14360

Northern Atlantic Coastal Plain Dune and Swale

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Mixed Upland and Wetland

Map Zones

65, 66

Geographic Range

This system ranges from northern North Carolina (Omernik ecoregion 63d) and southeastern Virginia to southern Maine. The southern limit is a transition zone from around Kitty Hawk, North Carolina, to the Virginia-North Carolina border. The northern limit is Merrymeeting Bay, Maine (NatureServe, 2006).

Biophysical Site Description

The associated system (CES203.273) for this biophysical setting (BpS) consists primarily of grasslands and related shrublands of Atlantic Coastal Plain coastal strands, sand dunes, barrier islands and related shoreline areas. Interdunal swales are included in this system as embedded shrublands or herbaceous vegetation, and small patches of natural woodland may also be present in limited areas (Nature Serve 2007).

Soils are sandy, with little organic matter and little or no horizon development. Soils may be excessively drained on the higher dunes. Soils are low in nutrient-holding capacity, but aerosol input of sea salt provides a continuous source of nutrients (Nature Serve 2007). On the loose sands, moderate diurnal winds maintain active, low and high dune fields where vegetation could not become established. Except on the most mobile sands and areas subject to semiannual salt water overwash, these communities are dependent upon a combination of salt spray and fire to prevent woody succession.

Principal gradients include a) elevation above the water table, a typical catena of soils being tall dunes, low dunes, and the moist “basement” of Holocene and recent sands resting on the water table; b) a salt spray gradient, with highest effect closest to the ocean and diminishing inland; and c) a fire frequency gradient (see below). All of these factors maintain a vegetation successional and structural gradient. Vegetation density ranges from sparse beach berm and new dune colonizers to maritime grassland with succession stabilized by fire, to wet and dry shrublands.

Vegetation Description

Dune Grasslands: In the unstable coast environment, dunes and flats can be seen in all stages of primary succession. This often occurs where longshore movement of sand causes accretion of sand at one end of the system. The new, low sands are typically first colonized by the first forbs such as sea-rocket (*Cakile edentula*). Endangered species: The federally threatened *Amaranthus pumilus* is another first colonizer and the least tern (*Sterna antillarum*) shares its early successional situation as nesting habitat. Such species are quickly followed by grasses such as *Panicum amarum*, salt meadow cordgrass (*Spartina patens*), and beachgrass (*Ammophila breviligulata*). These grasses begin to accumulate sand and small dunes, providing habitat for additional species. *Ammophila breviligulata* is the characteristic dominant on the youngest dunes and those most exposed to salt spray, while *Spartina patens* or *Schizachyrium littorale* tend to dominate older dunes and sand flats (Natureserve 2007).

Beach strand vegetation: The high beach, while geologically dynamic, is the first land stable enough to be colonized by pioneer vegetation such as American beachgrass (*Ammophila breviligulata*) and salt meadow cordgrass (*Spartina patens*). A suite of forbs adapted to these unstable sands includes sea-rocket (*Cakile edentula*), orach (*Atriplex patula*), and beach pea (*Lathyrus japonicus*).

Older dunes: Older dunes (including parabolic dunes) may have red cedar, pitch pine, larger patches of shrubs and patches of dune grassland vegetation in gaps. Some typical shrubs of more protected sites grading into maritime forest include bayberry (*Myrica pensylvanica*), *Smilax* species, and poison ivy in the woody transition zone where fire has no access or has been excluded.

Interdunal Swales: Numerous plant community types can be defined in interdunal swales depending particularly upon their age and depth to water table. Those with moist sand substrate may be dominated by graminoids such as *Schoenoplectus pungens*, *Scirpus* spp., and *Fimbristylis* spp., sometimes with cranberry (*Vaccinium macrocarpon*) as a dwarf shrub. In intermediate moisture regimes one may find *Panicum virgatum* and *Spartia patens* more abundant.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| AMBR | *Ammophila breviligulata* | American beachgrass |
| SPPA | *Spartina patens* | Saltmeadow cordgrass |
| MOPE6 | *Morella pensylvanica* | Northern bayberry |
| LAJA | *Lathyrus japonicus* | Beach pea |
| TORA2 | *Toxicodendron radicans* | Eastern poison ivy |
| JUVI | *Juniperus virginiana* | Eastern redcedar |
| PIRI | *Pinus rigida* | Pitch pine |
| HUTO | *Hudsonia tomentosa* | Woolly beachheather |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

