

MARITIME WETLANDS THEME

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MARITIME WETLANDS THEME

Concept: Maritime Wetlands encompass both woody and nonwoody communities of barrier islands and occasionally on shorelines of inland sounds, in places not flooded by tides but significantly influenced by wetness. They range from swamp forests to wet grasslands, isolated marshes, and ponds.

Distinguishing Features: Most Maritime Wetlands are distinguished by the combination of occurrence on barrier islands, wetland hydrology without tidal influence, and wetland vegetation. Some marginally wet areas are included in Maritime Upland Forests or Maritime Grassland themes, where their vegetation is not distinguishable from slightly drier vegetation. Estuarine Fringe Pine Forests, included in the Maritime Wetlands theme, occur along inland sound shorelines in settings that lack tidal influence but are affected by occasional saltwater intrusion.

Sites: Maritime Wetlands occur in dune swales and other depressions on barrier islands, occasionally on sand flats elevated above tide levels. The Estuarine Fringe Pine Forest and Estuarine Beach communities within this theme occur along mainland sound shorelines on sites elevated above tide levels but influenced by the presence of salty estuarine waters and occasionally storm surges.

Soils: Soils may be wet sandy Entisols, mucky sands, or true Histosols. Like other barrier island communities, Maritime Wetlands are subject to at least some salt spray, which adds nutrients. This, in combination with shell material in the young sand deposits, presumably makes the soils higher in pH and more fertile than comparable sandy soils inland.

Hydrology: Maritime Wetlands can potentially span the range of nontidal palustrine hydrology, from seasonally saturated to permanently flooded. Water comes from rainfall, but wetness is driven by high water tables in the highly permeable sands; in many it is associated with a lens of fresh groundwater. Water levels in many may vary substantially from year to year with varying rainfall. As in other barrier island communities, salt spray represents a stress to canopy species, though the location of wetlands in the interior of islands and in lower areas shelters them more than most other maritime communities. Some Maritime Wetlands are subject to intrusion by salt water in severe storms, while others are well sheltered by high dunes.

Vegetation: The vegetation within this theme encompasses a tremendous range of variation. Woody communities include forests dominated by wetland or facultative trees including *Nyssa biflora*, *Fraxinus* sp., *Taxodium distichum*, *Acer rubrum* var. *trilobum*, *Liquidambar styraciflua*, *Pinus taeda*, or *Pinus serotina*. Other communities may be dominated by tall shrubs: *Salix caroliniana*, *Swida foemina* (*Cornus stricta*), or *Persea palustris*. Wet grasslands are usually dominated by *Spartina patens*, or *Juncus* spp., often associated with a high diversity of herbaceous species. The wettest communities are marshes of a variety of grasses or sedges, drawdown zones of ponds, or submersed aquatic vegetation. Estuarine Beach communities may be herbaceous or woody, with a wide variety of species including many of the same species but also a number of opportunistic or weedy species.

Dynamics: The barrier islands and sound shorelines where these communities occur are extremely dynamic, more so than in other parts of North Carolina. They are subject to extreme natural disturbance by wind, heavy salt spray, saltwater intrusion during storms, and storm waves. Recovery may take several years. In addition to natural disturbance of vegetation, the environment itself may be drastically altered by natural processes of erosion and deposition, as well as sea level rise. Even well above sea level, new wetlands can develop as growing dunes or accreting land raise the freshwater lens beneath the barrier island.

Vegetation dynamics in the wetter communities can be strongly influenced by water levels, which vary with weather cycles. Soils may be exposed for several years in drought but flooded at other times, and drawdown zones may be exposed in some years but not others. Some plant species may be visible only in some years.

In wetlands that are not well surrounded by higher land, intrusion of salt water during major storms can be a catastrophic natural disturbance.

Comments: The Maritime Wetlands theme is circumscribed differently from Maritime Forests and Maritime Grasslands, encompassing both forest and nonforest communities as well as including some mainland communities. This is done primarily for convenience. Three themes could be warranted, but all would be very small.

