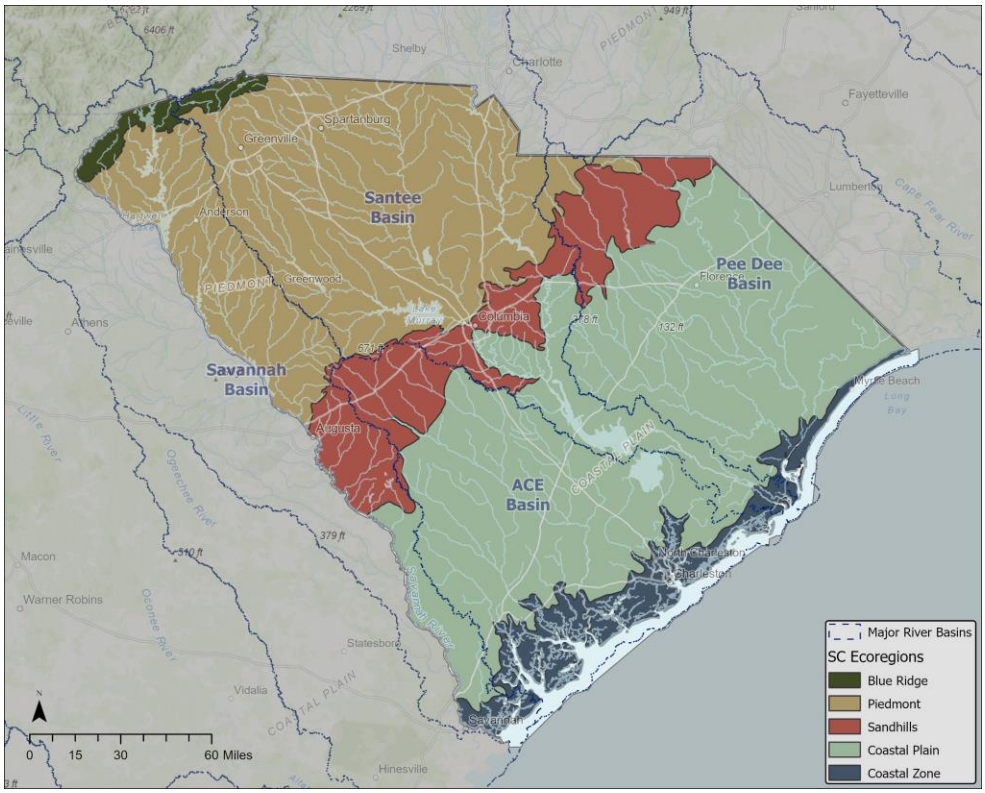

FIGURE 3-1: Ecobasins of South Carolina

Blue Ridge Ecoregion

Montane Rock Outcrops and Glades

Rock outcrops of widely varying sizes and slopes occur throughout the region. This includes communities defined as "Granitic Dome" and "Acidic Cliff" (Nelson 1986; McMillan et al. 2022) and corresponds to several themes in Schafale (2024) including "High Elevation Rock Outcrops", "Low Elevation Cliffs and Rock Outcrops", and "Piedmont and Mountain Glades and Barrens". The equivalent United States National Vegetation Classification (USNVC) ecosystem is "Eastern North American Cliff and Rock Vegetation". This ecosystem forms on exposed granite/gneiss. Slopes range from nearly horizontal to nearly vertical and vary widely in areal extent. Vegetation ranges from absent (bare rock), to lichen/moss dominated, to a mosaic of herbaceous plant, shrub, and tree-dominated communities. Successional trees, such as Eastern Red Cedar (*Juniperus virginiana*) and Virginia Pine (*Pinus virginiana*) are common at these sites. Crevices and ledges can only provide habitats for larger plants once sufficient soil has accumulated. Vegetative communities are influenced by drought/wet cycles and sometimes fires, thus outcrops may have areas of extreme dry to moist microhabitats. Steeper rock faces, called "Acidic Cliffs" by Nelson (1986), are mostly unvegetated but can be critical habitat for wildlife. Often associated with rock outcrops, "Glades" may form in area of slightly deeper but still thin soils over rock. These habitats feature dense graminoid and forb assemblages in sunny gaps or areas with sparse tree canopies. Vegetation composition of rock outcrops and glades varies with underlying geology, with herbs such as Rock Spikemosses (*Bryodesma* spp.), Beadle's Mountain-Mint (*Pycnanthemum beadlei*), Cliff Saxifrage (*Micranthes petiolaris*), Appalachian Rock-Pink (*Phemeranthus teretifolius*), Mountain Dwarf-Dandelion (*Krigia montana*), and Pineweed (*Hypericum gentianoides*) more common in moderately acidic areas, and Alumroots (*Heuchera* spp.), Beardtongues (*Penstemon* spp.), and Lipferns (*Myriopteris* spp.) more common over areas of richer gneiss geology.

Pine-Oak Heath

This community is new to this revision. In 2015 the SWAP omitted any ecosystem in the Blue Ridge Ecoregion with a significant presence of pine species. The concept here follows the "Pine-Oak Heath" of both Nelson (1986) and McMillan et al. (2022), of "Pine Forests" by Barry (1980), and the "Pine-Oak/Heath (Typic Subtype)" of Schafale (2024). The equivalent USNVC classification is "Southern Appalachian Virginia Pine-Table Mountain Pine Woodland Group". Pine-Oak Heath communities form at middle to high elevations on acidic well-drained soils such as ridges, steep south-facing slopes, and mountain tops. This is an open-canopied woodland ecosystem. Yellow pine species are usually dominant, including Virginia Pine (*Pinus virginiana*), Pitch Pine (*P. rigida*), Shortleaf Pine (*P. echinata*), and sometimes Table Mountain Pine (*P. pungens*). Hardwoods are usually present and include xeric-adapted oaks such as Rock Chestnut Oak (*Quercus montana*) and Blackjack Oak (*Q. marilandica*), and other hardwoods including Sourwood (*Oxydendrum arboreum*), Sassafras (*Sassafras albidum*), and Sour Gum (*Nyssa sylvatica*). Most or all pine-oak heaths are likely fire-dependent (McMillan et al. 2022). The shrub layer is usually dense and dominated by Mountain Laurel (*Kalmia latifolia*). Sites maintained with fire can have diverse and dense graminoids and forbs. Common species are

Common Little Bluestem (*Schizachyrium scoparium*), Poverty Oat-Grass (*Danthonia spicata*), and Woodland Coreopsis (*Coreopsis major*).

Appalachian Oak Forest

This concept includes the montane examples of "Chestnut Oak Forest" and "Oak-hickory Forest" of Nelson (1986) and McMillan et al. (2022), in addition to "Montane Oak-hickory Forests" of McMillan et al. (2022), and the "Ridgetops and Upland Oak Forests" of Barry 1980. Schafale (2024) treats "Mountain Oak Forests" broadly as a theme, with several subtypes each of "Chestnut Oak Forest", "Montane Oak-Hickory Forest", and "High Elevation Red Oak Forest" (which may not be in South Carolina at all), as well as "Low Montane Red Oak Forest" and "High Elevation White Oak Forest". The USNVC classification is "Southern Appalachian Oak Forest & Woodland Group". These forests compose the predominant vegetation type throughout the Blue Ridge Ecoregion. Vegetation composition and structure are highly variable, depending on exposure, position on slope, soil moisture, and underlying geology. On dry, acidic upper slopes, Rock Chestnut Oak (*Quercus montana*) may be dominant, often co-occurring with other oak species including Scarlet Oak (*Q. coccinea*), Spanish Oak (*Q. falcata*), Black Oak (*Q. velutina*), and hickories (*Carya* spp.), with an understory dominated by heaths such as Hillside Blueberry (*Vaccinium pallidum*) and Mountain Laurel (*Kalmia latifolia*). On mid-low slopes and richer soils, White Oak (*Q. alba*) and Northern Red Oak (*Q. rubra*) increase in abundance, and the herb layer becomes more diverse. American Chestnut (*Castanea dentata*) was formerly common or co-dominant in Appalachian Oak Forests. Appalachian Oak Forests are differentiated, floristically, from oak-dominated forests of the Piedmont by containing species characteristic of the mountains and rarely if ever seen in the Piedmont, such as Buffalo-Nut (*Pyrularia pubera*), Bear Huckleberry (*Gaylussacia ursina*), Fraser Magnolia (*Magnolia fraseri*), Eastern Hemlock (*Tsuga canadensis*), and Great Laurel (*Rhododendron maximum*).

Rich Cove Forest

This concept includes the "Cove Forest" of Nelson (1986), in part the "Mixed Mesophytic-Cove Segregate" and "Mixed Mesophytic-Slope Segregate" of Barry (1980), and "Rich Cove Forest" of McMillan et al. (2022). Schafale (2024) in North Carolina, subdivides this further into Montane and Intermediate subtypes based on elevation. The equivalent USNVC community is "Appalachian Mesic Forest". Rich Cove Forests occuppy relatively sheltered, well-drained sites on concave landforms and lower slopes. It is a rare type within the Ecoregion, occurring only on sites exhibiting unusually deep soils and high pH (generally greater than 6). Tulip-Tree (*Liriodendron tulipifera*), White Beech (*Fagus grandifolia* var. *caroliniana*), and Mountain Basswood (*Tilia americana* var. *heterophylla*) typically dominates the overstory, and Common Silverbell (*Halesia tetraptera*) is a characteristic species in the mid-story or understory. The shrub layer is typically sparse or absent. Herb species richness and cover are among the highest for any Blue Ridge Ecoregion plant community type. Characteristic ground flora species include Bloodroot (*Sanguinaria canadensis*), Escarpment Foamflower (*Tiarella austrina*), Partridge-Berry (*Mitchella repens*), Hill Cane (*Arundinaria appalachiana*), and Ginseng (*Panax quinquefolius*). Rich Cove Forests are recognized generally as supporting high densities and/or providing optimal habitat for many species of breeding birds and having high salamander species diversity (Hunter et al. 1999).

Acidic Cove Forest

This concept includes the "Hemlock Forest" of Nelson (1986), in part the "Mixed Mesophytic-Cove Segregate" of Barry (1980), and the "Acidic Cove Forest" of McMillan et al. (2022). Schafale (2024) also delineates this as "Acidic Cove Forest", with several subtypes. The USNVC classification is "Southern Appalachian-Interior Mesic Forest Group." Acidic Cove Forest occurs on well-drained, relatively sheltered sites in stream bottoms, along ravines of small streams, or on hill slopes. This landcover type is more prevalent on north-facing slopes or lower positions on other slopes. Eastern Hemlock (*Tsuga canadensis*) is the characteristic tree, occurring either as the dominant overstory or understory tree, while rhododendron dominates the shrub layer, occurring in thickets or solitary clumps. Tulip-Tree (*Liriodendron tulipifera*), White Pine (*Pinus strobus*), Hickories (*Carya* spp.), Sweet Birch (*Betula lenta*), and White Beech (*Fagus grandifolia* var. *caroliniana*) are common associates. White pine becomes much more dominant along with Eastern Hemlock in the Ellicott Rock/Chattooga River basin in the western portion of the Blue Ridge. With the decline of Eastern Hemlock due to the Hemlock Woolly Adelgid, Red Maple (*Acer rubrum*) and Sweet Birch (*Betula lenta*) have increased in relative abundance.

Mountain Alluvial Communities

The variable wetland ecosystems along rivers and creeks are delineated here as alluvial communities. This concept includes Nelson's "Shoal & Stream Bar" as well as "Small Stream Forest", and Barry's (1980) "Riverbanks and Alder Zones" and "Floodplain Forests", and in McMillan et al. (2022) the "Rocky Streamside" and "Canebrakes". Schafale recognizes these communities as subtypes of "Montane Alluvial Forest", "Rocky Bar and Shore", or "Piedmont/Mountain Canebrake". USNVC classifications include "Central Hardwoods Floodplain Forest" and "Eastern North American Rivershore Vegetation", in part. This habitat forms naturally along the riparian vegetation zone on streams and rivers—typically along wadable or navigable streams that are wide enough to prevent canopy closure—at scattered locations with a suitable substrate of seasonally flooded rocky or alluvial soils. It exhibits variation in size and persistence. At the base of the escarpment, this habitat also occupies broad floodplains, where it grades into the floodplain forest types of the upper Piedmont (Barry 1980). Canopy trees, where present, can include Sweet Gum (*Liquidambar styraciflua*), Tulip-Tree (*Liriodendron tulipifera*), Sycamore (*Platanus occidentalis*), and River Birch (*Betula nigra*). Tag Alder (*Alnus serrulata*) is a characteristic shrub species that occurs at a relatively high abundance. Other common shrubs are Yellowroot (*Xanthorhiza simplicissima*), Virginia-Willow (*Itea virginica*), Azaleas (*Rhododendron* spp.), and occasionally Black Willow (*Salix nigra*) and Mountain Sweet-Pepperbush (*Clethra acuminata*). Canebrakes were once vast stands of River Cane (*Arundinaria gigantea*) along floodplains, thought to be fire-maintained and associated with settlement patterns of Native Americans (Platt & Brantley 1997). They are now largely gone from floodplains, though smaller patches of River Cane are often seen in broader floodplain communities.

Fens and Spray Cliffs

This concept includes montane seepages as well as the spray cliffs and humid gorges associated with waterfalls. These are often small patch communities embedded within larger community types such as rock outcrops, rich coves, or Appalachian Oak Forests. The concept encompasses

Nelson's (1986) "High Elevation Seep", "Spray Cliff", "Upland Bog", and several communities described in detail by McMillan et al. (2022) including "Spray Cliffs", "Humid Gorge Outcrops", "Cataract Fens", and "Southern Appalachian Fens". The concept also includes Hill's (1999) description of "Ice Ponds", a unique community formed from frozen seepage forming pools below a north-facing cliff, and home to a relict flora characteristic of bogs or fens in cooler climates. Fen ecosystems in Schafale (2024) are classified as "Low Elevation Seep" and "Swamp Forest-Bog Complex", and other parts of this concept are included as "Upland Seepages and Spray Cliffs" theme. The USNVC equivalent community is "Central & Southern Appalachian Seep & Seepage Bog Group". As McMillan et al. (2022) detail, true "Bogs" are derived from precipitation, and most or all communities that have been referred to as bogs in the South Carolina Upstate are actually fens, with water and nutrients derived from seepage. The highly variable landforms within the Southern Blue Ridge Ecoregion include numerous wet places that increase local and regional habitat diversity, and they are often microhabitats within a mosaic of other vegetation but are quite distinctive. Open seeps of variable size occur on granitic cliffs and domes, with the best developed forming diverse fens. These form along wet seepage areas at the heads of or along the margins of small streams which are nearly always saturated. They are characterized by peat mosses (*Sphagnum* spp.) and other wetland species such as orchids and sedges. Vegetation in these fens is apparently fire-controlled in some places, but likely also influenced by beaver activity and flood/drought cycles, nutrient influx, and perhaps extinct megafauna. In the absence of burning or other limiting factors, succession leads to a wetland community dominated by woody vegetation. Perpetually moist habitats along waterfalls, seeps, and in humid gorges are also important for wildlife and rare plants.

Mountain Pools and Impoundments

This concept includes wetlands without flowing water and not covered under "Mountain Alluvial Communities" or "Fens and Spray Cliffs". These are small patch communities dominated by emergent, floating, marshy, or shrubby vegetation seen in floodplain depressions or along the margins of ponds or lakes. These communities are not discussed by Barry (1980), Nelson (1986), or McMillan et al. (2022) but correspond to Schafale's (2024) concepts of "Floodplain Pools" and "Piedmont/Mountain Semipermanent Impoundments". USNVC classification includes "South-Central Interior Small Stream and Riparian", "South-Central Interior Large Floodplain", "Southern Piedmont Large Floodplain Forest", and "Southern Piedmont Small Floodplain and Riparian Forest" communities. Natural examples are rare in the Blue Ridge Ecoregion. In many areas small, often ephemeral, wetlands may form from rainwater or local sources and hold standing water. These communities are important breeding grounds for amphibians. Vegetation may range from open marshes dominated by grasses, sedges, and wetland herbs to dense shrub thickets of Tag Alder (*Alnus serrulata*), Black Willow (*Salix nigra*), Red Maple (*Acer rubrum*), or Buttonbush (*Cephalanthus occidentalis*). Man-made impoundments are also important wildlife habitat and thus also included here.

Pine Plantation

This community is new to this revision. In the 2015 SWAP it was treated as part of the broad "Upland Pine" community of the Piedmont Ecoregion and "Pine Woodland" of the Coastal Plain and Coastal Zone Ecoregions. Those classifications, however, also included natural pine-dominated communities. The USNVC classification for these timber production areas is

"Temperate & Boreal Plantation". Planted pine plantations have less prominence in the Blue Ridge Ecoregion than in other parts of the State. Still, they are an important part of the region's landscape. These timber production areas are more common at lower elevation areas, especially along the Blue Ridge Escarpment. Like the rest of the State, Loblolly Pine (*Pinus taeda*) is the typical species, although White Pine (*P. strobus*) plantations are also frequent. Pine plantations are generally poor wildlife habitat, lacking in both the food and cover needed by native wildlife.

Early-Successional Habitats

Early successional habitats in the Blue Ridge Ecoregion make up less cover than in other Ecoregions but are still important habitats for wildlife species that depend on these open areas. These habitats are generally characterized by tree canopy coverage that is sparse or absent and herbaceous groundcover comprised of annual and perennial forbs and graminoids, and variable coverage of shrubs, vines, and small trees. A variety of open landcover types represent this category and can include old field sites, open canopy gaps, shrub thickets, recently re-forested areas, field borders, grassed waterways, and filter strips. Lawns, golf courses, pastures, hay fields, crop fields, airports, and various urban open spaces are sometimes included in this habitat type but lack the floristic and structural diversity to be considered high quality, early successional habitat. Maintenance of early successional habitat requires periodic disturbance or disruption of the existing vegetative community. Purposeful management of early-successional habitat is usually accomplished using timber harvest, prescribed burning, disking, or mowing. Target species for management will determine disturbance intervals, with shorter intervals (1-2 years) favoring those species dependent on herbaceous vegetation and longer intervals (3-5 years) favoring those species dependent on shrub cover. Optimal multi-species management often dictates concurrent maintenance of a variety of successional, or seral, stages.

Freshwater Streams, Rivers, Lakes, and Ponds

Although the Blue Ridge is the smallest ecoregion in South Carolina, encompassing only 1,204 km² (465 mi^2), it harbors a diverse and unique aquatic community. The Blue Ridge Ecoregion cuts across the top of two major South Carolina drainages, the Savannah and the Santee, forming two ecobasins: the **Savannah Blue Ridge** and the **Santee Blue Ridge**.