There are four principal disturbances to vegetation: salt spray, sand movement, salt water overwash during storms, and fire. Since these are largely treeless systems, hurricanes have little effect except to temporarily accelerate the first three disturbances. The dune grasslands carry fire readily but historical fire frequency was highly variable and fire was absent from isolated vegetation except where burned by Indians. The most frequently burned sites were those contiguous with or connected by *Juncus* or *Spartina* marsh with large, frequent-fire compartments and sites regularly burned by Native Americans. The large and small islands and peninsulas, and narrow mainland shorelines, make relatively small lightning targets. Habitats for *Schizachyrium littorale* and the other seaside graminoids have been greatly reduced by succession to woody components

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 10 | 62 | 5 | 77 |
| Moderate (Mixed) | 17 | 38 | 10 | 25 |
| Low (Surface) |  |  |  |  |
| All Fires | 6 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Because of the small fire compartment sizes, the scale of a typical wildfire would have ranged from 20-300ac. In a few cases larger fires could have spread for several miles in flammable vegetation. In some places, brackish *Juncus roemerianus*-*Distichlis spicata* marshes may have served to carry fire around unvegetated flats and dunes from one grassland to another.

Adjacency or Identification Concerns

Dune grasslands grade into maritime forest on sites protected from salt water overwash that have had time for primary succession to progress to the forest stage. On the ocean side the model includes coastal strand (high beach) vegetation down to the vegetation-free beach and unvegetated tidal flats. On slightly sheltered shorelines bordering saline environments, it grades into sloughs, salt flats, brackish and salt marsh. On the wetland side bordering freshwater wetlands it grades into wetland shrubs and saplings.

This system is distinguished from Northern Atlantic Coastal Plain Maritime Forest (CES203.302) by the lack of dominant woody vegetation. This distinction becomes blurred where dunes have been artificially enhanced and an unnatural succession to woody vegetation is occurring. The boundary on the southern end is based on a broad change in biogeography and climate, transitioning to Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273) which is characterized by a change in barrier island form and a shift in the dominant dune grass from *Ammophila breviligulata* in the north to *Uniola paniculata* in the south (NatureServe 2007).

Issues or Problems

There have been many changes associated with human disturbance of both fire flow and sand flow. Sand flow, required to maintain shifting, active dunes has been virtually eliminated. The tall dunes at Jockey’s Ridge State Park have had their sustaining sand flow cut off by construction of businesses and dense housing and by development of woody succession in the surrounding lows. Even the highest dunes are experiencing encroachment by loblolly pine, live oak and laurel oak. Salt water overwash has been eliminated by construction of artificial barrier dunes. Salt spray is intercepted by buildings and these dunes. In the increasingly heavily populated coastal zone the few wildfires are quickly extinguished and there is little use of prescribed fire. While natural woody primary succession characterized only a small percent of stands, perhaps only 5-10% of the coastal landscape under pre-settlement conditions, most of the coastal upland environment has been colonized by the early successional variants of maritime forest and shrubs on what were open sands or maritime grasslands before the construction of man-made barrier dunes, beginning when the work of the Civilian Conservation Corps in the 1930s stopped ocean overwash and reduced salt spray (Wentworth et al. 1992). Formation of new dune habitats by this version of primary succession has been essentially eliminated by human activities.

Native Uncharacteristic Conditions

Along the coast the largest percent of original grasslands have been replaced with woody vegetation.

Comments

Sue Gawler made significant suggestions to the model originally built for map zone 61 to make it more appropriate for MZ66. Her comments were incorporated and a new model was built by Randy Swaty.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | B | B | B | B | B | B | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | B | B | B | B | B | B | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | B | B | B | B | B | B | UN | UN | UN | UN |
| Shrub | >3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | UN | UN | UN | C | C | C | C | C | C | C |
| Tree | 5-10 | UN | UN | UN | C | C | C | C | C | C | C |
| Tree | 10-25 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 42 Early Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| AMBR | Ammophila breviligulata | American beachgrass | Upper |
| SPPA | Spartina patens | Saltmeadow cordgrass | Upper |
| PAAM2 | Panicum amarum | Bitter panicgrass | Upper |

Description

Open grassland on low and high dunes, colonizers on upper beaches and new sands, grasslands on the backside of relatively stable dune lines and dune fields, and flat to gently rolling maritime dry grassland some distance back from the sea. Also, graminoid-dominated communities of moist interdune flats and marsh/upland transitions.