The Estuarine Fringe Pine Forest and Estuarine Beach communities are particularly marginal for inclusion in this theme, but their inclusion is analogous to the inclusion of Coastal Fringe Evergreen Forest in the Maritime Upland Forests theme. Though lacking the extreme exposure to storms, unstable substrate, and salt spray of barrier islands, they share other characteristics with barrier islands. Their lack of tidal influence but influence of occasional saltwater intrusion and proximity to salty water is a common feature with Maritime Wetlands, while separating them from Estuarine Communities, Freshwater Tidal Wetlands, and Coastal Plain Nonalluvial Wetlands.

References:

- Au S. 1974. Vegetation and ecological processes on Shackleford Banks, North Carolina. National Park Service Monograph Series No. 6.
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KEY TO MARITIME WETLANDS

1. Community with semipermanent standing water, general 1-2 feet deep or more, drawing down only during prolonged drought; vegetation of floating or submersed aquatic plants, or vascular vegetation sparse, except on the edges. **Interdune Pond**
1. Community saturated, seasonally flooded, or, if semipermanently flooded, only shallowly; vegetation of rooted vascular plants, usually dense.
 2. Community on the mainland, on the edges of estuaries and influenced by them, though not subject to tidal flooding; affected by infrequent saltwater intrusion during storms (consider Freshwater Tidal Communities and Estuarine Communities where tidal flooding may occur).
 3. Community dominated by *Pinus* in a dense or open canopy; shrub layer dominated or codominated by *Morella cerifera*; located on the inland edge of a tidal marsh or occasionally on an estuary shoreline that is not exposed to wave action.
 4. Community dominated by *Pinus taeda*; substrate mucky mineral soil..... **Estuarine Fringe Pine Forest (Loblolly Pine Subtype)**
 4. Community dominated by *Pinus serotina*; substrate shallow to deep organic soil **Estuarine Fringe Pine Forest (Pond Pine Subtype)**
 3. Community not dominated by *Pinus*, though individuals may be present; located on shorelines of estuaries where wave disturbance is significant; vegetation a mix of wetland, estuarine, and disturbance-dependent species. **Estuarine Beach**
2. Community on a barrier island, similar coastal spit, or occasionally on exposed islands in estuaries; in wet dune swales or back-barrier flats that are low but above normal tidal flooding.
 5. Vegetation dominated by trees or shrubs, generally *Nyssa*, *Acer*, *Taxodium*, *Fraxinus*, *Cornus*, *Persea*, or *Salix*.
 6. Vegetation a forest dominated by *Nyssa*, *Acer*, *Fraxinus*, *Taxodium*, or *Quercus*; trees at least more than 10 meters tall when not recently disturbed.
 7. Very rare forest dominated by *Taxodium distichum*..... **Maritime Swamp Forest (Cypress Subtype)**
 7. Forest not dominated by *Taxodium*; dominated by *Acer*, *Nyssa*, *Fraxinus*, or occasionally other species..... **Maritime Swamp Forest (Typic Subtype)**
 6. Vegetation of tall shrubs or short, shrub-like trees, dominated by *Persea*, *Cornus*, or *Salix*; canopy no more than 10 meters tall.
 8. Community dominated by *Salix* **Maritime Shrub Swamp (Willow Subtype)**
 8. Community dominated by *Persea* or *Swida* (*Cornus*)
 9. Community dominated by *Persea palustris* with little or no *Cornus*. **Maritime Shrub Swamp (Red Bay Subtype)**
 9. Community dominated by *Swida foemina* (*Cornus stricta*), sometimes with abundant *Persea palustris*..... **Maritime Shrub Swamp (Dogwood Subtype)**
5. Vegetation herbaceous, with woody plants sparse or confined to the edges.
 10. Community in a depression with standing water wet into the growing season; vegetation marsh-like, dominated by large graminoids such as *Cladium*, *Typha*, *Zizania*, or *Schoenoplectus*, or by small flood-tolerant graminoid such as *Leersia*, *Leptochloa*, or *Carex*. **Interdune Marsh**
 10. Community in a dune swale depression or back-barrier flat, with standing water shallow and primarily in winter; vegetation dominated by *Spartina patens*, *Juncus*, *Rhynchospora*, *Panicum*, or a diverse mix of graminoids and forbs less tolerant of prolonged standing water.
 11. Community dominated by *Panicum virgatum*; on Currituck Banks..... **Maritime Wet Grassland (Switchgrass Subtype)**