The Blue Ridge portion of the **Savannah drainage** originates in the mountains of South Carolina, North Carolina, and Georgia. Major tributaries in the Ecobasin include the Chauga, Chattooga and Toxaway rivers. The Ecobasin encompasses approximately 733 km^2 (283 mi^2). Most of the land is publicly owned with a significant portion protected by federal and state entities including the Jocassee Gorges Recreation Area, the Greenville Watershed Easement, and Sumter National Forest Wild and Scenic River Corridor along the Chattooga River. The Ecobasin encompasses approximately 599 km (372 mi.) of lotic habitat and 3,358 ha (8,298 ac.) of impoundments. There are 586 km (364 mi.) of wadeable streams in the Savannah-Blue Ridge Ecobasin.

The Blue Ridge portion of the **Santee drainage** originates in South Carolina as the headwaters of the Saluda River, which flows southeast and is a major tributary to the Santee River. The Ecobasin encompasses approximately 453 km^2 (175 mi^2). Most of the land is privately owned; however, a significant portion is protected by state, municipal, and private entities. The ecobasin

encompasses approximately 394 km (245 mi.) of lotic habitat. There are 409 km (254 mi.) of wadeable streams in the Santee-Blue Ridge Ecobasin.

Aquatic habitats in the Blue Ridge change physically, chemically, and biologically as water flows from the headwaters to streams, larger streams, and ultimately rivers while being influenced by the surrounding watershed and landscape (Hynes 1975, Vannote et al. 1980). Higher elevation streams are contained in their channels by erosion-resistant bedrock. Step-pools are commonly interspersed with riffle-run-pool habitats containing boulders, cobble, and gravel beds. Water pH is generally neutral, ranging from 6.4 to 7.4, with low dissolved solids and low hardness (Jennings et al. 2023). Habitat complexity and species diversity increase with stream size, producing a continuum of aquatic species assemblages from headwaters to the largest rivers. Whereas certain species are generalists and occur along the entire continuum in varying abundance, others are highly specialized for the precise set of physical and chemical characteristics produced by the underlying geology and surrounding landscape and only occur in certain stream sizes or habitat types within the Ecoregion.

Wadeable streams are the dominant aquatic classification in the Blue Ridge Ecoregion, and overall water quality is good. Wadeable streams are defined as streams with Strahler stream orders of 0 to 3 that generally can be waded comfortably throughout most of the year. Wadeable streams in the Blue Ridge are typically high gradient with clear water and a mixture of bedrock, gravel, cobble, and sand substrates. These streams contain a variety of habitats including riffles, runs, pools, glides, and cascades. At higher elevations, many of these streams contain cascades and waterfalls.

Navigable streams are less common in the Blue Ridge Ecoregion with only about 32 km (20 mi.) of free-flowing stream within South Carolina. These streams are generally defined as being large enough to operate watercraft, if only a canoe, and are generally too deep to be waded throughout most of the year. The Chauga and Chattooga Rivers are examples of navigable streams in the Blue Ridge. Navigable streams in the Blue Ridge contain a myriad of aquatic habitats including riffles, shoals, pools, runs, and glides in various combinations. These streams are somewhat more productive than the wadeable streams, despite being generally swift flowing and clear. Substrate in these habitats is primarily bedrock, gravel, cobble, and sand. Lakes of the area are man-made, with artificial species management; they are not pertinent habitat for the conservation of native species.

In an aquatic bioassessment framework developed by Denison et al. (2021) utilizing fish assemblage data, streams of the Blue Ridge Ecoregion responded similarly to those of the Piedmont Ecoregion to change in environmental and watershed characteristics (i.e. upland physical and chemical characteristics, disturbance). Across this Ecoregion, differences in fish assemblage composition and response to disturbance are primarily attributable to taxonomic differences between the Savannah and Santee River Basins due largely to the presence of "sister species" (i.e. taxonomically distinct but ecologically equivalent species) (Figure 3-2). The response of Blue Ridge streams to changes in environmental disturbance would therefore be expected to be most similar among streams within river basins.

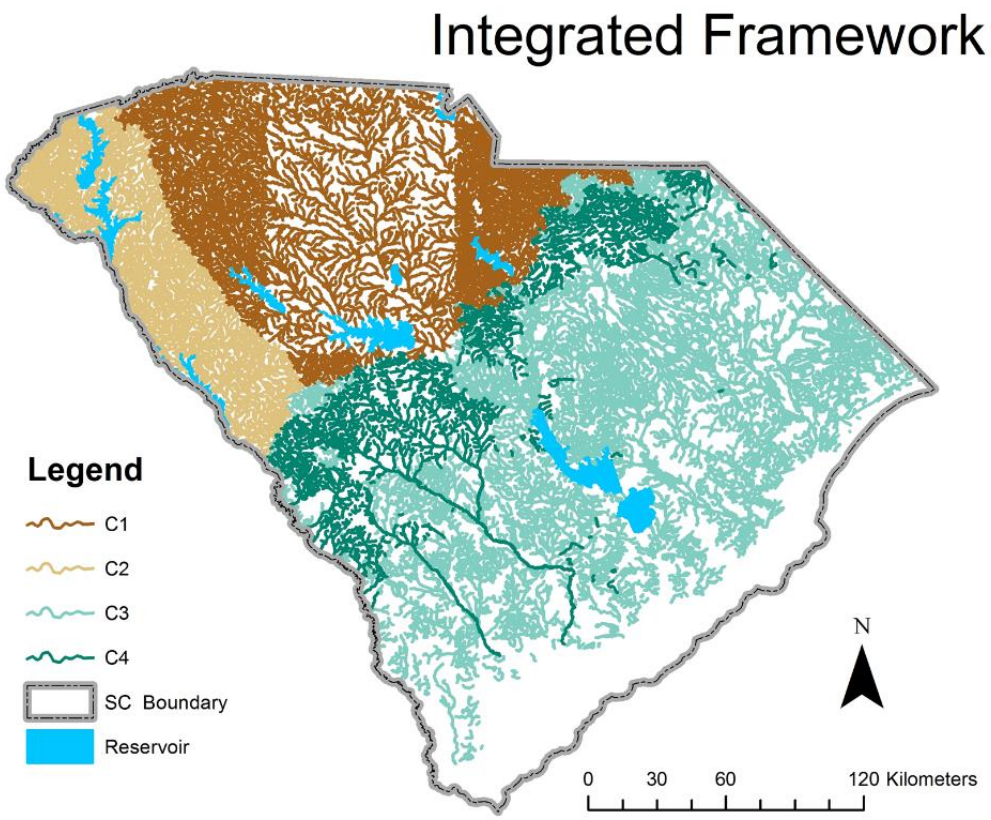

FIGURE 3-2: Freshwater fish bioassessment classes of South Carolina (Denison et al. 2021). Class 1 = Uplands-Santee/Pee Dee basins; Class 2 = Uplands-Savannah basin; Class 3 = Coastal Plain-Perennial/Intermittent; Class 4 = Coastal Plain-Stable Baseflow.

Piedmont Ecoregion

Piedmont Rock Outcrops and Glades

This concept includes Piedmont examples of "Granitic Dome" and "Granitic Flatrock" communities of Nelson (1986), and "Granitic Domes" and "Granitic Flatrocks" of McMillan et al. (2022), and "Flat Rock Communities" of Barry (1980). Schafale (2024) includes these communities in a broad "Low Elevation Cliffs and Rock Outcrops" theme as well as a "Granitic Flatrocks" theme. The USNVC classification is "Piedmont-Blue Ridge Dome and Flatrock". Rock outcrops of widely varying sizes and slopes occur throughout the region and are composed of granite or gneiss. These are often associated with monadnocks which are isolated hills rising from the surrounding terrain. Slopes range from nearly horizontal to nearly vertical. As classified here, Rock Outcrops that have more extensive and exposed outcrops have their own characteristic vegetation and habitat features. Vegetation ranges from none (bare rock) to a mosaic of herbaceous plant, shrub, and sparse tree tree-dominated communities. Successional trees, such as Eastern Red Cedar (*Juniperus virginiana*) and Virginia Pine (*Pinus virginiana*), are common on these sites. Other rocky communities can occur embedded in various Piedmont ecosystems, and those microhabitats themselves can be important for wildlife. Crevices and

ledges can only provide habitats for larger plants once sufficient soil has accumulated. A cliff or dome may also have small areas of wet seepage zones, with a mosaic of xeric to wet microhabitats in a small area. Some rock outcrops have small vernal pools with shallow soils. These pools are fed by later winter and spring rains and dry out when temperatures rise. These habitats are critical for several rare plant species, such as the federally threatened Pool-Sprite (*Gratiola amphiantha*) which can complete their life cycles during the brief wet period. These pools are also important breeding sites for amphibians.

Piedmont Monadnock Forest

This community is new to this revision. Isolated hills in the Piedmont often have a unique flora and topography in many ways more similar to the mountains than to the surrounding flatter areas of the Piedmont. This concept follows the "Piedmont Monadnock Forest" of Schafale (2024) and corresponds to the "Chestnut Oak-Heath Forests" of Barry (1980). The USNVC classification is "Piedmont-Coastal Plain Oak Forest and Woodland Group". Acidic monadnocks are often dominated by Chestnut Oak (*Quercus montana*) sometimes mixed with Shortleaf Pine (*Pinus echinata*) on drier ridges. Hardwoods are usually present and include xeric-adapted oaks such as Post Oak (*Q. stellata*) and Blackjack Oak (*Q. marilandica*), and others including Sourwood (*Oxydendrum arboreum*), Sassafras (*Sassafras albidum*), and Sour Gum (*Nyssa sylvatica*). The shrub layer is often dominated by Mountain Laurel (*Kalmia latifolia*) or Sparkleberry (*Vaccinium arboreum*). Sites maintained with fire can have diverse and dense graminoids and forbs. Common species are Little Bluestem (*Schizachyrium scoparium*), Poverty-Oat Grass (*Danthonia spicata*), and Woodland Coreopsis (*Coreopsis major*). A striking example is seen at Glassy Mountain in Pickens County, where the underlying geology is more mafic, so there are species more commonly found in dry but nutrient-rich areas such as White Oak (*Q. alba*), Northern Red Oak (*Q. rubra*), and Southern Black Haw (*Viburnum rufidulum*).

Oak-Hickory Forest

This concept includes the "Oak-Hickory Forest" of Nelson (1986) and McMillan et al. (2022), and "Ridgetop Forests", "Midslope Forests" and "Chestnut Oak-Heath Forests" in Barry (1980). Schafale (2024) includes several communities here under the "Piedmont and Coastal Plain Oak Forests" theme. The USNVC classification is "Piedmont-Coastal Plain Oak Forest and Woodland Group". Oak-Hickory Forest is a widely distributed community that varies from site to site and, as noted by McMillan et al. (2022), is complex and difficult to characterize. It is associated with acidic soils characteristic of rolling uplands in the Piedmont. It is made up of a diverse assemblage of hardwoods, primarily oaks and hickories, including Mockernut Hickory (*Carya tomentosa*), Pignut Hickory (*C. glabra*), Spanish Oak (*Quercus falcata*), Tulip-Tree (*Liriodendron tulipifera*), and Sour Gum (*Nyssa sylvatica*), and sometimes with mixed pines (*Pinus* spp.). Shrub and herbaceous layers are highly variable dependent on the canopy species present, their abundance, and other geomorphological factors.

Mesic Mixed Hardwood Forest

This concept includes the mesic Mixed Hardwood Forest of Nelson (1986) and the Beech Forest of McMillan et al. (2022) while Schafale (2024) classifies it as "Mesic Mixed Hardwood Forests (Piedmont Subtype)". The USNVC classification is "Southern Appalachian-Interior Mesic Forest Group". Mesic forests occur on mesic slopes, ravines, and sometimes flats. This habitat is typically characterized by closed canopy hardwood forests with White Beech (*Fagus grandifolia*

var. *caroliniana*), Tulip-Tree (*Liriodendron tulipifera*), Sour Gum (*Nyssa sylvatica*), Red Maple (*Acer rubrum*), and Sweet Gum (*Liquidambar styraciflua*). The understory is variable and typically composed of smaller tree species and shrubs. Where the understory is sparse to absent, a herbaceous layer of moderate density and diversity may develop.

Basic Mesic Forest

This concept includes the "Basic Forest" of Nelson (1986), Mixed-Mesophytic-Cove Hardwood Forest" of Barry (1980), and the "Basic Mesic Forest" of McMillan et al. (2022). Schafale (2024) classifies it as "Basic Mesic Forest (Piedmont Subtype)" while the USNVC classification is "Southern Appalachian-Interior Mesic Forest Group". Basic mesic forests form on high pH (circumneutral), mesic soils in sheltered locations such as north-facing slopes and ravines. They are among the most botanically diverse of Piedmont forests. Sites are widely scattered and often small. The canopy and understory are composed of hardwoods including White Beech (*Fagus grandifolia* var. *caroliniana*), Tulip-Tree (*Liriodendron tulipifera*), Sour Gum (*Nyssa sylvatica*), Sourwood (*Oxydendrum arboreum*), White Oak (*Quercus alba*), Northern Red Oak (*Q. rubra*), Black Oak (*Q. velutina*), Sweet Gum (*Liquidambar styraciflua*), Red Maple (*Acer rubrum*), Mountain Basswood (*Tilia americana* var. *heterophylla*), American Hornbeam (*Carpinus caroliniana*), Flowering Dogwood (*Benthamidia florida*), American Holly (*Ilex opaca*), Northern Witch-Hazel (*Hamamelis virginiana*) and American Hop-Hornbeam (*Ostrya virginiana*). Shrub species are usually numerous, and the herbaceous flora is fairly rich, including many spring ephemerals.

Piedmont Seepage Forest

This concept includes the "Piedmont Seepage Forest" of Nelson (1986), "Piedmont Springhead Seepage Forest" of McMillan et al. (2022), and subtypes of Schafale's (2024) "Low Elevation Seep" occurring in the Piedmont. The USNVC classifies these in part as "Central Hardwood Swamp Forest" and in part as "Eastern North American Seep and Rock Pool". Piedmont Seepage Forests are distinguished from forest alluvial communities along rivers and streams because they arise as seepage swamps, and soils and water have high mineral content. The canopy is mixed with Red Maple (*Acer rubrum*), Sweet Gum (*Liquidambar styraciflua*), Tulip-Tree (*Liriodendron tulipifera*), and often Swamp Tupelo (*Nyssa biflora*). Understory shrubs include Southern Wild Raisin (*Viburnum nudum*), Tag Alder (*Alnus serrulata*), Red Chokeberry (*Aronia arbutifolia*), and Southern Arrow-Wood (*V. dentatum*). Vines including Eastern Poison Ivy (*Toxicodendron radicans*), Virginia-Creeper (*Parthenocissus quinquefolia*), Climbing Hydrangea (*Hydrangea barbara*), and greenbriers (*Smilax* spp.) are often abundant, with a variable herb layer that often includes several species of sedges (*Carex* spp.), Common Jack-In-The-Pulpit (*Arisaema triphyllum*), Cinnamon Fern (*Osmundastrum cinnamomeum*), and Netted Chain Fern (*Lorinseria areolata*). The finest examples of this community are found in Greenville County near Travelers Rest, where the seepages support many rare herbs such as the federally endangered Bunched Arrowhead (*Sagittaria fasciculata*) and the federally threatened Dwarf-Flowered Heartleaf (*Hexastylis naniflora*).

Piedmont Alluvial Communities

This concept includes wetlands along rivers and creeks, following "Bottomland Hardwoods", "Small Stream Forest", "Shoal and Stream Bar" of Nelson (1986), and "Rocky Shoals" of McMillan et al. (2022). Schafale (2024) treats this in a broad "Piedmont and Mountain

Floodplains" theme, including "Piedmont Alluvial Forest", Piedmont Headwater Stream Forest", Piedmont Levee Forest", Piedmont Bottomland Forest", "Piedmont Swamp Forest", and Rocky Bar and Shore". The USNVC classifies these as mainly "Oak-Sweet Gum Floodplain Forest Group" but also as "Eastern North American Riverine Sand-Gravel Bar Group". Piedmont Alluvial Communities consist of usually hardwood-dominated woodlands, but also shrub-dominated or herbaceous wetlands, with moist soils that are associated with river and creek floodplains. Compared to the Coastal Plain, the floodplains of major rivers in the Piedmont are confined by topography and geology to relatively narrow corridors. Vegetation can be extremely variable depending on hydrology, soils, geology, and canopy. Characteristic tree species include Sweet Gum (*Liquidambar styraciflua*), Loblolly Pine (*Pinus taeda*), Water Oak (*Quercus nigra*), Willow Oak (*Q. phellos*), Laurel Oak (*Q. laurifolia*), Cherrybark Oak (*Q. pagoda*), and American Holly (*Ilex opaca*). Sunny edges along open water can be dominated by hardwood species that are adapted to wetter conditions such as Black Willow (*Salix nigra*), American Sycamore (*Platanus occidentalis*), River Birch (*Betula nigra*), and Tag Alder (*Alnus serrulata*). Emergent aquatic herbs may be present in shallow sunny areas, such as the edges of stream or river channels and along backwaters and oxbows. Rocky shoals at Fall Line sites can support populations of emergent and submerged aquatics such as American Water-Willow (*Justicia americana*), Shoals Spiderlily (*Hymenocallis coronaria*), and Threadfoot (*Podostemum ceratophyllum*). Canebrakes were once vast stands of River Cane (*Arundinaria gigantea*) along floodplains, thought to be fire-maintained and associated with settlement patterns of Native Americans (Platt & Brantley 1997). They are now largely gone from floodplains, though smaller patches of River Cane are often seen in broader floodplain communities.

Montmorillonite Forest

This community is new to this revision. This includes the "Montmorillonite Forest" of Nelson (1986), and "Piedmont Xeric Hardpan Forest" of McMillan et al. (2022). Schafale (2024) classifies this as "Xeric Hardpan Forest", with several subtypes, and also as "Mixed Moisture Hardpan Forest". The USNVC classification is "Piedmont-Coastal Plain Oak Forest and Woodland". This ecosystem is restricted to a small number of Piedmont counties and is best represented in York County. It forms on circumneutral pH "shrink-swell" clay soils, often over a rock hardpan. These soils and hardpan (when present) limit infiltration of water and roots. Sites flood after rainfall but can be extremely dry during drought. The canopy consists of stunted trees including Post Oak (*Quercus stellata*), Black Oak (*Q. velutina*), Willow Oak (*Q. phellos*), Carolina Shagbark Hickory (*Carya carolinae-septentrionalis*), Eastern Red Cedar (*Juniperus virginiana*), and sometimes Shortleaf Pine (*Pinus echinata*) and/or Virginia Pine (*P. virginiana*). The herbaceous layer is sometimes diverse, with rare plant species that are more characteristic of midwestern prairies such as Wild Hyacinth (*Camassia scilloides*). Montmorillonite Forests form on soils that can also support a subtype of Piedmont Prairie, but more work needs to be done to understand the long-term history and ecological processes of these two differently structured ecosystems.