*Maximum Tree Size Class*  
None

Class B 12 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MOPE6 | Morella pensylvanica | Northern bayberry | Upper |
| AMBR | Ammophila breviligulata | American beachgrass | Upper |
| HUTO | Hudsonia tomentosa | Woolly beachheather | Lower |

Description

Alternate succession on dry sites, closed pathway, with fire frequency too low to exclude shrubs and tree saplings. Mostly early primary succession with colonization by shrubs on dry sites with remnant *Ammophila* and other dune graminoids and forbs in openings.

*Maximum Tree Size Class*  
Sapling >4.5ft; <5" DBH

Class C 46 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| MOPE6 | Morella pensylvanica | Northern bayberry | Upper |
| JUVI | Juniperus virginiana | Eastern redcedar | Upper |
| PIRI | Pinus rigida | Pitch pine | Upper |

Description

Mid-primary succession leading to Maritime Forest. Stands of almost entirely woody species with remnant *Ammophila breviligulata* and other graminoids and forbs in openings. See Maritime Forest model for later stages with and without fire.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:OPN | 0 | Late1:CLS | 9 |
| Mid1:OPN | 10 | Late1:CLS | 20 |
| Late1:CLS | 10 | Late1:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Alternative Succession | Early1:OPN | Mid1:OPN | 1 | 1 | Yes | 8 |
| Mixed Fire | Early1:OPN | Early1:OPN | 0.1 | 10 | No | 0 |
| Replacement Fire | Early1:OPN | Early1:OPN | 0.2 | 5 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:OPN | 0.08 | 13 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:OPN | 0.013 | 77 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Mid1:OPN | 0.02 | 50 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:CLS | 0.04 | 25 | No | 0 |

References

Au, S. 1974. Vegetation and ecological processes on Shackleford Bank, NC. Washington, DC: National Park Service. Scientific Monograph Series, No. 6. 86 pp.

Bond, J.F. 1908. Special report on an examination of the Sand Banks along the NC coast. In: Hyde, J.H. Biennial report of the State Geologist. Raleigh: N.C. Geological and Economic Survey. 42-48.

Byrd, William. 1728 [1967]. Histories of the dividing line betwixt VA and NC. Dover Publications, NY. 340 pp.

Cowardin, L.M., V. Carter, F.C. Golet and E.T. LaRoe. 1985. Classification of wetlands and deepwater habitats of the US. Washington: US Fish and Wildlife Service pub. FWS/OBS/79-31. 131 pp.

Dolan, R., P.J. Godfrey and W.E. Odum. 1973. Man's impact on the Barrier Islands of NC. American Scientist 61:152-162.

Dunbar, G.S. 1958. Historical Geography of the NC Outer Banks. Baton Rouge: Louisiana State University Press. 234 pp.

Frost, Cecil C. 2004. Presettlement vegetation and fire frequency of Bailey Island, SC. Report to the Nature Conservancy.

Frost, Cecil C. 2000. Studies in landscape fire ecology and presettlement vegetation of the Southeastern United States. Doctoral dissertation, University of NC, Chapel Hill. 620 pp.

Godfrey, P.J. and M.M. Godfrey. 1976. Barrier island ecology of Cape Lookout National Seashore and vicinity, NC. Washington, DC: National Park Service Scientific Monograph Series. No. 9. 160 pp.

Latrobe, B. H. 1799. Memoir on the Sand-hills of Cape Henry in VA. Trans. Am. Philosophical Soc. 4:439-444.

McFarland, M.W., ed. 1953a. The papers of Wilbur and Orville Wright. Vol. 1:1899-1905. NY: Arno Press reprint 1972. 673 pp.

McFarland, M.W., ed. 1953b. The papers of Wilbur and Orville Wright. Vol. 2: 1906-1948 NY: Arno Press reprint 1972. 674-1127.

NatureServe. 2006. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, USA. Data current as of 18 July 2006.

Stick, D. 1985. Bald Head, a history of Smith Island and Cape Fear. Wendell, NC: Broadfoot Pub. Co. 143 pp.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/.

Wentworth, T.R., M.P. Schafale, A.S. Weakley, R.K. Peet, P.S. White and C.C. Frost. 1992. A preliminary classification of NC barrier island forests. In: C.A. Cole and K. Turner, eds: Proceedings of a conference on barrier island ecology of the mid-Atlantic coast. December 7-8. 1989. Kill Devil Hills, NC. National Park Service Tech Rept. NPS/SERCAHA/NRTR-93/04. Atlanta, GA.

Wilbur and Orville Wright. 1898-1911. Wright Brothers’ Outer Banks Photo Collection, Wright State University, Dayton, OH.