11. Community not dominated by *Panicum virgatum*; dominated by *Spartina patens*, *Muhlenbergia filipes*, *Juncus*, *Rhynchospora*, *Eleocharis*, *Centella*, or a diverse mix of species; throughout the barrier islands..... **Maritime Wet Grassland (Southern Hairgrass Subtype)**

MARITIME WET GRASSLAND (SOUTHERN HAIRGRASS SUBTYPE)

Concept: Maritime Wet Grasslands are herbaceous wetlands of interdune swales and low sand flats on barrier islands in the interior and inland side of barrier islands. They have seasonally to permanently saturated soils or shallow flooding but no regular saltwater flooding (though overwash may occur during severe storms). Vegetation is dominated by any of several grasses, sedges, or rushes, but not by species of the Dune Grass community. The Southern Hairgrass Subtype is the common Maritime Wet Grassland throughout the state, where *Spartina patens* or *Muhlenbergia filipes* typically dominate and *Panicum virgatum* is at most a minor component.

Distinguishing Features: Maritime Wet Grasslands are distinguished by herbaceous wetland vegetation on barrier islands in settings that do not receive tidal flooding or strong influence of salt water and are not deeply flooded for long periods. They are distinguished from Brackish Marshes by the presence of salt-intolerant species such as *Muhlenbergia sericea*, *Rhynchospora colorata*, *Panicum virgatum*, *Andropogon glomeratus*, *Centella erecta*, and *Eustachys petraea* throughout the community. They are distinguished from Interdune Marshes by the same species, as well as by usual dominance by *Spartina patens*. Interdune Marshes are dominated by larger herbs such as *Cladium jamaicense* or *Zizania aquatica*, or by short-lived plants that are active only when water is low.

Brackish Marsh (Transitional Subtype) and the upland ecotone of other tidal marshes may contain some of the same species, but they contain them only locally, in a community consisting primarily of more salt-tolerant species.

The Southern Hairgrass Subtype represents most examples in North Carolina, with the exception of northern examples with *Panicum virgatum* as a major component.

Synonyms: *Muhlenbergia filipes* - *Spartina patens* - *Eustachys petraea* Herbaceous Vegetation (CEGL004051).

Ecological Systems: Northern Atlantic Coastal Plain Dune and Swale (CES203.264)? Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273).

Sites: Maritime Wet Grasslands occur on barrier islands, in dune swales and sometimes on sand flats that are intermediate in elevation between those that support marshes and Maritime Dry Grasslands. They are somewhat sheltered from salt spray and are above the highest normal tidal flooding, though some may be inundated by overwash or storm surge.

Soils: Maritime Wet Grasslands have wet sandy soils, generally mapped as Corolla (Aquic Quartzipsamment) or Duckston (Typic Psammaquent) when large enough to be distinguished. As in many maritime communities, the soils are more fertile than typical sands because of the presence of shell fragments and the input of nutrients by salt spray.

Hydrology: Maritime Wet Grasslands are seasonally to permanently saturated by a high water table or seepage from adjacent dunes. They may have shallow standing water in wet seasons. Any flooding by salt or brackish water is only in extreme events.