Piedmont Prairies and Woodlands

This community is new to this revision, treated only generally in 2015 under a broad "Grasslands and Early Successional Habitats" classification. This includes the "Piedmont Prairie" and "Oak Savanna" of McMillan et al. (2022) but is not described by either Barry (1980) or Nelson (1986).

Schafale (2024) classifies this in his "Piedmont and Mountain Glades and Barrens" theme, with communities and their subtypes delineated by soil (type, pH, depth, slope) and vegetation structure (open, or with a sparse canopy). The growing literature indicates that open prairie and savanna ecosystems were once a prominent feature in the Piedmont and the restoration of these habitats are a high conservation priority, thus the need to separate them from modern early-successional habitats. The two difficulties in describing this community are that 1) it was likely many community types, and 2) examples have either been eliminated from the State or completely altered and only historical accounts or theories remain. Only fragments of what were likely widespread prairies and woodlands remain today. The best examples are in York County (Rock Hill Blackjacks Heritage Preserve), and the Post Oak Savanna natural area in Sumter National Forest in Saluda County. Otherwise, most remnants are along road shoulders and utility rights-of-ways with plant species that indicate the former presence of prairies or woodlands. These communities likely had scattered trees (i.e. woodland ecosystems), but it is possible that some were treeless (prairies). Open conditions would have been influenced by period fires, both from lightning and by Native Americans. Canopy species likely included Post Oak (*Quercus stellata*), Blackjack Oak (*Q. marilandica*), and pines such as Shortleaf Pine (*Pinus echinata*). The groundcover was likely rich in graminoids and forbs with widespread species including Little Bluestem (*Schizachyrium scoparium*), Big Bluestem (*Andropogon gerardi*), and Yellow Indiangrass (*Sorghastrum nutans*). Soil type would have strongly influenced species composition. Prairies on wet "shrink-swell" soils have an unusual set of species with midwestern prairie affinities.

Even roadsides that harbor native plant species can provide habitat for insect species such as this Monarch Butterfly in Charleston County, SC. Photo by Anna Smith, SCDNR

Piedmont Pools, Depressions, and Impoundments

This heterogeneous concept includes any wetland with standing water at least part of the year not covered in "Piedmont Alluvial Communities" or "Piedmont Small Stream Seepage Forest" or "Piedmont Rock Outcrops and Glades" above, such as pools, depressions, and man-made impoundments. Included here are Nelson's (1986) concept of "Upland Depression Swamp Forest" and Schafale's "Piedmont and Mountains Upland Pools and Depressions" theme as well as his concepts of "Floodplain Pool" and "Piedmont/Mountain Semipermanent Impoundment" of USNVC. In many areas, small, often ephemeral, wetlands may form from rainwater or local sources and hold standing water. Vegetation may range from small pools or open marshes to dense forests. Beaver activity may contribute to semipermanent impoundments, but man-made impoundments are also important wildlife habitat so are therefore included here.

Pine Plantation

This community is new to this revision. In the 2015 SWAP it was treated as part of the broad "Upland Pine" community of this Piedmont Ecoregion, and "Pine Woodland" of the Coastal Plain and Coastal Zone Ecoregions, and absent from the Blue Ridge Ecoregion. Those classifications, however, also included natural pine-dominated ecosystems. The USNVC classification for these timber production areas is "Temperate and Boreal Plantation". Planted pine plantations are the dominant vegetation type in the Piedmont's landscape. Loblolly Pine (*Pinus taeda*) is the most planted species, although Eastern White Pine (*P. strobus*) plantations are also present. Loblolly Pine is often co-dominant with dense Sweet Gum (*Liquidambar styraciflua*). Pine plantations are generally poor wildlife habitat, lacking in both the food and cover needed by native wildlife.

Early-Successional Habitats

Early-successional habitats are important habitats for wildlife species that depend on these open areas. These habitats are generally characterized by tree canopy coverage that is sparse or absent and herbaceous groundcover comprised of annual and perennial forbs and graminoids with variable coverage of shrubs, vines, and small trees. A variety of open landcover types represent this category and can include old field sites, open canopy gaps, shrub thickets, recently cleared forests, field borders, grassed waterways, and filter strips. Lawns, golf courses, pastures, hay fields, crop fields, airports and various urban open spaces are sometimes included in this habitat type but lack the floristic and structural diversity to be considered high quality, early-successional habitat. Maintenance of early-successional habitat requires periodic repeated disturbance or disruption of the existing vegetative community. Purposeful management of early successional habitat is usually accomplished through timber harvest, prescribed burning, disking, or mowing. Target species for management will determine disturbance intervals, with shorter intervals (1-2 years) favoring those species dependent on herbaceous vegetation and longer intervals (3-5 years) favoring those species dependent on shrub cover. Optimal multi-species management often dictates concurrent maintenance of a variety of successional, or seral, stages.

Freshwater Streams, Lakes, and Ponds

The Piedmont Ecoregion extends south of the Blue Ridge to the Fall Line near Columbia, South Carolina and from the Savannah River east to the Pee Dee River. Encompassing 24 counties and 27,941 km² (10,788 mi^2), the Piedmont is the largest physiographic province in South Carolina. The Piedmont is an area with gently rolling hills dissected by narrow stream and river valleys. Forests, farms, and orchards dominate most of the land. Elevations range from 114 to 305 m (375 to 1,000 ft.). Freshwaters in the Piedmont Ecoregion total approximately 17,703 km (11,000 mi.) of streams and rivers with over 777 km² (300 mi^2) of major impoundments. By length, first-through fourth-order (wadeable) streams comprise the primary aquatic habitat type. At higher elevations, Piedmont streams may exhibit moderate gradient with coarse substrates including cobble, gravel, and bedrock. Lower elevation Piedmont streams generally have less gradient with substrates primarily consisting of sand, gravel, and silt. Piedmont streams are typified by long runs of intermediate depth separated by shallow riffles and deeper pools. The Piedmont Ecoregion cuts across the top of 3 major South Carolina drainages, the Savannah, the Santee, and the Pee Dee, forming 3 ecobasins: the **Savannah-Piedmont, Santee-Piedmont** and **Pee Dee-Piedmont**.

The **Savannah River drainage** originates in the mountains of North Carolina and Georgia. The Savannah River flows southeast along the border of South Carolina and Georgia through the Piedmont for approximately 211 km (131 mi.) on its way to the Atlantic Ocean. Major tributaries to the Savannah River in the South Carolina portion of this Ecobasin include the Tugaloo River, Seneca River, Chauga River, Rocky River, Little River and Stevens Creek. The Ecobasin encompasses 36 watersheds and approximately 7,457 km^2 (2,879 mi^2) and contains 5,356 km (3,328 mi.) of lotic habitat with 370 km^2 (143 mi^2) of impoundments.

The Stevens Creek watershed in Edgefield, McCormick, and Greenwood Counties is known to be a unique aquatic resource. Priority fish species such as the Christmas Darter and imperiled mussels such as the Carolina Heelsplitter reside in streams of this watershed. Tributaries such as Hard Labor Creek drain the region around metropolitan Greenwood, South Carolina. This is an area of rapid urban growth and increasing human population. Impacts to the watershed from point- and non-point sources can have a degrading effect on the aquatic community downstream.

The upper **Santee River drainage** originates mostly in the south-central Piedmont of North Carolina but receives some input from the mountains of South Carolina and North Carolina through the Saluda and Catawba River systems, respectively. The Broad River and Catawba-Wateree Rivers are the dominant rivers in this Ecobasin. The Broad River flows nearly directly south from North Carolina to Columbia, South Carolina where it merges with the Saluda River at the Fall Line to form the Congaree River. As the Broad River flows south, it picks up inputs from the Pacolet River, Tyger River, and Enoree River along the western portion of the drainage and Kings Creek, Turkey Creek, Sandy River, and Cedar Creek from the eastern portion of the drainage. The Catawba River originates on the eastern slope of the Blue Ridge in North Carolina and flows through the Inner Piedmont and Charlotte, North Carolina before entering South Carolina. The Catawba flows south through South Carolina until it is impounded to form Lake Wateree and thereafter is known as the Wateree River. The Wateree River continues to flow south through the Southeastern Plains until it merges with the Congaree River to from the Santee River.

The **Santee-Piedmont Ecobasin** is the largest in the State, containing part or all of 84 watersheds and encompassing 19,694 km^2 (7,604 $mi.^2$). The Ecobasin contains approximately 18,547 km^2 (7,161 mi.) of stream habitat and nearly 414 km^2 (160 $mi.^2$) of impoundments. The Santee-Piedmont Ecobasin contains several areas of conservation priority (Smith et al. 2002). Conservation targets that contain rare, threatened, and endemic species include: the Saluda River headwaters, which encompass the North Saluda River, South Saluda River, and Oolenoy River watersheds located in the Inner Piedmont of Greenville and Pickens Counties; the Clouds Creek watershed in the Slate Belt region in Saluda County; the main stem of the Broad River from the North Carolina line to Parr Shoals Reservoir in South Carolina; the Kings Creek watershed and the Clarks Fork system in the Bullocks Creek watershed located primarily in the Kings Mountain area in Cherokee and York Counties; the Six Mile Creek and Waxhaw Creek systems in the Twelve Mile Creek watershed in Lancaster County; the Gills Creek system in the Camp Creek watershed in Lancaster County; and the Wateree Creek watershed in Richland County. The Saluda River headwaters contain populations of priority fish species including Turquoise Darter and Carolina Fantail Darter. The Clouds Creek watershed contains populations of the priority fish species the Carolina Darter (formerly Saluda Darter) as well as at least one priority mussel

species, the Savannah Lilliput. The main stem of the Broad River contains priority fish species including several catostomids (Notchlip Redhorse, V-lip Redhorse, Quillback, and Highfin Carpsucker) and percids (Seagreen Darter, Carolina Fantail Darter, and Piedmont Darter). The Kings Creek watershed and Clarks Fork system contain several priority fish species including the Carolina Fantail Darter, the Seagreen Darter, and the Piedmont Darter. The Six Mile Creek and Waxhaw Creek systems contain several priority mussel species including the Notched Rainbow, Carolina Creekshell, and the federally endangered Carolina Heelsplitter. The Gills Creek system also contains Carolina Creekshell and Carolina Heelsplitter. The Wateree Creek watershed contains several priority fish species including the Carolina Darter, Piedmont Darter, and Seagreen Darter.

The South Carolina Piedmont portion of the **Pee Dee drainage** originates just across the State line in North Carolina. The **Pee Dee-Piedmont Ecobasin** is the second smallest ecobasin in the State, encompassing only 715 km^2 (276 $mi.^2$). Tributaries to the Pee Dee River included in the Ecobasin are the Lynches River and Thompson Creek. There are approximately 753 km (468 mi.) of stream habitat within the Ecobasin and only 136 ha (337 ac.) of impounded water. The majority of the Ecobasin is a primary conservation target, including the Lynches River, Flat Creek, and Little Lynches River systems in the upper Lynches River basin located in Lancaster and Chesterfield Counties. Also, the Thompson Creek system in the upper Pee Dee basin in Chesterfield County is a high priority. Several priority fish species occur in the upper Lynches River basin, including the "Thinlip" Chub, Sandhills Chub, and "Broadtail" Madtom. In addition to those fish species, several priority mussel species populate the basin including the Brook Floater, Creeper, Notched Rainbow, and the federally endangered Carolina Heelsplitter. The Thompson Creek system contains several priority fish species—"Thinlip" Chub, Sandhills Chub, Fantail Darter, and Piedmont Darter—as well as several species whose populations in South Carolina are entirely restricted to that system such as the Satinfin Shiner, Redlip Shiner, and Comely Shiner.

In the Piedmont, aquatic habitats change physically, chemically, and biologically as water flows from the headwaters to streams, larger streams, and ultimately rivers while being influenced by the surrounding watershed and landscape (Hynes 1975, Vannote et al. 1980). In the higher elevation sections of the Piedmont, gradients average 5-10 m/km and substrates remain generally course. In lower elevations, broader alluvial valley characteristics prevail, with riffle-run-pool sequences the dominant habitat type. Water pH is relatively neutral, with a range of 6.4 to 7.4, with relatively low dissolved solids and hardness (Jennings et al. 2023). Habitat complexity and species diversity increase with stream size, producing a continuum of aquatic species assemblages from headwaters to the largest rivers. Whereas certain species are generalists and occur along the entire continuum in varying abundance, others are highly specialized for the precise set of physical and chemical characteristics produced by the underlying geology and surrounding landscape and only occur in certain stream sizes or habitat types within the Ecoregion.

Wadeable streams are the dominant habitat in the Piedmont and are defined as those with Strahler stream orders of 0 to 3; they are generally comfortably wadeable throughout most of the year. Wadeable streams in the Piedmont possess different characteristics based chiefly on their gradient. Streams in the Inner Piedmont (just below the Blue Ridge) typically have moderate

gradients with clear to moderately turbid water. Substrates in those streams are generally sand, gravel, and coble with boulders and exposed bedrock occurring less frequently. These streams contain a variety of habitats including frequent long stretches of riffles and runs separated by short sections of pools and glides. As one moves south and east through the Outer Piedmont toward the Fall Line, wadeable streams have less gradient; runs and riffles become less frequent and shorter in length, while slow-flowing pools comprise the majority of habitat. Outer Piedmont streams are generally turbid, carrying a heavy sediment load from both historic and current conversion of forested land to agriculture and silviculture. These streams have substrates of mostly sand, silt, clay, and detritus.

Navigable streams are common in the Piedmont Ecoregion and include large rivers like the Savannah River, Saluda River, Broad River, and Catawba River, as well as smaller rivers like the Reedy River, Enoree River, and Fishing Creek. These streams are generally defined as being large enough to operate watercraft, if only a canoe, and are generally too deep to be waded throughout most of the year. These larger streams are more productive than their smaller counterparts and typically carry a heavy sediment burden. Substrates are typically sand, clay, and detritus, although the high gradient areas produce shoals and riffles that contain gravel, cobble and, occasionally exposed bedrock and boulders. All of the large rivers (Savannah, Saluda, Broad, and Catawba) and many of the smaller rivers (Reedy, Enoree, and Tyger) have been impounded somewhere along their course. These impoundments have forever altered the natural hydrographs of these rivers and the habitats they contain.

In an aquatic bioassessment framework developed by Denison et al. (2021) utilizing fish assemblage data, streams of the Piedmont Ecoregion responded similarly to those of the Blue Ridge Ecoregion to change in environmental and watershed characteristics (i.e. upland physical and chemical characteristics, disturbance). Across this Ecoregion, differences in fish assemblage composition and response to disturbance are primarily attributable to taxonomic differences between the Savannah and Santee River basins due largely to the presence of "sister species" (i.e. taxonomically distinct but ecologically equivalent species) (Figure 3-2). The response of Piedmont streams to changes in environmental disturbance would therefore be expected to be most similar among streams within river basins.

Sandhills Ecoregion

Longleaf Pine Sandhill

This ecosystem is defined extremely broadly here and includes any Longleaf Pine- (*Pinus palustris*) dominated ecosystem in the Ecoregion. This includes the "Pine-Scrub Oak Sandhill", "Xeric Sandhill Scrub" of Nelson (1986), "Turkey Oak Barrens", "Scrub Oak Barrens", and in part the "Xeric Pine-mixed Hardwoods" of Barry (1980), and the "Longleaf Pine-scrub Oak Sandhills" and "Longleaf Pine-Turkey Oak Sandhills" of McMillan et al. (2022). Schafale (2024), under the "Dry Longleaf Pine Communities" theme, divides this vegetation type into a variety of Longleaf Pine-dominated forest, barren, scrub, and Sandhill types. The USNVC classification is "Xeric Longleaf Pine Woodland Group". On the well-drained sands of the Ecoregion, frequent fires have formed Longleaf Pine- (*Pinus palustris*) dominated communities. The Longleaf Pine-Wiregrass subtype is dependent on fire for maintenance. Wiregrass and leaf litter generally carry fire well and Longleaf Pine is well-adapted to fire due to its specialized

juvenile stage and thick bark. Where fire is excluded, Turkey Oak (*Quercus laevis*) and other scrub oak species gradually increase in abundance. Sandhill communities are variable in structure and species composition correlated with soils, fire frequency, and geography. Most typically, there is a relatively open canopy, an understory of xeric-adapted oak species, and a diverse groundcover of graminoids and forbs. In the most xeric sands "Sand Barren" subtypes may form, with large areas of open sand with little herbaceous cover. Sandhill habitats with loamier soils can have much more diverse herb and graminoid communities, supporting rare species and abundant members of the bean family (*Fabaceae*), though the dominant species is still usually wiregrass, with Southern Wiregrass (*Aristida beyrichiana*) occurring in the southern part of the region, and Carolina Wiregrass (*A. stricta*) in the northern part.

Oak-Hickory Forest

This concept includes the "Oak-Hickory Forest" of Nelson (1986) and McMillan et al. (2022), and "Xeric Pine-Mixed Hardwoods" of Barry (1980). Schafale (2024) calls it "Dry Oak–Hickory Forest (Coastal Plain Subtype)". USNVC classifies it as "Piedmont-Coastal Plain Oak Forest and Woodland Group". Oak-Hickory Forest is a widely distributed and variable community. Occurring in highly fragmented stands, later successional stages tend to be made up of a diverse assemblage of hardwoods, primarily oaks and hickories, as co-dominants, sometimes in combination with pines. Understory, shrub, and herbaceous layers are present in varying degrees, represented by diverse woody and non-woody species. Vegetation on most sites consists of early- to mid-successional managed stands of pine and pine-hardwood forest. The understory in pure pine stands is often open, but in mixed or older stands, it is dominated by the hardwoods characteristic of the site. Characteristic canopy species include White Oak (*Quercus alba*), Spanish Oak (*Q. falcata*), and often Post Oak (*Q. stellata*), Mockernut Hickory (*Carya tomentosa*), and Loblolly Pine (*Pinus taeda*), and sometimes Shortleaf Pine (*Pinus echinata*). The understory usually contains Sourwood (*Oxydendrum arboreum*), Flowering Dogwood (*Benthamidia florida*), and American Holly (*Ilex opaca*). The herbaceous layer is often sparse but can include dense Slender Spikegrass (*Chasmanthium laxum*).