Vegetation: Maritime Wet Grasslands of the Southern Hairgrass Subtype have dense vegetation dominated by grasses or, occasionally, rushes. While most maritime communities have only a small number of specialized species, they often are more species-rich and share plants with other Coastal Plain wetlands. *Spartina patens* is highly constant and usually dominant, but *Muhlenbergia sericea* codominates in about half the sites. *Hydrocotyle bonariensis* is highly constant in CVS plot data. Other species frequent and sometimes codominant or abundant in plot data include *Fimbristylis castanea*, *Rhynchospora colorata*, and *Solidago mexicana*. Other frequent species in plot data include *Juncus megacephalus*, *Juncus marginatus*, *Eustachys petraea*, *Andropogon glomeratus*, *Eragrostis spectabilis*, *Sabatia stellaris*, *Phyla nodiflora* var. *nodiflora*, and species shared with Dune Grass and Maritime Dry Grassland, including *Oenothera humifusa*, *Conyza canadensis* var. *pusilla*, *Opuntia mesacantha*, and *Uniola paniculata*. Less frequent species sometimes noted as abundant in plot data or site descriptions include *Centella erecta*, *Juncus dichotomus*, *Juncus scirpoides*, *Setaria magna*, *Schoenoplectus pungens* (= *Scirpus pungens*), and *Eleocharis* spp., including *rostellata*, *fallax*, and *cellulosa*. Less frequent species that show the character of the community include *Ludwigia microcarpa*, *Setaria parviflora*, *Euthamia hirtipes*, *Hydrocotyle umbellata*, *Eupatorium leucolepis*, *Spiranthes vernalis*, *Rhynchospora odorata*, *Sisyrinchium angustifolium*, *Pluchea rosea*, *Galium tinctorium*, *Mikania scandens*, *Andropogon tenuispatheus*, *Andropogon glaucopsis*, *Oenothera fruticosa*, *Rhexia virginica*, *Dichantherium sphaerocarpon*, *Dichantherium neuranthum*, *Dichantherium caeruleum*, *Ionactis linariifolia*, *Erianthus* sp., and *Erigeron quercifolius*. The exotic *Eremochloa ophiuroides* sometimes occurs in them. Woody plants are often present in small numbers, more abundant in examples that are transitional or undergoing succession. *Baccharis halimifolia*, *Borrchia frutescens*, *Morella cerifera*, and *Juniperus silicicola* are the most frequent.

Range and Abundance: Ranked G2. In North Carolina, Maritime Wet Grasslands are scattered throughout the undeveloped barrier islands but are rare, with fewer than 20 occurrences known. The equivalent association ranges southward to Florida but probably is rarer in the more forested sea islands of South Carolina and Georgia.

Associations and Patterns: Maritime Wet Grasslands are small patch communities. Most occurrences are a few acres or less, though a few occur in complexes that can add up to larger acreage. They tend to be surrounded by Dune Grass or Maritime Dry Grassland, but they may also border tidal communities or any other maritime community. They are not a regular part of the barrier island landscape mosaic and often are largely absent.

Variation: The Southern Hairgrass Subtype is one of the most variable communities in the 4th Approximation. Additional subdivision is likely with further study, but no variants are recognized at present. Little is known of seasonal or year-to-year variation, which may affect perceptions of composition. Abundance of *Juncus*, presence or absence of *Rhynchospora colorata*, and connection to marshes are other characters that might be a basis for distinguishing variants or subtypes.

Dynamics: As with all maritime communities, Maritime Wet Grasslands are highly dynamic. They may undergo severe natural disturbance by saltwater intrusion or may quickly give way to other communities because of erosion, sand movement, or direct or indirect natural changes in

sheltering from salt spray and overwash. However, many occur in stable dune fields where such disturbances have not occurred for many decades.

Normal dynamics include seasonal and year-to-year changes in wetness with water table movement, though variation is less than in Interdune Marshes or Interdune Ponds.

Comments: Maritime Dry Grasslands are often not distinguished from Maritime Wet Grasslands in site descriptions, and the relative abundance of these two types is not well known. The nature of the transition between them needs further investigation. Many CVS plots resemble Maritime Dry Grassland but contain small amounts of a few wetland species. It is unclear if these are transition communities or are areas with small or peripheral inclusions of other communities. While there has been less scientific interest in Maritime Wet Grasslands than Dune Grass, they were well described by Au (1974) and Godfrey and Godfrey (1976), focusing on the middle Outer Banks, and were included in Rosenfeld (2004) at Bird Island. A moderate number of CVS plots and plots collected by NatureServe for the National Park Service represent them.

Schoenoplectus pungens - *Fimbristylis (castanea, caroliniana)* Herbaceous Vegetation (CEGL004117) is an association of the Chesapeake Bay region, may be a northern equivalent of the Sedge Variant.

Rare species:

Vascular plants: *Dichantherium caerulescens*, *Dichantherium neuranthum*, *Eleocharis cellulose*, *Eleocharis montevidensis*, *Eleocharis rostellata*, *Euphorbia bombensis*, *Juncus articulatus*, *Ludwigia alata*, *Paspalum vaginatum*, *Rhynchospora microcarpa*, *Rhynchospora odorata*, *Scleria verticillata*, *Trichostema nesophilum*, and *Yucca gloriosa*.

Vertebrate animals: *Sterna caspia*.

References:

- Au, S.F. 1974. Vegetation and ecological processes on Shackleford Banks, North Carolina. National Park Service Scientific Monograph Series No. 6.
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MARITIME WET GRASSLAND (SWITCHGRASS SUBTYPE)

Concept: Maritime Wet Grasslands are herbaceous wetlands of interdune swales and low sand flats on barrier islands in the interior and inland side of barrier islands. They have seasonally to permanently saturated soils or shallow flooding but no regular saltwater flooding (though overwash may occur during severe storms). The Switchgrass Subtype is a northern community rare in North Carolina, where *Panicum virgatum* is dominant or codominant.

Distinguishing Features: Maritime Wet Grasslands are distinguished by herbaceous wetland vegetation on barrier islands in settings that do not receive tidal flooding or strong influence of saltwater and are not deeply flooded for long periods. They are distinguished from Brackish Marshes by the presence of salt-intolerant species such as *Muhlenbergia sericea*, *Rhynchospora colorata*, *Panicum virgatum*, *Andropogon glomeratus*, *Centella erecta*, and *Eustachys petraea* throughout the community. They are distinguished from Interdune Marshes by the same species, as well as by usual dominance by *Spartina patens*. Interdune Marshes are dominated by larger herbs such as *Cladium jamaicense* or *Zizania aquatica*, or by short-lived plants that are active only when water is low. The Switchgrass Subtype is distinguished by the dominance or codominance of *Panicum virgatum* in sites on the Currituck Banks. *Spartina patens* may be codominant or may be a minor component.

Synonyms: (*Morella cerifera*) - *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL004129).

Ecological Systems: Northern Atlantic Coastal Plain Dune and Swale (CES203.264).

Sites: Maritime Wet Grasslands occur on barrier islands, in dune swales and sometimes on sand flats that are intermediate in elevation between those that support marshes and Maritime Dry Grasslands. They are somewhat sheltered from salt spray and are above the highest normal tidal flooding, though some may be inundated by overwash or storm surge.

Soils: Maritime Wet Grasslands have wet sandy soils, generally mapped as Corolla (Aquic Quartzipsamment) or Duckston (Typic Psammaquent) when large enough to be distinguished. As in many maritime communities, the soils are more fertile than typical sands because of the presence of shell fragments and the input of nutrients by salt spray.

Hydrology: Maritime Wet Grasslands are seasonally to permanently saturated by a high water table or seepage from adjacent dunes. They may have shallow standing water in wet seasons. Any flooding by salt or brackish water is only in extreme events.