Mesic Mixed Hardwood Forest

This concept includes the "Mesic Mixed Hardwood Forest" of Nelson (1986), and "Beech Forest" of McMillan et al. (2022). Schafale (2024) calls this "Mesic Mixed Hardwood Forest (Coastal Plain Subtype). The USNVC classification is "Southern Mesic Beech-Oak-Mixed Deciduous Forest Group". Mesic forests are scattered throughout the region, often associated with river bluffs and other sites where fire shadows form. Soils are moist, intermediate between the dryer soils of Oak-Hickory Forest and wet soils of alluvial forests, and have a lower pH than Basic Mesic Forest. These forest communities may consist of a mixed hardwood canopy. Common canopy species include White Beech (*Fagus grandifolia* var. *caroliniana*), Tulip-Tree (*Liriodendron tulipifera*), Water Oak (*Quercus nigra*), White Oak (*Q. alba*), Sweet Gum (*Liquidambar styraciflua*), and often Loblolly Pine (*Pinus taeda*), although a wide variety of tree species can occur. The shrub layer often includes American Beautyberry (*Callicarpa americana*), Sweetleaf (*Symplocos tinctoria*), Dangleberry (*Gaylussacia frondosa*), and Switch Cane (*Arundinaria tecta*). Herbs and graminoids may be sparse to dense.

Basic Mesic Forest

Forests with high pH have not been well-described for the Sandhills Ecoregion. This concept somewhat follows the "Basic Forest" of Nelson (1986). He restricted that community to the Piedmont Ecoregion, but Sandhill Ecoregion examples have similarities. Schafale includes this as Basic Mesic Forest (Coastal Plain Subtype). The USNVC calls this "Southern Mesic Beech - Oak - Mixed Deciduous Forest Group". Basic Mesic Forests are found on high pH soils and are dominated by a mixed canopy of hardwoods. This is a rare ecosystem in the Sandhills Ecoregion, and examples are mainly found associated with bluffs along large rivers such as the Congaree, Savannah, and Wateree, close to the Fall Line where high pH substrates are exposed beneath well-drained sands. Canopy composition varies with soil moisture, but species include Live Oak (*Quercus virginiana*), Basket Oak (*Q. michauxii*), American Hop-Hornbeam (*Ostrya virginiana*), and White Beech (*Fagus grandifolia* var. *caroliniana*). There may be an understory of shrubs or palms including Common Wax-Myrtle (*Morella cerifera*) and Dwarf Palmetto (*Sabal minor*). There will be plant species that are indicators of calcareous or circumneutral soils including Silverbells (*Halesia* spp.), American Hop Hornbeam (*O. virginiana*), Silky Camellia (*Stewartia malacodendron*), Richweed (*Collinsonia canadensis*), or Mellichamp's Skullcap (*Scutellaria mellichampii*).

Streamhead Pocosin

This community is new to this revision. It includes the "Seepage Pocosin" and "Streamhead Pocosin" of Nelson (1986) and "Streamhead Pocosin" of McMillan et al. 2022. Schafale includes it as a "Streamhead Pocosin" theme and all four community types under it are included here, including "Streamhead Pocosin", "Sandhill Streamhead Swamp", "Streamhead Canebrake", and "Streamhead Atlantic White Cedar Forest". The USNVC includes these as "Southern Coastal Plain Mixed Evergreen Swamp Group" and for canebrakes "Southeastern Coastal Pocosin and Shrub Bog Group". These pocosin ecosystems are frequent in the Sandhills, arising at streamheads in Longleaf Pine communities. All are characterized by permanently saturated soils in seepage-fed Sandhill drainages. Vegetation structure is variable, as reflected in Schafale's classification, but is usually a suite of evergreen shrubs and sometimes with a canopy of Pocosin Pine (*Pinus serotina*) or much more rarely Atlantic White Cedar (*Chamaecyparis thyoides*). Variation is due to fire history and fire regime, slope, hydrology, and physiography. A tree canopy is often more abundant downslope where fires penetrate less frequently, grading into Blackwater Floodplains. Common tree species include Pocosin Pine, Tulip-Tree (*Liriodendron tulipifera*), Swamp Bay (*Tamala palustris*), and Sweet Bay (*Magnolia virginiana*). Shrub species include Little Gallberry (*Ilex glabra*), Big Gallberry (*Ilex coriacea*), Shining Fetterbush (*Lyonia lucida*), and Poison Sumac (*Toxicodendron vernix*). The graminoid and forb layer is usually sparse unless fires are very frequent.

Sandhill Seep

This includes the "Hillside Herb Bog" of Nelson (1986), "Hillside Bogs" of Barry (1980), and Herbaceous Seepage Slopes" of McMillan et al. (2022). Schafale (2024) calls this "Sandhill Seep". The USNVC classification is "Wet-Mesic Longleaf Pine Open Woodland Group". Sandhill seeps occur on sites having a hard clay, moisture-confining layer underlying the sandy soil, such as iron-bearing sandstone or kaolin deposits. Water percolating downhill is forced to the surface, which results in seasonally or permanently saturated soils. This ecosystem is related

to Streamhead Pocosins because they can form on similar sites, but Sandhill Seeps are characterized by a dense graminoid and forb groundcover, often with shrubs. Vegetation is variable, depending on position on the slope, the amount of peat accumulation, and fire history, but is here defined as having a sparse tree canopy and low shrub density. Lacking fire, woody plant density may become dense causing succession to Streamhead Pocosin. An open canopy of Pocosin Pine (*Pinus serotina*) is typical, but sometimes with sparse hardwoods such as Tulip-Tree (*Liriodendron tulipifera*). Shrubs include Pocosin Bayberry (*Morella caroliniensis*), blueberries (*Vaccinium* spp.), Pocosin Witch-Alder (*Fothergilla gardenii*), St. John's-worts (*Hypericum* spp.), Little Gallberry (*Ilex glabra*), Big Gallberry (*Ilex coriacea*), Shining Fetterbush (*Lyonia lucida*), and Poison Sumac (*Toxicodendron vernix*). This is now a rare ecosystem in South Carolina because of fire suppression. Some of the best examples remaining occur in utility rights-of-ways where woody plants are controlled through prescribed fire or periodic mowing. Those managed with herbicide application are generally of lower floristic quality and have fewer conservative species.

Depression Wetlands; Carolina Bays

This community is very broadly defined here and includes depression wetlands representing many distinctive habitats within this broad category. This includes Carolina Bays, High Ponds, vernal pools, flatwoods pond, wet weather pond, and broad swales that aren't connected to alluvial systems. This concept includes the "Pocosin" and "Pond Cypress Pond" or Nelson (1986), and "Pocosins" and possibly "Depression Meadows" of McMillan et al. (2022). Schafale (2024) treats these in a broad "Coastal Plain Depression Communities" theme that encompasses the Sandhills and Coastal Plain. This includes depression pocosin, depression swamp, vernal pool, cypress savanna, draw-down meadow, and depression pond. USNVS communities include "Southern Atlantic Coastal Plain Depression Pond" and "Atlantic Coastal Plain Clay-Based Carolina Bay Wetland".

Depression wetlands in the Sandhills formed due to many reasons, such as the collapse of a friable subterranean layer such as sandstone, or due to natural concavities, bowls, or slumps on the surface topography. These depressions will hold water given the presence of an impermeable soil layer such as clay, rock, or humate-impregnated sand. Depression wetlands are often referred to as "perched" water tables because they hold water perched above the normal sub-surface water table. They are also referred to as isolated, temporary wetlands due to the general lack of connection to surface streams and the pulsed nature of their hydrology, typically filling and drying with rainfall cycles.

Some of these wetlands display unique geomorphologies, such as Carolina Bays and High Ponds. The latter are poorly understood and are restricted to an area of Atlantic Southern Loam Plain that's inland of the true Sandhills Ecoregion, around the intersection of Aiken, Edgefield, and Saluda counties. Carolina Bays, and likely also High Ponds, are a class of depression wetland that display both a unique shape and orientation. Carolina Bays are either oval or elliptical in shape with the long axis of the ellipse, or oval lying along a northwest to southeast alignment. There are several hypotheses about the origin of these features, but no conclusive data supports any one of them to date.

Depression wetlands in the Coastal Plain can support a variety of vegetative community types ranging from Pond-Cypress- (*Taxodium ascendens*) or Swamp Tupelo- (*Nyssa biflora*) dominated ponds, to Pond Cypress savannas and wet meadow communities, and/or to pocosin and Pocosin Pine (*Pinus serotina*) woodlands. Open water ponds, hardwood ponds, and sedge-dominated ponds may occur in other parts of the State as well.

Despite the differences in origin, geomorphology, and vegetative structure, these habitats are similar in ecological function. With a few notable exceptions, these habitats are primarily linked to rainfall cycles, relying on rain to fill their basins and subsequently drying out during periods of low rainfall. The frequency of inundation may vary both in time and in location, such that most of these wetlands do not fill and dry on an annual basis.

Depression wetland habitats are detritus-based systems. When they dry, herbaceous plants and grasses die back and desiccate, forming a detrital layer. When the basins are inundated again, this detritus forms the base of a food web that can support a variety of invertebrate and vertebrate species. Many native plant and animal species, including numerous rare species, rely on depression wetlands as a primary habitat or for some life history stage such as breeding habitat. Because these habitats fill and dry cyclically, they typically do not support large predatory fish populations. Numerous amphibian species in South Carolina breed preferentially or exclusively in depression wetland habitats. Avoidance of larval predators, such as fish, is a critical adaptive mechanism for amphibians, and one solution is to breed in fish-free habitats such as depression wetlands. As such, depression wetlands are critically important habitats for several amphibian species in South Carolina.

Blackwater Floodplains

This concept includes the variety of alluvial ecosystems that occur along blackwater waterways including rivers and streams. Because of the variation, a crosswalk to other sources is difficult, but it does include blackwater examples of Nelson's (1986) "Atlantic White Cedar Swamp", "Bald-Cypress-Tupelo Gum Swamp, "Bay Forest" (likely in part), "Bottomland Hardwoods", "Levee", "Shoal & Stream Bar", and "Small Stream Forest". McMillan et al. (2024) includes "Atlantic White Cedar Forests" and different kinds of "Bottomland Forest Communities" including blackwater types of "Bald-Cypress-Tupelo Gum Swamp Forests", "Hardwood Bottom Forests", and "Levee Forests". Schafale (2024) has a broad treatment of a "Coastal Plain Floodplains" theme, and his blackwater communities are included here, including "Levee/Bar Forest", "Bottomland Hardwoods", "Cypress-Gum Swamp", "Oxbow Lake", "Sand and Mud Bar", "Riverine Floating Mat", and "Semipermanent Impoundment". The USNVC classification includes "Oak-Sweetgum Floodplain Forest Group", "Oak-Sweetgum Floodplain Forest Group", "Bald-cypress-Tupelo Floodplain Forest", Eastern North American Riverine Sand-Gravel Bar Group", "South Atlantic and Gulf Coastal Plain River and Basin Freshwater Marsh and Wet Meadow Group", and "Eastern North American Freshwater Aquatic Vegetation Group". Streams and rivers arising in the Sandhills and Coastal Plain are commonly known as "blackwater" for the color of tannins that leach from decaying vegetation. They are more acidic than "brownwater" rivers with lower ion concentrations. Forests on the floodplains formed by these waterways typically have a canopy dominated by Swamp Tupelo (*Nyssa biflora*) and Red Maple (*Acer rubrum*). On broader sites, Bald-Cypress (*Taxodium distichum*) can become an important canopy species. Tulip-Tree (*Liriodendron tulipifera*), Sweet Gum (*Liquidambar*

styraciflua), Pocosin Pine (*Pinus serotina*), Loblolly Pine (*Pinus taeda*) and Laurel Oak (*Quercus laurifolia*) are important associates. The shrub layer is open in areas subject to the most flooding, or it can be dense and pocosin-like in areas subject to infrequent flooding. Headwaters and wet flats immediately above the floodplain can support dense, pocosin-like shrub thickets or, under suitable fire conditions, pure stands of Atlantic White Cedar (*Chamaecyparis thyoides*). Sunny areas along the waterways can support marsh vegetation. Draw-down zones during low water can support an assemblage of herbaceous annual plant species.

Brownwater Floodplains

This concept includes the variety of alluvial ecosystems that occur along brownwater waterways including rivers and streams. Because of the variation, a crosswalk to other sources is difficult, but it does include brownwater examples of Nelson's (1986) "Bald-Cypress-Tupelo Gum Swamp, "Bottomland Hardwoods", "Levee", "Shoal and Stream Bar", and "Small Stream Forest". McMillan et al. (2024) includes different kinds of "Bottomland Forest Communities" including brownwater types of "Bald-Cypress-Tupelo Gum Swamp Forests", "Hardwood Bottom Forests", and "Levee Forests". Schafale (2024) has a broad treatment of a "Coastal Plain Floodplains" theme, and his brownwater communities are included here, including "Levee/Bar Forest", "Bottomland Hardwoods", "Cypress-Gum Swamp", "Oxbow Lake", "Sand and Mud Bar", "Riverine Floating Mat", and "Semipermanent Impoundment". The USNVC classification includes "Southern Ash-Elm-Willow Floodplain Forest Group", "South Central-Appalachian-Northeast Floodplain Forest Group", "Oak-Sweetgum Floodplain Forest Group", "Bald-cypress-Tupelo Floodplain Forest", "Bald-Cypress-Tupelo Floodplain Forest", "Eastern North American Riverine Sand-Gravel Bar Group", and "Eastern North American Freshwater Aquatic Vegetation Group".

Streams and rivers arising or cutting through the Piedmont and Blue Ridge are commonly known as "brownwater" for the dark brownish color due to high amounts of silt and clay particles suspended in the water. Forests on the floodplains formed by these waterways typically have a canopy dominated by Sweet Gum (*Liquidambar styraciflua*), Loblolly Pine (*Pinus taeda*), Water Oak (*Q. nigra*), Willow Oak (*Q. phellos*), Laurel Oak (*Q. laurifolia*), Cherrybark Oak (*Q. pagoda*) and American Holly (*Ilex opaca*). The Cypress-Tupelo Swamp subtype occurs on lower elevation sites as seasonally flooded swamps. Dominant trees are Bald-Cypress (*Taxodium distichum*), Water Tupelo (*Nyssa aquatica*), Planer-Tree (*Planera aquatica*) and Red Maple (*Acer rubrum*). Sunny areas along the waterways can support marsh vegetation or floating mats, or occasionally canebrakes. Draw-down zones during low water can support an assemblage of herbaceous annual plant species.

Pine Plantation

This community is new to this revision. In the 2015 SWAP, it was treated as part of the broad "Upland Pine" community of the Piedmont Ecoregion and "Pine Woodland" of the Coastal Plain and Coastal Zone Ecoregions. Those classifications, however, also included natural pine-dominated woodlands. The USNVC classification for these timber production areas is "Temperate and Boreal Plantation". Planted pine plantations are very abundant in the Sandhills Ecoregion, comprising much of the area formerly occupied by the various communities making up the greater Southeastern Longleaf Pine ecosystem. Like the rest of the State, Loblolly Pine

(*Pinus taeda*) is the typical species. Pine plantations are generally poor wildlife habitat, however, lacking in both the food and cover needed by native wildlife.

Early-Successional Habitats

Early-successional habitats in the Sandhills Ecoregion are important habitats for wildlife species that depend upon these open areas. These habitats are generally characterized by tree canopy coverage that is sparse or absent and herbaceous groundcover comprised of annual and perennial forbs and graminoids and a variable coverage of shrubs, vines, and small trees. A variety of open landcover types represent this category and can include old field sites, open canopy gaps, shrub thickets, recently reforested areas, field borders, grassed waterways, and filter strips. Lawns, golf courses, pastures, hay fields, crop fields, airports, and various urban open spaces are sometimes included in this habitat type but lack the floristic and structural diversity to be considered high-quality, early-successional habitat. Maintenance of early-successional habitat requires periodic disturbance or disruption of the existing vegetative community. Purposeful management of Early -Successional Habitat is usually accomplished through the use of timber harvest, prescribed burning, disking, or mowing. Target species for management will determine disturbance intervals, with shorter intervals (1-2 years) favoring those species dependent on herbaceous vegetation and longer intervals (3-5 years) favoring those species dependent on shrub cover. Optimal multi-species management often dictates concurrent maintenance of a variety of successional, or seral, stages.

Freshwater Streams, Rivers, Lakes, and Ponds

[The aquatic habitats in this ecoregion are discussed in the framework of the larger Southeastern Plains instead of just the Sandhills.]

Streams and rivers originating in the Sandhills Ecoregion are generally low to moderate gradient and often possess tannin-stained waters imparted by the surrounding vegetation. The classic Sandhills stream exhibits steady, moderate flow over a predominantly sand substrate with patches of rooted aquatic vegetation and scattered woody debris. Streams in this region may also transition into swamps and wetlands in areas of lower gradient. First- through fourth-order streams make up the majority of freshwater habitats on the landscape.

Portions of all of South Carolina's major river basins occur in the Sandhills Ecoregion. The region denoted the Southeastern Plains encompasses the Sandhills and Upper Coastal Plain and is sandwiched between the Piedmont to the north and the Lower Coastal Plain to the south. (This follows the Griffith et al. 2002 ecoregion map before its modification for the SWAP in Figures 2-1 and 3-1.) It extends northwest from the Savannah River to the Pee Dee River. The Southeastern Plains encompasses portions of 24 counties and 23,584 km² (9,106 mi²). Just below the Fall Line, the region is dominated by sandy soils with scrub vegetation on moderately sloping lands. This portion is known as the Sandhills and varies in elevation from 76-137 m (250-450 ft.) above mean sea level. Moving toward the coast, the topography is reduced to gentle sloping and then to nearly level lands with elevations of 130-137m (25-450 ft.).

The **Savannah-Southeastern Plains Ecobasin** extends from the southern portions of Edgefield County south to the southern portion of Allendale County. It includes about 137 km (85 mi.) of the Savannah River as it meanders toward the Coastal Plain and ultimately the Atlantic Ocean.

Major South Carolina tributaries to the Savannah River in the Ecobasin include Horse Creek, Hollow Creek, Upper Three Runs Creek, and Lower Three Runs Creek. The Ecobasin encompasses most of 6 watersheds and parts of 10 others in its 2,538 km^2 (980 $mi.^2$). The Ecobasin contains 1,576 km (979 mi.) of lotic habitat and 2,600 ha (6,425 ac.) of lentic habitat, primarily impoundments. A small portion of the lentic habitat is comprised of Carolina Bays.