Vegetation: Where known in North Carolina, the Switchgrass Subtype is codominated by *Panicum virgatum* and *Spartina patens*, with *Centella erecta* abundant or also codominant. Other species present in the one documented example include *Chasmanthium laxum*, *Dichantherium scoparium*, *Eupatorium mohrii*, *Juncus effusus*, *Senna marilandica*, *Viola primulifolia*, *Andropogon glaucopsis*, *Andropogon virginicus*, *Eupatorium hyssopifolium*, *Euthamia caroliniana*, *Dichantherium villosissimum* var. *villosissimum*, *Galium tinctorium* var. *floridanum*, *Juncus biflorus*, *Juncus polycephalos*, *Osmunda spectabilis*, *Kelloggloa (Panicum) verrucosa*, *Paspalum laeve*, *Persicaria punctata*, *Rhynchospora fascicularis*, *Solidago mexicana*, *Mikania*

scandens, *Eupatorium capillifolium*, *Hydrocotyle bonariensis*, *Eupatorium rotundifolium*, *Rhexia virginica*, and *Anchistea virginica*. Woody species present with low cover include *Toxicodendron radicans*, *Muscadinia rotundifolia*, *Baccharis halimifolia*, and young *Pinus taeda*.

Range and Abundance: Ranked G3. This subtype is extremely rare in North Carolina. It is known only from the northern Currituck Banks area, where it cooccurs with communities classified as the Southern Hairgrass Subtype. The equivalent association ranges northward to New Jersey.

Associations and Patterns: The Switchgrass Subtype is a small patch community. The full extent of its North Carolina occurrence is not known but it is not a regular part of the landscape mosaic and patches are a handful of acres at most. It occurs with Dune Grass and Maritime Shrub communities.

Variation: Little is known of the variation of this community in North Carolina, other than that the known example is very heterogeneous and grades into what appears to be the Southern Hairgrass Subtype. It is unclear how well it resembles examples farther north.

Dynamics: Dynamics are probably similar to the Southern Hairgrass Subtype and to maritime communities in general.

Comments: The NVC association is a northern Mid-Atlantic community that barely ranges into North Carolina. It is unclear how well it resembles examples farther north. Despite the abundance of *Panicum virgatum*, it has flora very similar to the Southern Hairgrass Subtype. A single CVS plot is definitively recognizable as this subtype.

Rare species: No rare species are known to be associated with the one example in North Carolina.

References:

No North Carolina references for this community are known.

INTERDUNE MARSH

Concept: Interdune Marshes are rare barrier island dune swale communities that are dominated by emergent wetland vegetation. They may occur as extensive marshes, or as broad marsh edge zones around open water ponds, but they are isolated from tidal marshes and tidal flooding. They are extremely variable in vegetation from site to site and in different years within a single site.

Distinguishing Features: Interdune Marshes are distinguished by the occurrence of marshy vegetation in barrier island depressions that are semipermanently flooded by freshwater and isolated from tidal flooding and from tidal marshes. They are distinguished from Maritime Wet Grasslands, which also have dense herbaceous vegetation in dune swales, by having longer hydroperiods, deeper water, and vegetation indicative of wetter conditions. Interdune Marsh communities are usually dominated by large graminoids, such as *Typha* spp., *Schoenoplectus* spp., *Fimbristylis* spp., *Cladium jamaicense*, or *Zizania aquatica*, but may be dominated by smaller graminoids, such as *Diplachne maritima* (*Leptochloa fascicularis*, *Leptochloa fusca*), *Carex* spp., or *Leersia* spp., which do not dominate in Maritime Wet Grasslands. The most characteristic species of Maritime Wet Grasslands, *Spartina patens* and *Muhlenbergia sericea*, are scarce or absent in Interdune Marshes. Edges of Interdune Ponds may have similar vegetation but should be recognized as Interdune Marshes only if they cover a substantial area. Brackish Marsh (Transitional Subtype) and the upland ecotone of other estuarine communities can contain some of the same species but have more salt-tolerant species and are connected to tidal marsh communities.

Synonyms: Interdune Pond (3rd Approximation). *Typha domingensis* - *Setaria magna* Herbaceous Vegetation (CEGL004138).

Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261). Northern Atlantic Coastal Plain Dune and Swale (CES203.264). Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273).

Sites: Interdune Marshes occur in basins in the interior of barrier islands, where standing water more than a few inches deep is present for long periods of time. Most are in dune swales, but some may be in former tidal channels that became blocked by sand movement.

Soils: Interdune Marshes are mapped as wet sandy soils such as Corolla (Aquic Quartzipsamment) or Duckston (Typic Psammaquent), but often have substantial organic accumulations.

Hydrology: Interdune Marshes are semipermanently flooded with fresh water, sometime one to two feet deep for long periods. However, surface water tends to disappear in drier years. They appear to reflect the elevation of the water table in the adjacent uplands. They are isolated from normal or rare tidal flooding but may have saltwater intrusion from storm surge.

Vegetation: Interdune Marshes are extremely variable in vegetation among patches. Most are dominated by tall graminoids such as *Typha domingensis*, *Typha latifolia*, *Zizania aquatica*, *Cladium jamaicense*, *Hymenachne (Panicum) hemitomom*, *Schoenoplectus tabernaemontani*. A few patches are dominated by medium sized plants such as *Leersia virginica*, *Leersia hexandra*, *Coleataenia rigidula*, *Juncus roemerianus*, *Diplachne maritima*, or by a mix of species. No species

have high frequency in site descriptions. Other species that are present in some examples include *Carex* spp. (*comosa*, *longyi*, *alata*, *lupulina*, *stipata* var. *maxima*), *Rhynchospora* spp. (*odorata*, *microcarpa*, *miliacea*, *mixta*), *Leersia oryzoides*, *Boehmeria cylindrica*, *Ludwigia palustris*, *Persicaria punctata*, *Persicaria hydropiperoides*, *Thelypteris palustris* var. *palustris*, *Mitreola petiolata*, *Fuirena pumila*, *Proserpinaca palustris*, *Diodia virginiana*, *Sagittaria lancifolia* var. *media*, *Pluchea rosea*, and *Bidens laevis*. Open patches where water is deeper may have *Eleocharis fallax* or *Potamogeton illinoensis*, while edges may have *Centella erecta*. A few woody species may be present, especially on the edges, including *Nekemias arborea* or other vine and *Swida foemina* (*Cornus stricta*).

Range and Abundance: Ranked G2 as defined here. Only a handful of widely scattered examples is known in North Carolina, and a few examples are likely to exist in other states. The NVC association ranges southward to Florida.

Associations and Patterns: Interdune Marshes are small patch communities. Patches tend to be a few acres or less, but one large complex amounting to more than 100 acres is present at Buxton Woods. Patches are usually surrounded by Maritime Evergreen Forest but might be surrounded by Maritime Dry Grassland, Maritime Wet Grassland, Dune Grass, or Maritime Shrub.

Variation: This is one of the most variable community types in the 4th Approximation. Each example is very different from the others and could be regarded as a distinct variant or even subtype. Many patches within the one large complex are also very different from each other. Some variation is attributable to variation in water depth, successional age, or amount of past saltwater intrusion, but much has no obvious cause and may simply be the result of isolation and limited dispersal among examples. Two variants equivalent to those in Interdune Pond are recognized:

Open Variant occurs in more open landscapes such as sand flats or among open, sometimes discontinuous dunes. Tending to occur in a landscape of Dune Grass, Maritime Dry Grassland, or Maritime Shrub, this variant presumably is younger or more subject to salt spray and occasional overwash. These marshes tend to have less diverse flora and to contain more salt-tolerant plants. Ponds surrounded by forest but open to saltwater intrusion should be treated as this variant, too.

Interior Swale Variant occurs in older relict dune systems with more relief, generally in a landscape of Maritime Deciduous Forest or Maritime Evergreen Forest. Salt spray is less and overwash or saltwater intrusion is less likely. These marshes have a flora that includes less salt-tolerant species. They may be more diverse, but many patches are still strongly dominated by single species.