Primary conservation targets in the Ecobasin include the main stem Savannah River in Aiken and Allendale Counties, Upper Three Runs Creek and its tributaries in Aiken and Barnwell Counties, and the Brier Creek system in Allendale County (Smith et al. 2002). The main stem of the Savannah River within the Ecobasin contains several aquatic animals on South Carolina's Species of Greatest Conservation Need (SGCN) List including Shortnose Sturgeon and Robust Redhorse, as well as several mussel species (e.g. Pod Lance and Savannah Lilliput). Priority fish species in Upper Three Runs Creek and its tributaries include the Savannah Darter and Turquoise Darter. The Savannah Darter and Bluebarred Pygmy Sunfish inhabit the Brier Creek system.

The **ACE–Southeastern Plains Ecobasin** is the only ecobasin in the State to originate entirely in the Southeastern Plains Ecoregion. The headwaters of the North and South Forks of the Edisto River originate in the extreme southern portion of Edgefield and Lexington Counties. The headwaters of the Salkehatchie River originate in Barnwell County. Major tributaries to the North Fork Edisto River in the Ecobasin include Black Creek, Bull Swamp Creek, and Caw Caw Swamp. Major tributaries to the South Fork Edisto River include Shaw Creek, Dean Swamp Creek, Little River, and Roberts Swamp. The Ecobasin includes portions of 27 watersheds and covers 5,747 km^2 (2,219 $mi.^2$). The Ecobasin contains approximately 2,239 km (2,117 mi.) of lotic habitat and 9,047 acres of lentic habitats. There are no major reservoirs within in the Ecobasin, and largest lentic areas (more than 730 ha or 5 ac.) are primarily Carolina Bays.

Primary conservation targets in the Ecobasin include the upper portion of the South Fork Edisto River in Aiken, Barnwell, and Orangeburg Counties; the main stem of the lower North Fork Edisto River in Orangeburg County; and Black Creek, a tributary to the North Fork Edisto River in Lexington County (Smith et al. 2002). Priority fish species in the upper South Fork Edisto River include the "Broadtail" Madtom, Savannah Darter, Turquoise Darter, and Blackbanded Sunfish. The lower North Fork Edisto River and its tributaries provide habitat for the "Broadtail" Madtom, Bluebarred Pygmy Sunfish, and Savannah Darter as well as the federally endangered Shortnose Sturgeon.

The upper extent of the **Santee-Southeastern Plains Ecobasin** is the Fall Line, which runs through central Lexington, Richland, and Kershaw Counties. The ecobasin extends southeasterly to the upper portion of Berkeley County and includes 3 major rivers. The Congaree and Wateree merge to form the Santee River southeast of Columbia. Major tributaries to the Congaree River include Congaree Creek, Gills Creek, and Cedar Creek. Major tributaries to the Wateree River include Five and Twenty Mile Creek, Big Pine Tree Creek, Colonel's Creek, and Beech Creek. The Ecobasin contains all of 17 watersheds and portions of 30 others and covers 5,346 km^2 (2,064 $mi.^2$). The Ecobasin contains approximately 3,589 km (2,230 mi.) of lotic habitat and 379 km^2 (146 $mi.^2$) of lentic habitat, most of which is contained in Lake Marion (352 km^2 or 136

mi.^{2}). Big Pine Tree Creek near Camden South Carolina is a primary conservation target in the Ecobasin as it holds one of very few known Carolina Pygmy Sunfish populations.

The **Pee Dee-Southeastern Plains Ecobasin** is located in the northeast corner of the State, originating in Chesterfield, Marlboro, and Dillon Counties and flowing through parts or all of Kershaw, Darlington, Florence, Lee, Marion, Sumter, and Clarendon Counties. The Ecobasin contains 3 major rivers including the Lynches, Pee Dee, and Little Pee Dee as well as the headwaters of the Black River. The Lynches River originates just north of South Carolina in the Piedmont of North Carolina. It flows about 34 km 114 km (21 mi.) through the South Carolina Piedmont before entering the Pee Dee-Southeastern Plains Ecobasin, then flows another 114 km (71 mi.) until it enters the Coastal Plain, picking up inputs from 2 major tributaries, Buffalo Creek and the Little Lynches River, along the way. The Pee Dee River originates in the southern portion of the North Carolina Piedmont and Southeastern Plains. Within the Pee Dee-Southeastern Plains Ecobasin, the Pee Dee River flows about 148 km (92 mi.) before entering the Coastal Plain. Major tributaries to the Pee Dee River include Thompson Creek, Crooked Creek, Black Creek, and Jefferies Creek. The Little Pee Dee River originates in the Southeastern Plains of North Carolina and flows approximately 119 km (74 mi.) through the Pee Dee-Southeastern Plains Ecobasin before entering the Coastal Plain of South Carolina. The primary tributary is Buck Swamp. Pocataligo River and Black River Swamp are the main tributaries of the Black River. Both originate within the Ecobasin and flow southeast before entering the Coastal Plain and merging to form the Black River. The Ecobasin contains all of 11 watersheds and parts of 46 others and covers 9,920 km^2 (3,830 mi.^{2}). There are about 7,388 km (4,591 mi.) of lotic habitat and 96 km^2 (37 mi.^{2}) of lentic habitat; the largest lentic area is Big Bay (1,002 ha or 2,476 ac.) which is a Carolina Bay.

Areas of primary conservation concern include the upper Lynches River and its Sandhills tributaries in Chesterfield, Kershaw, Lee, and Darlington Counties; the upper Pee Dee River between Marlboro and Chesterfield Counties; and Sandhills tributaries to the Little Pee Dee River along the border of South Carolina and North Carolina in Marlboro and Dillon Counties (Smith et al. 2002). The upper Lynches River is home to several aquatic priority fish (Sandhills Chub, "Thinlip" Chub, and "Broadtail" Madtom) and mussels (Brook Floater, Creeper, Notched Rainbow, and the federally endangered Carolina Heelsplitter). The main stem of the upper Pee Dee River contains several fish ("Carolina" Redhorse, Robust Redhorse, and the federally endangered Shortnose Sturgeon) and mussel (Yellow Lampmussel and Roanoke Slabshell) priority species. Sandhills tributaries to the Little Pee Dee River contain Sandhills Chub and once harbored populations of Pinewoods Darter that may now be extirpated from the State.

Aquatic habitats in the Sandhills change physically, chemically, and biologically as water flows from the headwaters to streams, larger streams, and ultimately rivers while being influenced by the surrounding watershed and landscape (Hynes 1975, Vannote et al. 1980). Habitat complexity and species diversity increase with stream size, producing a continuum of aquatic species assemblages from headwaters to the largest rivers. Whereas certain species are generalists and occur along the entire continuum in varying abundance, others are highly specialized for the precise set of physical and chemical characteristics produced by the underlying geology and

surrounding landscape and only occur in certain stream sizes or habitat types within the Ecoregion.

Wadeable streams are the dominant aquatic habitat in the Southeastern Plains Ecoregion and provide most of the habitat for aquatic animals on South Carolina's SGCN list. Wadeable streams are those with Strahler stream orders of 0 to 3; generally, these are streams that can be waded comfortably throughout most of the year. These streams are often bordered with pond-like backwaters and swamps. Wadeable streams in the Southeastern Plains are mostly low gradient, although some near the Fall Line have swifter flows. In moderate flowing areas, the substrate is chiefly clean shifting sand; with the absence of rocks in most streams, logs and debris jams provide habitat for aquatic fauna. In slow flowing areas, substrate is comprised of finer materials such as mud, clay, silt, and fine detritus. Most Southeastern Plains streams that receive ample sunlight are well vegetated with aquatic macrophytes. The streams that flow through the Ecoregion are often termed "blackwater" due to their tannin-stained waters; these streams commonly overflow their banks, bringing in organic material from the floodplain. Bacterial decomposition releases both tannic and fulvic acids, decreasing the pH to low levels; the average pH in the North and South forks of the Edisto River, for example, average 5.4 (Jennings et al. 2023).

Navigable streams are less common in the Southeastern Plains but provide habitat for many priority species. These streams are generally defined as large enough to operate watercraft, if only a canoe, and are usually too deep to be waded throughout most of the year. The Pee Dee River, Lynches River, and Edisto River are examples of navigable streams in the Southeastern Plains. These lazy meandering streams have substrates of mostly shifting sand in the flowing areas while finer materials (silt, clay and detritus) are deposited in the pools. As with the smaller streams in the Ecobasin, the navigable streams are also "blackwater," stained by the decomposition of organic materials.

The lower portion of the Southeastern Plains, known as the Atlantic Southern Loam Plains, contains the highest concentration of Carolina Bays in the State. Carolina Bays are shallow, elliptical depressions of unknown origin, many of which contain water throughout the year. The waters in Carolina Bays are highly acidic, which limits the number of fish species. However, some sunfish and minnow species populate these depressions. Carolina Bays may be important habitat for some rare crayfish species, as several have been observed in these formations. However, data on the crayfishes associated with Carolina Bays is particularly lacking; more surveys are needed in order to determine the importance of these depressions as crayfish habitat.

In an aquatic bioassessment framework developed by Denison et al. (2021) utilizing fish assemblage data, streams of the Sandhills were characterized predominantly by a Stable Baseflow hydrology with associated fish assemblages that are more oriented to greater water current velocities (Figure 3-2). The fish assemblage characteristics and expected response of Sandhills streams to changes in environmental or landscape factors (i.e. disturbance) would therefore be expected to be most similar among streams with this type of hydrology.

Coastal Plain Ecoregion

Pine Savannas and Flatwoods

This highly variable concept includes pine-dominated communities that are mesic to wet. This excludes drier Sandhill communities (see "Longleaf Pine Sandhill"), and it also excludes wet pine communities in Carolina Bays (see "Depression Wetlands/Carolina Bays" treatment). This concept follows the "Wet Pine Savannas" theme, and "Mesic Pine Savanna" communities of Schafale (2024). Similarly, it includes the "Pine/Saw Palmetto Flatwoods" and "Longleaf Pine Savannas" of McMillan et al. (2022) as well as the "Pine Flatwoods", "Pine Savannah", "Pine-Saw Palmetto Flatwoods" and "Pond Pine Woodland" of Nelson (1986). The USNVC classifications are "Dry-Mesic Loamy Longleaf Pine Woodland Group" and "Mesic Longleaf Pine Flatwoods-Spodosol Woodland Group". The canopy in these communities is dominated by one or several species of pine, generally Longleaf Pine (*Pinus palustris*) or Pocosin Pine (*Pinus serotina*), depending on soil moisture. Canopy closure ranges from very open, to dense on fire suppressed sites. When burning is frequent, graminoid and herb density and diversity can be very high, but in the absence of fire, shrubs can become predominant, including Dangleberry (*Gaylussacia frondosa*), Common Wax-Myrtle (*Morella cerifera*), and Little Gallberry (*Ilex glabra*). Optimal habitat for priority species consists of open stands of pine, sparse understory and shrub layers, and a dense groundcover. The community, as circumscribed here, is variable and could be broken down further. As detailed by Schafale (2024), mesic soils support "Mesic Pine Savanna" communities that are usually dominated by Longleaf Pine. Seasonally saturated sites support "Wet Pine Flatwoods" that are usually dominated by Pocosin Pine.

Dry Longleaf Pine

This concept is for pine communities on dry soil. It includes the "Pine-Scrub Oak Sandhill" and "Xeric Sandhill Scrub" of Nelson (1986), "Turkey Oak and Scrub Oak Barrens" of Barry (1980), and "Longleaf Pine-Scrub Oak Sandhills", "Longleaf Pine-Turkey Oak Sandhills" of McMillan et al. (2022). Schafale included this in a "Dry Longleaf Pine" communities theme, excluding savannas (see "Pine Savannas and Flatwoods" community). The USNVC classification is "Xeric Longleaf Pine Woodland Group" and "Dry-Mesic Loamy Longleaf Pine Woodland Group". Dry Longleaf Pine is a variation of "Pine Savannas and Flatwoods" composed of species adapted to xeric, sandy soils. This community type occurs along dry sand ridges including riverine sand ridges and Carolina Bay rims. It is characterized by an absence of frequent fire, a canopy of Longleaf Pine, and a subcanopy of Turkey Oak interspersed with scrub oak species and scrub-shrub cover. Frequent burning leads to the development of a diverse graminoid- and forb-dominated groundcover. Where sand ridges form in fluvial versus alluvial environments, the plant species composition may be dramatically different because of differences in soil composition. Regular flood events, that shift sand ridges along the Waccamaw or Little Pee Dee Rivers, may hinder the development of a more diverse suite of plant species. The sole canopy species is Longleaf Pine (*Pinus palustris*) when frequently burned. Shrub species can be diverse and abundant and include Turkey Oak (*Quercus laevis*), Blackjack Oak (*Quercus marilandica*), Bluejack Oak (*Quercus incana*), and Farkleberry (*Vaccinium arboreum*). Groundcover can vary considerably with soil conditions but often includes Carolina Wiregrass (*Aristida stricta*), Southern Wiregrass (*Aristida beyrichiana*), Common Little Bluestem (*Schizachyrium scoparium*), and a wide variety of herbaceous species.

Mesic Mixed Hardwood Forest

This concept combines the "Mesic Forest" and "Hardwood Slopes and Bottoms" of the 2015 SWAP. It also includes the "Mesic Mixed Hardwood Forest" of Nelson (1986) and the "Beech Forest" of McMillan et al. (2022). Schafale (2024) describes it as "Mesic Mixed Hardwood Forest (Coastal Plain Subtype)". The USNVC classification is "Southern Mesic Beech-Oak-Mixed Deciduous Forest Group". As Schafale (2024) describes, this community varies widely with hydrology, slope, soils, and fire frequency. The community forms on soils that are protected from fire, and with mesic to dry, low pH soils. It can occur on bluffs, swamp islands (often with abundant Loblolly Pine (*Pinus taeda*)), or on upland flats. Common hardwood canopy species include White Beech (*Fagus grandifolia* var. *caroliniana*), Water Oak (*Quercus nigra*), Black Oak (*Q. velutina*), White Oak (*Q. alba*), Pignut Hickory (*Carya glabra*), Mockernut Hickory (*C. tomentosa*), American Hornbeam (*Carpinus caroliniana*), Sour Gum (*Nyssa sylvatica*), Red Maple (*Acer rubrum*), and American Holly (*Ilex opaca*). The understory may be dense to open. Groundcover can be sparse or with dense Slender Spikegrass (*Chasmanthium laxum*) and sometimes other forbs and graminoids. These sites lack plant species that are indicators of calcareous soils that would be found in "Basic Mesic Forest".

Basic Mesic Forest

This concept follows the "Marl Forest", "Calcareous Cliff" (which is usually in association with this community type), and "Beech-Magnolia Hammock" (at least in part) of Nelson (1986), the "Magnolia Forest" of Barry (1980), and "Calcareous Forest" of McMillan et al. (2022). Schafale includes this as Basic Mesic Forest (Coastal Plain Subtype). Schafale (2024) calls this "Basic Mesic Forest (Coastal Plain Subtype)". Also included here are alluvial islands in some major rivers, such as the Savannah River, that are calcareous which Schafale calls "Swamp Island Evergreen Forest". The USNVC classification is "Southern Mesic Beech-Oak-Mixed Deciduous Forest Group" and "Southeastern Evergreen Oak Forest Group". Basic Mesic Forests are found on high pH soils and are dominated by a mixed canopy of hardwoods, but also frequently have Spruce Pine (*Pinus glabra*). Canopy composition varies with soil moisture, but species include Live Oak (*Quercus virginiana*), Swamp Chestnut Oak (*Q. michauxii*), Bluff Oak (*Q. austrina*), American Hop Hornbeam (*Ostrya virginiana*), and Southern Magnolia (*Magnolia grandiflora*). There may be an understory of shrubs or palms including Common Wax-Myrtle (*Morella cerifera*), Dwarf Palmetto (*Sabal minor*), and rarely Needle Palm (*Rhapidophyllum hystrix*). Many of the plant species are indicators of calcareous or circumneutral soils including Bluff Oak, Needle Palm, Spruce Pine, Southern Basswood (*Tilia americana* var. *caroliniana*), Silverbells (*Halesia* spp.), American Hop Hornbeam (*O. virginiana*), and Mottled Trillium (*Trillium maculatum*).

Oak-Hickory Forest

This concept includes a variety of hardwood-dominated forests on dry soils, including the "Oak-Hicky Forest" of Nelson (1986) and McMillan et al. (2022). Schafale (2024) includes this in a broad "Piedmont and Coastal Plain Oak Forests" theme as several types of dry oak-hickory forest, dependent on species composition and soil moisture. The USNVC classification is "Piedmont-Coastal Plain Oak Forest & Woodland Group". The composition of the vegetation in the upland forest landcover type is similar to that of Oak-Hickory Forest in the Piedmont, where

it is a major vegetation type. In contrast, upland forest is rare in the Coastal Plain, typically occurring on fire-protected upland slopes near river floodplains or between rivers and tributaries, intergrading with other communities. Representative canopy trees include White Oak (*Quercus alba*), Black Oak (*Q. velutina*), Post Oak (*Q. stellata*), Mockernut Hickory (*Carya tomentosa*), Pignut Hickory (*C. glabra*), Loblolly Pine (*Pinus taeda*), Flowering Dogwood (*Benthamidia florida*) and Sour Gum (*Nyssa sylvatica*), with sometimes pines as a minor component including Shortleaf Pine (*P. echinata*). Understory, shrub and herbaceous layers are present in varying degrees, represented by diverse woody and non-woody species.

Blackwater Floodplains

This concept includes the variety of alluvial ecosystems that occur along blackwater waterways including rivers and streams. Because of the variation, a crosswalk to other sources is difficult, but it does include blackwater examples of Nelson's (1986) "Atlantic White Cedar Swamp", "Bald-Cypress-Tupelo Gum Swamp", "Bay Forest" (likely in part), "Bottomland Hardwoods", "Levee", "Shoal and Stream Bar", and "Small Stream Forest". McMillan et al. (2024) includes "Atlantic White Cedar Forests" and different kinds of "Bottomland Forest Communities" including blackwater types of "Bald-Cypress-Tupelo Gum Swamp Forests", "Hardwood Bottom Forests", and "Levee Forests". Schafale (2024) has a broad treatment of a "Coastal Plain Floodplains" theme, and his blackwater communities are included here, including "Levee/Bar Forest", "Bottomland Hardwoods", "Cypress-Gum Swamp", "Oxbow Lake", "Sand and Mud Bar", "Riverine Floating Mat", and "Semipermanent Impoundment". The USNVC classification includes "Oak-Sweetgum Floodplain Forest Group", "Oak-Sweetgum Floodplain Forest Group", "Bald-Cypress-Tupelo Floodplain Forest", "Eastern North American Riverine Sand-Gravel Bar Group", "South Atlantic and Gulf Coastal Plain River and Basin Freshwater Marsh and Wet Meadow Group", and "Eastern North American Freshwater Aquatic Vegetation Group". Streams and rivers rising in the Sandhills and Coastal Plain are commonly known as "blackwater" for the color of tannins that leach from decaying vegetation. They are more acidic than South Carolina's "brownwater" rivers with lower ion concentrations. Forests on the floodplains formed by these waterways typically have a canopy dominated by Swamp Tupelo (*Nyssa biflora*) and Red Maple (*Acer rubrum*). On broader sites, Bald-Cypress (*Taxodium distichum*) can become an important canopy species. Tulip-Tree (*Liriodendron tulipifera*), Sweet Gum (*Liquidambar styraciflua*), Pocosin Pine (*Pinus serotina*), Loblolly Pine (*P. taeda*) and Laurel Oak (*Quercus laurifolia*) are important associates. The shrub layer is open in areas subject to the most flooding, or it can be dense and pocosin-like in areas subject to infrequent flooding. Headwaters and wet flats immediately above the floodplain can support dense, pocosin-like shrub thickets or, under suitable fire conditions, pure stands of Atlantic White Cedar (*Chamaecyparis thyoides*). Sunny areas along the waterways can support marsh vegetation. Draw-down zones during low water can support an assemblage of herbaceous annual plant species.

Brownwater Floodplains

This concept includes the variety of alluvial ecosystems that occur along brownwater waterways including rivers and streams. Because of the variation, a crosswalk to other sources is difficult, but it does include brownwater examples of Nelson's (1986) "Bald-Cypress-Tupelo Gum Swamp", "Bottomland Hardwoods", "Levee", "Shoal and Stream Bar", and "Small Stream

Forest". Barry (1980) includes it in a broad "Major River Bottoms" theme. McMillan et al. (2024) includes different kinds of "Bottomland Forest Communities" including brownwater types of "Bald-Cypress-Tupelo Gum Swamp Forests", "Hardwood Bottom Forests", and "Levee Forests". Schafale (2024) has a broad treatment of a "Coastal Plain Floodplains" theme, and his brownwater communities are included here, including "Levee/Bar Forest", "Bottomland Hardwoods", "Cypress-Gum Swamp", "Oxbow Lake", "Sand and Mud Bar", "Riverine Floating Mat", and "Semipermanent Impoundment". The USNVC classification includes "Southern Ash-Elm-Willow Floodplain Forest Group", "South Central-Appalachian-Northeast Floodplain Forest Group", "Oak-Sweetgum Floodplain Forest Group", "Bald-Cypress-Tupelo Floodplain Forest", "Eastern North American Riverine Sand-Gravel Bar Group", and "Eastern North American Freshwater Aquatic Vegetation Group".

Streams and rivers rising or cutting through in the Piedmont and Blue Ridge are commonly known as "brownwater" for the dark brownish color due to high amounts of silt and clay particles suspended in the water. Forests on the floodplains formed by these waterways typically have a canopy dominated by Sweet Gum (*Liquidambar styraciflua*), Loblolly Pine (*Pinus taeda*), Water Oak (*Quercus nigra*), Willow Oak (*Q. phellos*), Laurel Oak (*Q. laurifolia*), Cherrybark Oak (*Q. pagoda*) and American Holly (*Ilex opaca*). The Cypress-Tupelo Swamp subtype occurs on lower elevation sites as seasonally flooded swamps. Dominant trees are Bald-Cypress (*Taxodium distichum*), Water Tupelo (*Nyssa aquatica*), Planer-Tree (*Planera aquatica*), and Red Maple (*Acer rubrum*). Sunny areas along the waterways can support marsh vegetation or floating mats, or occasionally canebrakes. Draw-down zones during low water can support an assemblage of herbaceous annual plant species.

Depression Wetlands; Carolina Bays

This habitat is very broadly defined here and includes depression wetlands representing many distinctive habitats within this broad category. This includes Carolina Bays, vernal pools, flatwoods pond, limesink, wet weather pond, and broad swales that aren't connected to alluvial systems. Nelson (1986) includes "Depression Meadows", "Pond Cypress Pond" and "Swamp Tupelo Pond". McMillan et al. (2022) treats it as "Pond Cypress Savannas", Pond Cypress-Swamp Gum Upland Swamps", "Depression Meadows", and "Pocosins". Schafale (2024) includes these in a broad "Coastal Plain Depression Communities" theme, and a "Peatland Pocosins" theme. USNVC communities include "Southern Atlantic Coastal Plain Depression Pond Ecological System", "Atlantic Coastal Plain Clay-Based Carolina Bay Wetland Ecological System", and "Atlantic Coastal Plain Peatland Pocosin and Canebrake Ecological System". Depression wetlands in the Coastal Plain formed due to many reasons, such as the collapse of a friable subterranean layer such as limestone or sandstone, or due to natural concavities, bowls, or slumps on the surface topography. These depressions will hold water given the presence of an impermeable soil layer such as clay, rock, or humate-impregnated sand. Depression wetlands are often referred to as "perched" water tables because they hold water perched above the normal sub-surface water table. They are also referred to as isolated, temporary wetlands due to the general lack of connection to surface streams and the pulsed nature of their hydrology, typically filling and drying with rainfall cycles.

Some of these wetlands display unique geomorphologies, such as Carolina Bays and limesinks. Carolina Bays are a class of depression wetland that display both a unique shape and orientation.

Carolina Bays are either oval or elliptical in shape with the long axis of the ellipse or oval lying along a northwest to southeast alignment. There are several hypotheses about the origin of these features, but no conclusive data supports any one of them to date. Limesinks are typically circular on the surface with steep sides that are conical in form.

Depression wetlands in the Coastal Plain can support a variety of vegetative community types ranging from Pond-Cypress- (*Taxodium ascendens*) or Swamp Tupelo- (*Nyssa* biflora) dominated ponds, to Pond Cypress savannas and wet meadow communities, and/or to pocosin and Pocosin Pine (*Pinus serotina*) woodlands. Open water ponds, hardwood ponds, and sedge-dominated ponds may occur in other parts of the State as well.

Despite the differences in origin, geomorphology, and vegetative structure, these habitats are similar in ecological function. With a few notable exceptions, these habitats are primarily linked to rainfall cycles, relying on rain to fill their basins and subsequently drying out during periods of low rainfall. The frequency of inundation may vary both in time and in location, such that most of these wetlands do not fill and dry on an annual basis.

Depression wetland habitats are detritus-based systems. When they dry, herbaceous plants and grasses die back and desiccate, forming a detrital layer. When the basins are inundated again, this detritus forms the base of a food web that can support a variety of invertebrate and vertebrate species. Several native plant and animal species, including numerous rare species, rely on depression wetlands as a primary habitat or for some life history stage such as breeding habitat. Because these habitats fill and dry cyclically, they typically do not support large predatory fish populations. Numerous amphibian species in South Carolina breed preferentially or exclusively in depression wetland habitats. Avoidance of larval predators, such as fish, is a critical adaptive mechanism for amphibians, and one solution is to breed in fish-free habitats such as depression wetlands. As such, depression wetlands are critically important habitats for several amphibian species in South Carolina.

Pine Plantation

This community is new to this revision. In the 2015 SWAP it was treated as part of the broad "Upland Pine" community of the Piedmont Ecoregion and "Pine Woodland" of the Coastal Plain and Coastal Zone Ecoregions. The USNVC classification for these timber production areas is "Temperate and Boreal Plantation". Those classifications, however, also included natural pine-dominated woodlands. Planted pine plantations are abundant and widespread in the Coastal Plain and are an important part of the region's landscape. Like the rest of the state, Loblolly Pine (*Pinus taeda*) is the typical species, although Slash Pine (*P. elliottii*) plantations are also frequent. Pine plantations are generally poor wildlife habitat, however, lacking in both the food and cover needed by native wildlife.

Early-Successional Habitats

Early-successional habitats in the Coastal Plain Ecoregion are important habitats for wildlife species that depend on these open areas. These habitats are generally characterized by tree canopy coverage that is sparse or absent and herbaceous groundcover comprised of annual and perennial forbs and graminoids, and variable coverage of shrubs, vines, and small trees. A variety of open landcover types represent this category and can include old field sites, open

canopy gaps, shrub thickets, recently reforested areas, field borders, grassed waterways, and filter strips. Lawns, golf courses, pastures, hay fields, crop fields, airports, and various urban open spaces are sometimes included in this habitat type but lack the floristic and structural diversity to be considered high quality, early-successional habitat. Maintenance of early-successional habitat requires periodic disturbance or disruption of the existing vegetative community. Purposeful management of early-successional habitat is usually accomplished through the use of timber harvest, prescribed burning, disking, or mowing. Target species for management will determine disturbance intervals, with shorter intervals (1-2 years) favoring those species dependent on herbaceous vegetation and longer intervals (3-5 years) favoring those species dependent on shrub cover. Optimal multi-species management often dictates concurrent maintenance of a variety of successional, or seral, stages.

Freshwater Streams, Rivers, Lakes, and Ponds

Freshwater habitats in the Coastal Plain exhibit a wide range of characteristics depending on elevation and gradient, with first- through fourth-order streams comprising the majority of aquatic habitats by length. Streams at higher elevations in this ecoregion may possess moderate flow and primarily sand substrate with patchy aquatic vegetation, often slowing and widening into densely vegetated swamps in areas of lower gradient. In the lower elevations of the region, streams generally are sluggish, strongly meandering blackwater channels with primarily organic substrates including detritus and woody debris. Streams in the Coastal Plain are often strongly associated with adjacent floodplain swamps and wetlands in which the exchange of water, nutrients, and biota is critical to ecosystem function. The Coastal Plain contains portions of all of South Carolina's major river basins.

The Lower Coastal Plain is situated directly below the Southeastern Plains and terminates at the Coastal Zone marsh. In South Carolina, it extends northwest from the Savannah River to the North Carolina State line. The Lower Coastal Plain intersects 19 counties and covers approximately 22,157 km^2 (8,555 $mi.^2$). The Coastal Plain is nearly level with elevations ranging from 8-38 m (25-125 ft.). The major aquatic habitats within the Ecoregion include lazy meandering streams, swamps, marshes, and estuaries. Pocosins and Carolina Bays are abundant in some areas. These unique aquatic habitats are discussed in more detail in the Coastal Zone Ecoregion.

The **Savannah-Coastal Plain Ecobasin** is located in the extreme southwest corner of the State, extending from southern Allendale County through Hampton and Jasper Counties before terminating at the Coastal Zone marsh. The Ecobasin includes 72 km (45 mi.) of the Savannah River as it meanders toward the coast. Primary tributaries to the Savannah River in this ecobasin include Brier Creek and Boggy Branch. The Ecobasin intersects 10 watersheds and covers 906 km^2 (350 $mi.^2$). The Ecobasin contains approximately 446 km (277 mi.) of lotic habitat and 251 ha (620 ac.) of lentic habitat.

Primary conservation targets within the Ecobasin include the main stem of the Savannah River throughout the Ecobasin and the Brier Creek/Boggy Gut Creek system in Allendale County (Smith et al. 2002). The main stem of the Savannah River contains several aquatic animals that are on South Carolina's SGCN list including fish (Shortnose Sturgeon and Robust Redhorse) and

mussels (Pod Lance and Savannah Lilliput). The Brier Creek/Boggy Gut Creek system is home to one of the few known populations of Bluebarred Pygmy Sunfish.

The northern extreme of the **ACE-Coastal Plain Ecobasin** is situated in central Bamberg and Orangeburg Counties. The Ecobasin encompasses parts of Allendale, Hampton, Colleton, Dorchester, Jasper, Beaufort, Berkeley and Charleston Counties before terminating at the Coastal Zone marsh. Coastal rivers in the Ecobasin include the Coosawhatchie, Salkehatchie, Combahee, Ashepoo, Ashley, Edisto, and Cooper.

The Coosawhatchie River originates just north (10 km or 6 mi.) of the Coastal Plain in the Southeastern Plains and flows for about 76 km (47 mi.) through the Coastal Plain before merging with the Tulifiny River to form the Broad River, which ultimately is deposited into the Atlantic Ocean at Port Royal Sound. The Salkehatchie River originates in the Southeastern Plains and flows for about 43 km (27 mi.) through the Coastal Plain before merging with the Little Salkehatchie River to form the Combahee River, which flows for 82 km (51 mi.) through the Coastal Plain before terminating in the Atlantic Ocean at St. Helena Sound. The Ashepoo River originates in the Coastal Plain and flows for about 92 km (57 mi.), picking up inputs from Horseshoe Creek and Deer Creek before terminating at the Atlantic Ocean in St. Helena Sound. The Edisto River is formed at the confluence of the North Fork Edisto River and South Fork Edisto River. Each fork originates in the Southeastern Plains and flows for about 31 km (19 mi.) through the Coastal Plain before merging and forming the Edisto River. The Edisto River flows for about 196 km (122 mi.) through the Coastal Plain before entering St. Helena Sound and the Atlantic Ocean. As the Edisto flows through the Coastal Plain, it picks up inputs from Field Swamp, Four Hole Swamp, and Penny Creek. The Ashley River originates entirely in the Coastal Plain. Its headwater, Great Cypress Swamp, flows for about 40 km (25 mi.) until it merges with Captains Creek to form the Ashley River. The Ashley River flows for about 64 km (40 mi.) through the Coastal Plain until terminating at Charleston Harbor and the Atlantic Ocean. The Cooper River is formed at the confluence of the East Branch and West Branch Cooper River. Once a self-contained drainage, the Cooper River now receives inputs from the Santee River via a diversion canal that diverts water from Lake Marion to Lake Moultrie. The West Branch Cooper River originates at the tailrace of Lake Moultrie and flows through the Coastal Plain for about 29 km (18 mi.) before merging with the East Branch Cooper River to form the Cooper River. The Cooper River flows through the Coastal Plain for about 48 km (30 mi.), picking up inputs from the Back River, Goose Creek, and Filbin Creek along its western shore; further, Flag Creek and Yellow House Creek are picked up along its eastern shore before being deposited in Charleston Harbor and the Atlantic Ocean.

The Ecobasin intersects 72 watersheds and encompasses 10,601 km^2 (4,093 $mi.^2$). There are approximately 5,919 km (3,678 mi.) of lotic habitat and 280 km^2 (108 $mi.^2$) of lentic habitat within the Ecobasin. The majority (231 km^2 or 89 $mi.^2$) of lentic habitat is represented by Lakes Moultrie and Marion, the only major reservoirs in the Coastal Plain.

Primary areas of conservation concern in the ACE-Coastal Plain Ecobasin include the Jasper County wetlands in Jasper County; the Cypress/Beaver Dam Creek systems in Jasper and Hampton Counties; the Sandy Run system in Colleton County; the lower North Fork Edisto and main stem Edisto Rivers throughout the ecobasin; and the Cooper River in Berkeley and

Charleston Counties. The Jasper County wetlands, Cypress/Beaver Dam Creek, and the Sandy Run systems all contain populations of Bluebarred Pygmy Sunfish and other fishes that are on South Carolina's SGCN list. The North Fork and main stem Edisto River contain several fish species on the priority species list ("Broadtail" Madtom, Shortnose Sturgeon, Bannerfin Shiner, and Striped Bass). The Cooper River and its backwaters contain populations of Bluefin Killifish, Striped Bass and the Federally Endangered Shortnose Sturgeon.

The **Santee-Coastal Plain Ecobasin** originates in southeastern Clarendon County and encompasses portions of Williamsburg, Berkeley, Georgetown, and Charleston Counties before terminating at the coast. The only major river within the Ecobasin is the Santee River. The headwaters of the Santee originate in the Blue Ridge and Piedmont Ecoregions. The Santee River flows for approximately 130 km (81 mi.) through the Coastal Plain, receiving inputs from Echaw Creek and Wambaw Creek, until terminating at the Atlantic Ocean. The Ecobasin intersects 19 watersheds and encompasses 1,606 km^2 (620 $mi.^2$). There are 921 km (572 mi.) of lotic habitat and 11 km^2 (4.4 $mi.^2$) of lentic habitats.

The **Pee Dee-Coastal Plain Ecobasin** is located in the northeast corner of the State and encompasses portions of Dillon, Lee, Horry, Florence, Marion, Sumter, Clarendon, Williamsburg, and Georgetown Counties. Several coastal rivers are located within the ecobasin, including the Black River, Lynches River, Pee Dee River, Little Pee Dee River, and Waccamaw River. The headwaters of the Black River originate in the Southeastern Plains. The Black River flows unimpounded through approximately 198 km (123 mi.) of the Coastal Plain before merging with the Pee Dee River at the coast. As the Black River flows through the Coastal Plain, it picks up inputs from several major tributaries including Black Mingo Creek, Peters Creek, Cottage Creek, Lanes Creek and Six-mile Creek. The headwaters of the Lynches River originate in the Piedmont of South Carolina and North Carolina. The Lynches flows unimpounded through approximately 124 km (77 mi.) of the Coastal Plain before merging with the Pee Dee River near Gilbert Crossroads, SC. Major tributaries to the Lynches River in the Coastal Plain include Sparrow Swamp and Lake Swamp. The Pee Dee River originates in the southern portion of the North Carolina Piedmont and Southeastern Plains and flows through about 143 km (89 mi.) of South Carolina's Coastal Plain before terminating at Winyah Bay. As the Pee Dee flows through the Coastal Plain, it picks up inputs from several significant tributaries, including Catfish Creek, Lynches River, Little Pee Dee River, Conch Creek and the Black River. The Little Pee Dee River originates in the Southeastern Plains of North Carolina and flows through approximately 119 km (74 mi.) of the South Carolina's Southeastern Plains before entering the Coastal Plain. Within the Coastal Plain, the Little Pee Dee River flows for about 105 km (65 mi.), receiving input from the Lumber River before merging with the Pee Dee River. The Waccamaw River originates in the Coastal Plain of North Carolina and flows through approximately 167 km (104 mi.) of South Carolina's Coastal Plain before terminating at Winyah Bay. Within the Ecobasin, the Waccamaw River picks up significant inputs from Buck Creek, Simpson Creek, and Kingston Swamp.

The Ecobasin intersects 50 watersheds and encompasses 9,044 km^2 (3,492 $mi.^2$). Within the Ecobasin, there are approximately 6,027 km (3,745 mi.) of lotic habitat and 47.4 km^2 (18.3 $mi.^2$) of lentic habitats. There are no major impoundments (lakes) within the Ecobasin. Areas of primary conservation concern in the Pee Dee-Coastal Plain Ecobasin include the Lynches River

and its tributaries in Lee, Florence, and Sumter Counties; the Pee Dee River from its confluence with the Lynches River to Winyah Bay; and the upper Waccamaw River in Horry County. The Lynches River contains populations of "Broadtail" Madtom as well as several mussel species on South Carolina's SGCN list (Brook Floater, Creeper and Notched Rainbow). The Pee Dee River and its backwaters contain several fishes on the priority list including the "Broadtail" Madtom, Robust Redhorse, Carolina Pygmy Sunfish and the federally endangered Shortnose Sturgeon. Several mussel species on the priority list are in the Pee Dee River, including the Waccamaw Spike, Yellow Lampmussel, Roanoke Slabshell, and Rayed Pink Fatmucket. The upper Waccamaw contains populations of Carolina Pygmy Sunfish and "Broadtail" Madtom as well as mussel species (Waccamaw Spike and Yellow Lampmussel).

In the Coastal Plains, aquatic habitats continually change physically, chemically, and biologically as water flows from the headwaters to streams, larger streams, and downstream to rivers while being influenced by the surrounding watershed and landscape (Hynes 1975, Vannote et al. 1980). Slow moving, low velocity, and low topographic channels are common and contribute to "blackwater" habitats in which tannic and fulvic acids are leached out of decomposing organic material in the water. These channel systems often flow through old, utisol soils that are low in cation-exchange capacity, leading to low water hardness and low pH. In the Santee Basin, pH readings of 4 to 6 are common; the Edisto River averages 5.4 in its upper reaches but is a more moderate 6.8 lower in the system (Jennings et al. 2023). Habitat complexity and species diversity increase with stream size, producing a continuum of aquatic species assemblages from headwaters to the largest rivers. Whereas certain species are generalists and occur along the entire continuum in varying abundance, others are highly specialized for the precise set of physical and chemical characteristics produced by the underlying geology and surrounding landscape and only occur in certain stream sizes or habitat types within the Ecoregion.

In an aquatic bioassessment framework developed by Denison et al. (2021) utilizing fish assemblage data, streams of the Coastal Plain were characterized predominantly by a perennial/intermittent (i.e. slow current, swamp-like) hydrology with associated fish assemblages (Figure 3-2). The fish assemblage characteristics and expected response of Coastal Plain streams to changes in environmental or landscape factors (i.e. disturbance) would therefore be expected to be most similar among streams with this type of hydrology.

Coastal Zone Ecoregion

Pine Savannas and Flatwoods

This concept includes pine-dominated communities that are mesic to wet. This excludes drier sandhill communities (see "Dry Longleaf Pine" in the Coastal Plain Ecoregion), and it also excludes wet pine communities in Carolina Bays (see "Depression Wetlands, Carolina Bays" treatment in the Coastal Plain Ecoregion). There are significant areas of this habitat in the Ecoregion in northern Charleston County. This concept follows the "Wet Pine Savannas" theme, and "Mesic Pine Savanna" communities of Schafale (2024). Similarly, it includes the "Pine/Saw Palmetto Flatwoods" and "Longleaf Pine Savannas" of McMillan et al. (2022), the "Pine Flatwoods", "Pine Savannah", "Pine-Saw Palmetto Flatwoods" and "Pond Pine Woodland" of

Nelson (1986), and "Savannas" of Barry (1980). The USNVC classifications are "Dry-Mesic Loamy Longleaf Pine Woodland Group" and "Mesic Longleaf Pine Flatwoods-Spodosol Woodland Group". The canopy in these communities is dominated by one or several species of pine, generally Longleaf Pine (*Pinus palustris*), or Pocosin Pine (*P. serotina*) depending on elevation and soil type. Canopy closure ranges from very open, to dense on fire-suppressed sites. When burning is frequent, graminoid and herb density and diversity can be very high, but in the absence of fire, shrubs can become predominant, including Common Wax-Myrtle (*Morella cerifera*) and Little Gallberry (*Ilex glabra*). Optimal habitat for priority species consists of open stands of pine, sparse understory and shrub layers, and a dense groundcover. The community as circumscribed here is variable and could be broken down further. As detailed by Schafale (2024), mesic soils support "Mesic Pine Savanna" communities that are usually dominated by Longleaf Pine. Seasonally saturated sites support "Wet Pine Flatwoods" that are usually dominated by Pocosin Pine.

Coastal Fringe Evergreen Forest

The concept of this community follows Schafale's several kinds of "Coastal Fringe Forest" types (2024) and is also treated by Nelson (1986) as "Beech-Magnolia Hammock" and "Middens", and a broad "Maritime Forest" by Barry (1980) and McMillan et al. (2022). The USNVC classification is "Coastal Live Oak-Hickory-Palmetto Forest". The concept here is variable and includes hardwood forests in mainland coastal areas that are protected from salt spray, including on Native American shell middens and shell rings. (There are 25 known shell rings in South Carolina.) Soils can be dry to moist and can be deep sands or shell. Vegetation is a dense to partially copen canopy of hardwoods, often with Southern Red Cedar (*Juniperus silicicola*) and Cabbage Palmetto (*Sabal palmetto*). Common canopy trees include Live Oak (*Quercus virginiana*), Southern Magnolia (*Magnolia grandiflora*), Sand Laurel Oak (*Q. hemisphaerica*), Pignut Hickory (*Carya glabra*), Southern Hackberry (*Celtis laevigata*), and Southern Basswood (*Tilia americana* var. *caroliniana*). The subcanopy may be dense to open, with species such as Yaupon (*Ilex vomitoria*), and Red Buckeye (*Aesculus pavia*). Examples on Native American shell middens and shell rings have a flora influence by the calcareous soils and often have several rare plant species, some of which were probably culturally important.

Maritime Forest

This concept follows Schafale's (2024) "Maritime Evergreen Forest" (several kinds), "Maritime Shrub". Barry (1980), Nelson (1986), and McMillan et al. (2022) treat it as "Maritime Forest", with fairly broad definitions. The USNVC classification is "Central Atlantic Coastal Plain Maritime Forest". This is the typical forested plant community in the Coastal Zone on barrier islands, salt marsh islands (including hammock islands) and mainland areas that are influenced by salt spray, usually just inland of an Ocean Beach. Maritime forests are typically dominated by Live Oak (*Quercus virginiana*), Southern Magnolia (*Magnolia grandiflora*), and one or more species of pine, including Slash Pine (*Pinus elliottii*) and Loblolly Pine (*P. taeda*). Typical shrubs and small trees include Southern Red Cedar (*Juniperus silicicola*), Cabbage Palmetto (*Sabal palmetto*), American Holly (*Ilex opaca*), Red Bay (*Tamala borbonia*), Common Wax-Myrtle (*Morella cerifera*), and Yaupon (*Ilex vomitoria*). The herbaceous layer is usually sparse due to the dense canopy cover.

Marsh Hammock Island

This concept mainly follows the "Marsh Hammock" of Schafale (2024), and some aspects of Nelson's (1986) and Barry's (1980) broad "Maritime Forest". The USNVC classification is "Coastal Live Oak-Hickory-Palmetto Forest". This ecosystem forms on uplands and occurs in small patches embedded in marshes, or on their edges, either on islands or on the mainland, and usually contain some marsh species. Soils range from dry to slightly wet. Approximately 3,500 hammock (or hummock) islands are distributed throughout the coastal tidelands of South Carolina. Marsh hammock islands are most abundant (90%) within the expansive estuarine and brackish marshlands and tidal waterways of Charleston, Colleton, and Beaufort Counties. Marsh hammock islands range in size from 0.04 to 404.5 ha (0.1-1,000 ac.) and are surrounded by tidal wetlands. Most were naturally formed, although in this concept uplands are included along the Intracoastal Waterway that have similar vegetation. These were originally created by the disposal of dredged materials. Typical canopy species include Live Oak (*Quercus virginiana*), Cabbage Palmetto (*Sabal palmetto*), Southern Red Cedar (*Juniperus silicicola*), Loblolly Pine (*Pinus taeda*), and—where better developed—other hardwoods such as Hickories (*Carya* spp.) and Oaks (*Quercus* spp.).

Tidal Freshwater Marsh

This is a new community for this revision. This ecosystem is best described under "Tidal Freshwater Marsh" by Schafale (2024) who also subdivides North Carolina examples into 12 subtypes. This was also called "Tidal Freshwater Marsh" by Nelson (1986) and McMillan et al. (2022). The USNVC classification is "South Atlantic and Gulf Coastal Tidal Freshwater Marsh Group". Tidal freshwater wetlands include marshes and swamps that are regularly inundated by tidal flooding along a range from fresh to oligohaline salinity. Saltier water may intrude periodically, especially during storm events. Tidal freshwater marshes grade into tidal freshwater swamps upstream, and brackish marsh downstream, and distinguishing the communities in these gradients may be difficult. Tidal freshwater marshes are graminoid and herb-dominated ecosystems but are extremely variable. Part of this variation is complicated by the conversion of vast areas of the ecosystem that was converted to rice impoundments in the 18th and 19th centuries. Common species include Southern Wild-Rice (*Zizaniopsis miliacea*), Sawgrass (*Cladium jamaicense*), Giant Cordgrass (*Spartina cynosuroides*), and cattails (*Typha* spp.). In some areas, shrubs can also become common including Common Wax-Myrtle (*Morella cerifera*) and Swamp Rose (*Rosa palustris*) as well as young trees such as Red Maple (*Acer rubrum*), Loblolly Pine (*Pinus taeda*), and Bald-Cypress (*Taxodium distichum*). Waterways along the edges of this community may have extensive stands of Narrowleaf Pondlily (*Nuphar sagittifolia*).

Tidal Freshwater Swamp

This is a new community for this revision. This ecosystem is best described under "Tidal Freshwater Swamp" by Schafale (2024) who also subdivides North Carolina examples into 2 subtypes. This includes the "Tidal Bald-Cypress-Tupelo Gum Swamp" of Nelson (1986). The USNVC classification is "Bald-Cypress-Tupelo Floodplain Forest Group". Freshwater tidal wetlands include marshes and swamps that are regularly inundated by tidal flooding along a range from fresh to oligohaline salinity. Saltier water may intrude periodically, especially during storm events, although to less of an extent than Tidal Freshwater Marsh. Tidal Freshwater

Swamps grade into Tidal Freshwater Marshes downstream, and distinguishing the communities where they grade together may be difficult to differentiate. Tidal Freshwater Swamps are ecosystems with closed to open canopies usually represented by gum-cypress, but other species combinations may be present, such as ash- or elm-dominated areas. Common canopy species include Bald-Cypress (*Taxodium distichum*), Water Tupelo (*Nyssa aquatica*), Ash (*Fraxinus* spp.), Red Maple (*Acer rubrum*), and American Elm (*Ulmus americana*). The understory is also variable, sometimes with dense shrub cover, such as Common Wax-Myrtle (*Morella cerifera*), or open with dense herbs and graminoids. Waterways along the edges of this community may have extensive stands of Narrowleaf Pondlily (*Nuphar sagittifolia*).

Freshwater Streams, Rivers, Lakes, and Ponds

Fresh waters in the Coastal Zone are limited and primarily confined to the interior portion of this ecoregion where large volumes of fresh water enter via major rivers. These areas include portions of the Waccamaw, Santee, Cooper, Ashley, Edisto, and Combahee rivers. These habitats usually support a mixture of brackish water species and freshwater species tolerant of higher salinity.

Isolated Maritime Wetlands

Depressions, including pools and isolated wetlands, occur throughout the Coastal Zone and are usually embedded within larger habitats such as forests, hammocks, pine savannas, early successional habitats, and diked spoil islands. Four kinds are delineated below.

- ***Vernal Pools***
  These are small, seasonally flooded depressions with gradually sloping margins that occur in sandy uplands on barrier islands and within other landforms of recent origin such as spoil islands. These pools may be embedded within the interior of uplands, or they may lie near the perimeter of uplands and receive occasional input of water of varying salinity on exceptionally high tides. Except where soils are highly saline, many of these habitats have been colonized by the non-native invasive Chinese Tallowtree (*Triadica sebifera*). Vernal pools may be a primary source of low salinity water for birds and mammals and may serve as breeding and/or resident habitat for turtles, amphibians, and crayfish. Since these pools are only seasonally flooded, large predatory fishes are absent. Smaller vernal pools may afford the only wetland habitats on smaller islands. Some examples of this habitat include Schafale's (2024) "Freshwater Marsh Pool". Vegetation is extremely variable and varies from open marsh to swamp forest structures. This is classified in the USNVC as "Eastern North American Freshwater Aquatic Vegetation Group".

- ***Small Depression Ponds***
  These may intergrade with vernal pools but are permanently flooded, except possibly during severe droughts. Obligate aquatic plants, like White Waterlily (*Nymphaea odorata*) or Broadleaf Pondlily (*Nuphar advena*), may inhabit submerged areas, and a variety of emergent and wetland species, including sedges and grasses, generally colonize shallow and intermittently exposed borders. Small depression ponds are generally not affected by tidal activities and can represent a variety of types such as Carolina Bays which are very poorly represented in this ecoregion.

- ***Interdune Ponds and Swales***
  This concept includes Schafale's (2024) "Interdune Pond", both types of "Maritime Wet Grassland", and "Interdune Marsh". Nelson (1986) treats this as "Interdune Pond". The USNVC classification is "Southern Atlantic Coastal Plain Dune and Maritime Grassland". These are depressions located in swales between beach secondary dunes or ridges that contain permanent or vernal pools. Both vegetation and animal life in pools are largely determined by salinity. Interdune ponds, whether permanently or seasonally watered, may provide at least a short-term supply of low salinity water in areas where it is otherwise generally absent.

- ***Man-made Ponds***
  These are constructed for recreational, water supply, or stormwater retention, and are highly variable with regard to their physical features, water chemistry, and connection to open tidal systems. These factors, as well as land use and other human activities near such constructed features, primarily control both floral and faunal features. Though such habitats are not generally considered high quality wildlife habitat, some provide suitable foraging, nesting, roosting and resting habitat for priority species of wading birds.

Managed Impoundments
The coastal wetland impoundments of South Carolina comprise managed and formerly managed tidal wetlands that were primarily created for rice production in the 18ths and 19th centuries. The USNVC classification is "Southeastern Ruderal Marsh, Wet Meadow and Shrubland". Many of these are managed for migratory waterfowl. These impoundments generally occur from Georgetown County southward, coincident with the State's most extensive tidal freshwater marshlands. Salinity regimes range from fresh to brackish, depending on their water sources and management practices. Depending on management regimes and hydrology, a diverse assemblage of rooted floating aquatics, such as White Waterlily (*Nymphaea odorata*), American Lotus (*Nelumbo lutea*), and Pondweeds (*Potamogeton* spp.), occupies managed freshwater impoundments. Emergent plants such as cattails (*Typha* spp.), Southern Wild-Rice (*Zizania aquatica*), and Pickerel Weed (*Pontederia cordata*) are common. Submerged and free-floating aquatic plant species also occur and include duckweeds (*Lemna* spp.) and bladderworts (*Utricularia* spp.). Managed brackish and intermediate emergent wetlands principally contain Widgeongrass (*Ruppia maritima*), Saltmarsh Bulrush (*Bolboschoenus robustus*), and Dwarf Spikerush (*Eleocharis parvula*).

Ocean Beach
Schafale (2024) recognizes a suite of habitat types in his "Maritime Grasslands Theme". Those in South Carolina include "Stable Dune Barren (Southern Subtype)", Dune Grass (Southern Subtype)", "Maritime Dry Grassland", and "Maritime Vine Tangle". He also places the sparsely vegetated "Upper Beach (Southern Subtype)" and "Sand Flat" in an "Estuarine Communities" theme. Nelson (1986) treats it as "Maritime Grassland" and "Maritime Shrub Thicket". McMillan et al. 2022 calls the community "Coastal Dunes and Maritime Grasslands". Barry (1980) treats it as "Coastal Dunes" and "Dune-Shrub Communities". To maintain consistency with the 2015 SWAP, two kinds of dune ecosystem are recognized corresponding to vegetation structure, whether grass-dominated, or shrub-dominated. South Carolina's coastline is the 11th

longest in the nation at 301 km or 187 mi. Ocean beaches and the associated transition zones are formed primarily from unconsolidated sand and are ubiquitous features on barrier islands or ocean strands that directly front the Atlantic Ocean. Dune habitat includes sand dunes and swales, flats and pools between dunes, and between dunes and other features. Seaward of the dune system, sandy flats may occur in areas where dunes have been eroded. Beaches and associated habitats are influenced by wind-blown salt spray and sand and may be occasionally flooded, particularly during storms. The following habitats are generally recognized within the beach ecosystem.

- ***Maritime Grassland***
  This concept includes Schafale's "Stable Dune Barren (Southern Subtype)", "Dune Grass (Southern Subtype)", "Maritime Dry Grassland", "Maritime Vine Tangle" and "Upper Beach (Southern Subtype)". The USNVC classification is "South Atlantic and Gulf Coastal Dune Grassland". This represents that portion of the dune system vegetated by grasses and herbs. This habitat includes sand dunes, swales, and flats between dunes as well as between dunes and other features. Characteristic plants include Sea Oats (*Uniola paniculata*), Bitter Seabeach Grass (*Panicum amarum*), Seabeach Evening-Primrose (*Oenothera humifusa*), and Dune Pennywort (*Hydrocotyle bonariensis*).

- ***Maritime Shrub Thicket***
  Thickets of shrubs, vines, and stunted trees are often in swales within secondary dunes. Trees and shrubs must be salt-tolerant and are "pruned" by wind-blown salt spray and sand. Typical plants are Southern Red-Cedar (*Juniperus silicicola*), Common Wax-Myrtle (*Morella cerifera*), Red Bay (*Tamala borbonia*), Silverling (*Baccharis halimifolia*), Saw Greenbrier (*Smilax bona-nox*), and Eastern Poison Ivy (*Toxicodendron radicans*).

- ***Sand Backshore***
  The sand backshore is the area between the front dune and the intertidal beach face. This area is dry under normal conditions. Only a few invertebrates such as the ghost crab live in the backshore. This habitat is generally comprised of >90% sand and no vegetation. Most of the beaches in SC are publicly accessible and provide economic benefits through tourism.

Pine Plantation

This community is new to this revision. In the 2015 SWAP it was treated as part of the broad "Upland Pine" community of the Piedmont Ecoregion and "Pine Woodland" of the Coastal Plain and Coastal Zone Ecoregions. Those classifications, however, also included natural pine-dominated woodlands. Planted pine plantations are abundant and widespread in the Coastal Plain and are an important part of the region's landscape. Like the rest of the State, Loblolly Pine (*Pinus taeda*) is the typical species, although Slash Pine (*P. elliottii*) plantations are also frequent. Pine plantations are generally poor wildlife habitat, however, lacking in both the food and cover needed by native wildlife.

Early-Successional Habitat
Early-successional habitats in the Coastal Zone Ecoregion are important habitats for wildlife species that depend on these open areas. These habitats are generally characterized by tree canopy coverage that is sparse or absent and herbaceous groundcover comprised of annual and perennial forbs and graminoids, and variable coverage of shrubs, vines, and small trees. A variety of open land cover types represent this category and can include old field sites, open canopy gaps, shrub thickets, recently reforested areas, field borders, grassed waterways, and filter strips. Lawns, golf courses, pastures, hay fields, crop fields, airports and various urban open spaces are sometimes included in this habitat type but lack the floristic and structural diversity to be considered high quality, early-successional habitat. Maintenance of early successional habitat requires periodic disturbance or disruption of the existing vegetative community. Purposeful management of early-successional habitat is usually accomplished through the use of timber harvest, prescribed burning, disking, or mowing. Target species for management will determine disturbance intervals, with shorter intervals (1-2 years) favoring those species dependent on herbaceous vegetation and longer intervals (3-5 years) favoring those species dependent on shrub cover. Optimal multi-species management often dictates concurrent maintenance of a variety of successional, or seral, stages.

Estuarine Systems

Estuaries form one of the predominant landscapes of the Coastal Zone and are considered the most productive ecosystem in the world. Estuaries form where seawater on the flood tide mixes with freshwater in semi-enclosed areas such as Charleston Harbor, Port Royal Sound, and Winyah Bay and behind barrier islands. Salinity in estuaries varies with the height of the tide, riverine flow, and the amount of runoff from local rainfall. Strong currents, modified by bottom structure, run through estuaries bringing nutrients from uplands and from the adjacent ocean. Incoming ocean currents and tides also bring in the larvae and juveniles of many species of recreational and commercial fish and shellfish. Over 75% of commercially important species use estuaries during some portion of their life cycle (NOAA 2024). Estuaries consist of interconnected networks of intertidal marshland with tidal channels of various sizes branching throughout, generally interfacing with marine or Atlantic Ocean waters via deep channels through sounds and bays or through smaller inlets. If all convolutions (bays, inlets, etc.) are included, South Carolina ranks 12th with 4,628 km or 2,876 mi. of shoreline. The USFWS National Wetlands Inventory estimates 628,085 ac (254,177 ha) of Estuarine and Marine Deepwater and Wetlands occur in the estuarine areas of the State. Approximately 40% is subtidal habitat and the remaining 60% is intertidal (e.g. salt marsh, salt pan, intertidal flat). Listed here are the broadly recognized vegetative and geophysical components of estuaries and their inter-relationships.

- ***Salt Marsh***
  This includes the "Salt Marsh" concept of Nelson (1986), McMillan et al. (2022), and Schafale (2024), and as "Salt Marsh and Border Zonation" by Barry (1980). The USNVC classification is "Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh". Salt marshes are intertidal marshlands in estuarine systems near full salinity sea water (salinity ranges ~15 to ~36 ppt) and are variously flooded and drained by tidal forces with influence from lunar cycles, wind, rainfall, and river discharge, particularly within or near

river deltas. Smooth Cordgrass (*Spartina alterniflora*) is the dominant plant. Other species such as Black Needle Rush (*Juncus roemerianus*), Saltgrass (*Distichlis spicata)*, Carolina Sea-Lavender (*Limonium carolinianum*), and Glassworts (*Salicornia* spp.) may be present. There are 350,000 acres of salt marsh in South Carolina with 75% of fishery resources utilizing it during some stage of their life cycle (Denise Sanger, SCDNR, pers. comm.). Salt marsh habitats are critical nursery and feeding grounds for many fish, crustaceans, and birds as they are highly productive.

- ***Brackish Marsh***
  This includes several types of brackish marsh subtypes of Schafale (2024), including "Saltmeadow Cordgrass", "Needlerush", "Smooth Cordgrass", and shrub transitional subtypes. Barry (1980) and Nelson (1986) treat it as "Brackish Marsh" while McMillan et al. (2022) calls it "Salt Marshes". The USNVC classification is "Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh". They are influenced to a lesser degree by salt than in the Salt Marsh community because of freshwater influences. Vegetation is variable and may contain or be dominated by Black Needle Rush (*Juncus roemerianus*), Small Saltmeadow Cordgrass (*Spartina patens*), or Saltmarsh Cordgrass (*S. alternifolia*). Other wetland graminoids and herbs are usually present in a higher diversity than in Salt Marsh.

- ***Salt Flat / Salt Pan***
  This includes the "Salt Flat" of Nelson (1986), McMillan et al. (2024), and Schafale (2024). The USNVC classification is "Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh". These areas are sparsely vegetated, hypersaline (salinity > 40 ppt), exposed flats of primarily sand. Inundation only occurs during high spring tides. Typical plants include glassworts (*Salicornia* spp.), Saltwort (*Batis maritima*), and Saltgrass (*Distichlis spicata*).

- ***Salt-Shrub Thicket***
  This includes the "Salt Shrub", both "High" and "Low" subtypes, of Schafale (2024) while Nelson (1986) calls it "Salt Shrub Thicket". The USNVS classification is "Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh". The community consists of bands or patches of usually low, dense shrubs that typically interface with high salt marsh and uplands. Characteristic plants include Silver Seaside Oxeye (*Borrichia frutescens*), Marsh Elder (*Iva frutescens*), and Silverling (*Baccharis halimifolia*). These plants are tolerant of salt spray and occasional storm surges.

- ***High Marsh Pool***
  These are poorly drained pools in high salt marsh, often near uplands. Salinity is highly variable depending on the frequency and timing of tidal inputs and rainfall. Both soils and water may become hypersaline (salinity > 40 ppt).

- ***Estuarine Intertidal Flat***
  These are mud and sand flats in estuarine systems that have little or no vegetation and are drained on the ebb tide and flooded during high tides. When these areas have high water

content, it is referred to as pluff mud. These flats may occur between marshlands, channels, and creeks or may be interspersed within marshlands.

- ***Estuarine Intertidal Sandbar***
  These are sandbars in estuarine systems that are partially exposed during part of most tidal cycles (i.e. spring and neap tidal cycles) and river stages but are typically submerged during high tide. These areas are often used as recreational areas by boaters at low tide.

- ***Docks and Bulkheads / RipRap***
  Man-made structures can provide hard surfaces, vertical relief, and structural complexity in the water column, all of which promote the attachment of many aquatic, sessile, and sedentary species. These include algae and mosses in low salinity waters, and algae and invertebrates (e.g. hydroids, bryozoans, sponges, barnacles, oysters, and mussels) in estuarine waters. In 2015, it was estimated that 10% of the estuarine shoreline had erosion control structures (Jackson 2017). Bulkheads and riprap in inland waterways can protect the immediate shoreline while potentially exacerbating erosion of the nearby, unprotected shoreline. Docks are prevalent in the developed areas of coastal South Carolina and provide vertical structure.

Apache Pier in Myrtle Beach, SC (Horry County) provides structure on which sessile marine organisms can attach. Photo by SCW staff.

- ***Oyster Reef***
  These are fringing oyster reefs and extensive reef flats primarily composed of live Eastern Oysters. Oyster reefs are predominantly (>95%) intertidal and are often found in close spatial proximity to salt marshes for which they serve as natural breakwaters (fringing reefs). Oyster reefs also occur as flats between tidal channels and salt marsh. Oyster reefs provide habitat for other invertebrates, and the resulting communities are refuge habitat for many fish and invertebrates as well as foraging habitat for larger fish and shorebirds such as American Oystercatchers.

- ***Estuarine Tidal Channels, Creeks, and Open Estuary***
  These are tidal estuarine waterways of variable depth and with currents generated by riverine and/or tidal flows. This is largely the "Estuarine and Marine Deepwater" habitat described in the National Wetlands Inventory (NWI). This includes both the water column and the bottom habitat which can be sand, mud and shellhash, or in combination. Tidal creeks are smaller, branching systems that meander through and shape salt and brackish marsh platforms. They are conduits for stormwater runoff from the upland to the

larger tidal channels and open estuary. They are also conduits for the fish and crustaceans between the estuary and marsh. The tidal channels and open estuarine areas are deeper and generally have higher dissolved oxygen than the smaller tidal creeks. These are highly productive areas.

- ***Estuarine Subtidal / Submerged Flat***
  These are mud and sand flats with little or no vegetation that are inundated during all tidal cycles. Submerged flats include sand and/or mud bottom areas outside of channels and creeks and usually lie between channel habitats and tidal marshlands. These are important feeding areas for many species.

- ***Intertidal Estuarine Reefs – Man-Made Structures***
  These are living shorelines or man-made intertidal reefs—commonly constructed of shell, refurbished crab traps, concrete coated wire mesh, or concrete blocks—that serve the same purpose as naturally occurring oyster reefs. The hard surfaces and structures are substrate for the attachment of oysters and other invertebrates, and the resulting communities are refuge habitat for many fish and invertebrates as well as foraging habitat for larger fish and shorebirds such as American Oystercatchers. These reefs are often used to stabilize eroding shorelines along tidal creeks and have proved effective at encouraging saltmarsh expansion.

- ***Shell Rakes***
  Shell rakes are piles of "washed shell" which were at one time on the bottom of a channel, perhaps remnants of old subtidal oyster beds. They are so old that their shells are very light-weight, and over time they get moved by boat wakes, dredging, and storms and gradually wash up into the high intertidal zone. They are common along the Intracoastal Waterway but also in many tidal creeks and estuaries. A survey published by the SCDNR in 1979 lists 998 washed shell deposits, 58% of which are in Beaufort County and 36% in Charleston County. That survey says, "Shell deposits are formed in estuarine areas where an abundance of submerged oyster shells are exposed to frequent wave action generated by prevailing winds or boat traffic" (Anderson et al. 1979). Shell rakes are favored nesting, roosting, and foraging areas for many shorebirds such as the American Oystercatcher.

Marine Habitats

South Carolina's coastline is the 11th longest in the nation at 301 km or 187 mi. The state marine ecosystem occurs along all of South Carolina's Atlantic Ocean coastline and extends offshore to the State 4.8 km (3 mi.) jurisdictional boundary, incorporating a surface area of nearly 140,000 ha (345,946 ac.). This is discussed as the Continental Shallow Shelf below. In addition, deep, non-state territorial marine habitats exist including the deeper continental shelf (>4.8 km (>3 mi.)) and continental slope (>113 km (>70 mi.)) Ocean beaches and the associated transition zones are formed primarily from unconsolidated sand and are ubiquitous features on barrier islands or ocean strands that directly front the Atlantic Ocean. The following aquatic habitats are generally recognized within the marine ecosystem.

Intertidal Beach
The front ocean beach region is typically inundated on flood tides and drained on ebb tides. Invertebrate fauna in the intertidal beach zone, such as the Coquina Clam (*Donax variablis*) and the Mole Crab (*Emerita talpoida*), are an integral part of the food chain for shorebirds and seabirds (e.g. Piping Plover, Willet, Sanderling, and Red Knot) that forage on the intertidal beach and at the surf interface.

Subtidal Surf Zone
The submerged portion of the beach area extends offshore to a depth of at least 2 m (6 ft.) at any tidal stage. Marine aquatic species in this zone are heavily influenced by turbulence from wave action. As many as 98 fish and 317 macro-invertebrate species are recognized as at least occasional inhabitants of this zone.

Continental Shelf – State Waters
The continental shelf is a continuation of habitats beyond the Surf Zone and submerged in the Atlantic Ocean offshore to the 4.8 km (3 mi.) State territorial limit. The continental shelf lies along South Carolina's Atlantic Ocean coastline and extends offshore to the State 4.8 km (3 mi.) jurisdictional boundary, incorporating a surface area of nearly 140,000 ha (345,946 ac.). Shallow shelf habitats can be further divided into three important types: soft bottom, hard bottom, and the pelagic zone.

- **Shallow Shelf Soft Bottom**
  Soft bottom is composed of unconsolidated sediments that supply sand to the continental shelf, barrier islands, and beaches; store nutrients in the sediment; and provide critical nursery and feeding habitat to fish and invertebrates. Soft bottom can consist of mud and sand flats with little or no vegetation that are constantly submerged. Vegetation can include algae and marine vascular plants. This habitat type is often called "trawlable" because of the lack of obstructions to bottom trawl gears and are essential for South Carolina's shrimping industry. Animals associated with soft bottom can be infaunal (i.e. buried)—typically invertebrates—or demersal (i.e. free ranging above the surface), which can be either fish or invertebrates.

- **Shallow Shelf Hard Bottom**
  Hard bottom habitats are composed of rock pavement, exposed rocks or boulders, or exposed ledges. Hard bottom habitats are often colonized by attached organisms such as algae, corals, and sponges due to their need for a solid attachment and the increased surface area provided by complex rock formations. Due to the rock and biota structure, many hard bottom habitats attract a variety and concentration of invertebrates and fish, making them attractive locations for recreational and commercial fishers for species such as Sheepshead, Black Sea Bass, and grouper species.

- **Shallow Shelf Pelagic Zone**
  The pelagic zone consists of the water column above either soft or hard bottom habitats where the water and species are not interacting with the bottom. The pelagic zone is governed by wind, currents, light penetration, and nutrient additions, including from estuarine outflow or offshore upwelling. This creates a variable environment of

temperature, nutrients, oxygen, and productivity. The pelagic zone supports many resident nekton (water-column) species (i.e. those capable of determining their position in the water column against tide currents) and plankton species (i.e. those unable to control their positions in the water column), but also forms an important migration route or habitat for transient species.

Piers, Jetties & Groins – Man-Made Structures

For the ocean-facing shorelines, the South Carolina Department of Environmental Services' Bureau of Coastal Management's (SCDES-BCM) inventory on erosion control structures has approximately 133 miles of developed or developable ocean/inlet-facing South Carolina coastline. Based on SCDES-BCM's inventory, approximately 18 miles (13%) of this coastline has erosion control structures. Rock groins, jetties, and piers provide hard substrate, vertical relief, and structural complexity for the attachment of organisms in intertidal and subtidal zones, while exposed rock may be used as resting and foraging habitat for shorebirds and seabirds, most notably the Purple Sandpiper which prefers rocky coast habitats that are generally rare in the Southeast. Submerged rock also provides refuge habitat for many fishes and invertebrates. Hardened structures designed for shoreline and channel protection also disrupt the natural processes of sand movement along beaches and can therefore contribute significantly to beach erosion. Many aquatic, sessile, and sedentary species such as algae and invertebrates (e.g. hydroids, bryozoans, sponges, barnacles, oysters, and mussels) attach to these substrates. Such structures also interfere with the nesting of sea turtles either by totally displacing nesting sites or by rendering them more susceptible to flooding.

- ***Nearshore Subtidal Reefs – Man-Made***

  Nearshore subtidal reefs are comprised of man-made structures that account for a relatively small percentage of the Exclusive Economic Zone (EEZ) off South Carolina. Each site is made up of numerous individual steel or concrete structures ranging from small, prefabricated concrete modules to large, steel-hulled vessels hundreds of feet in length. Each structure provides surface area for the attachment of sessile organisms including algae, barnacles, corals, sponges, hydroids, and bryozoans which become the foundation of the reef community. Once colonized by invertebrates, other marine animals such as crabs, shrimps, urchins, amphipods, and mollusks take up residence as well. Studies have documented nearly 300 invertebrate species attached to or residing on artificial reef structures. The ultimate goal of creating man-made reefs is the creation of finfish habitat for the enhancement of fisheries resources. Over 50 species of fishes have been observed on the State's artificial reefs, including both recreational and commercially important species and in densities usually higher than in natural areas. In addition, nesting and spawning activities on these reefs attest to their use as permanent fish habitat. Artificial reefs off South Carolina have been declared Essential Fish Habitat (EFH) by the South Atlantic Fishery Management Council (SAFMC).

Deep, Non-State Territorial Marine

- ***Continental Shelf***

  The deeper, non-state territorial continental shelf is the portion submerged in the Atlantic Ocean offshore greater than 4.8 km (3 mi.) State territorial limit to approximately 112-129 km (70-80 mi.) The deep continental shelf shares many of the same characteristics as described above for the shallow continental shelf.

- ***Continental Slope***

  The continental slope begins where the continental shelf ends (~90 km or 50 mi. from shore off South Carolina) and is characterized by a rapid increase in depth and reduction in light penetration to the bottom. This habitat can be further divided into bottom and pelagic zone.

  - **Bottom**
    This habitat can be made up of a mixture of hard (rocky) and soft (muddy) benthos. The continental slope is a steep area that begins at the shelf break, usually around 140 m depth. It is often cut by submarine canyons. Different mobile organisms use different substrate types. Density of marine fauna is low in most of this region. However, some economically important species can be found here, such as Snowy Grouper, Atlantic Wreckfish, and tilefish species.

  - **Pelagic zone**
    This habitat is an extension of the pelagic zone above the continental shelf and is of a similar structure. It consists of the upper water column of the continental slope region, not near or associated with the benthos. The regional and vertical distribution of pelagic life is governed by temperature, nutrients, light, oxygen, and ultimately productivity by phytoplankton. Several economically important species use this region, such as marlin species, sailfish species, and dolphinfish species.

- ***Open Ocean (Pelagic Habitats Offshore of the Continental Slope)***

  The open ocean habitat is the area away from coastal boundaries and above the seabed. This habitat encompasses the entire water column and lies beyond the edge of the continental shelf. It is a highly dynamic and heterogenous region. The regional and vertical distribution of pelagic life is governed by the temperature range, abundance of available nutrients, and oxygen levels. The regional and vertical distribution of pelagic life is governed by currents, temperature, nutrients, and photosynthesis by phytoplankton.

- ***Offshore Reefs - Man-made Structures***

  Offshore Reefs are comprised of man-made structures and account for a relatively small percentage of the EEZ off South Carolina. The State's 38 offshore sites are typically 160 acres (0.25 square miles). The offshore reefs share many of the same characteristics as described above for the inshore reefs.

Note: The following species mentioned in this chapter are of cultural significance from a habitat standpoint: Giant Cane (*Arundinaria gigantea*), Longleaf Pine (*Pinus palustris*), and Shortleaf Pine (*Pinus echinata*).

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