Dynamics: As with all maritime communities, Interdune Marshes are potentially highly dynamic. They may undergo severe natural disturbance by saltwater intrusion or may quickly give way to other communities because of erosion, sand movement, or direct or indirect natural changes in sheltering from salt spray and overwash. However, many occur in stable forested dune fields where such disturbances have not occurred for many decades.

Water levels vary widely from year to year and over periods of years, in response to rainfall. When water levels fall, areas with dense emergent vegetation may change little, but local areas of deeper water may be colonized by short-lived opportunistic plants such as *Biden mitis*.

Comments: Interdune Marshes were treated as part of the Interdune Pond type of the 3rd Approximation because marshy zones on the edges of ponds tie them together. However, most Interdune Marsh patches are not connected to ponds. Much of the earlier literature on Interdune Ponds did not tend to include Interdune Marshes, or at least did not explicitly distinguish them from edge zones of open ponds.

Leptochloa fusca ssp. *fascicularis* - *Sesuvium maritimum* Herbaceous Vegetation (CEGL004125) is an interdune marshy pond defined on the basis of a site in the Bald Head Island complex. It has had repeated saltwater intrusion and appears to be transitioning to a tidal marsh edge community.

Fimbristylis castanea - *Schoenoplectus pungens* Seasonally Flooded Herbaceous Vegetation (CEGL003790), which was defined as an association attributed solely to North Carolina at Cape Hatteras and Cape Lookout National Seashores, needs further investigation into its ecological character and affinities. It appears to represent a shallower community intermediate between Interdune Marsh and Maritime Wet Grassland, but it may instead represent freshwater swales that are more frequently affected by saltwater.

Rare species:

Vascular plants: *Eleocharis cellulosa*, *Ludwigia alata*, *Oplismenus hirtellus*, *Potamogeton illinoensis*, *Rhynchospora microcarpa*, *Rhynchospora odorata*, *Sabal palmetto*, and *Scleria verticillata*.

Vertebrate animals: *Fundulus confluentus*.

References:

INTERDUNE POND

Concept: Interdune Ponds are open freshwater pond communities in the deepest, most permanently flooded interdune swales of barrier islands. In these ponds, long term emergent vegetation is confined to edge zones. Otherwise, open water, submersed aquatic plants, or floating aquatic plants predominate. Annual plants such as *Cyperus* spp. may establish during rare periods of drawdown. Marshy ponds, included in Interdune Ponds in the 3rd approximation, are now treated as the Interdune Marsh type.

Distinguishing Features: Interdune Ponds are distinguished by permanent or semipermanent open fresh water in a barrier island setting isolated from tidal marshes. Floating aquatic plants such as *Lemna* spp. may or may not be present, as may submersed aquatic plants such as *Potamogeton* spp. Woody plants as well as herbs may occur on the edges, including *Nyssa biflora*, *Cephalanthus occidentalis*, *Salix nigra*, *Decodon verticillatus* and other species. Opportunistic plants may potentially establish in the pond bed in periods of extreme drawdown.

Synonyms: No NVC equivalent. Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261). Northern Atlantic Coastal Plain Dune and Swale (CES203.264). Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273).

Sites: Interdune Marshes occur in basins in the interior of barrier islands, where standing water more than a few inches deep is present for long periods of time. Most are in dune swales, but some may be in former tidal channels that became blocked by sand movement.

Soils: Interdune Ponds generally are mapped as water rather than soil map units, if big enough to be distinguished. Their substrate often has substantial organic accumulations in the center but may be sandy on the edge.

Hydrology: Interdune Ponds are permanently flooded over most of their area, with standing water present except during drought. Drawdown zones on the edge may be exposed seasonally.

Vegetation: Vegetation in Interdune Ponds is extremely variable, from site to site and among ponds within complexes. Stable ponds in older dune areas may have a number of floating aquatic plants in deep water, including *Lemna* spp., *Wolffia* spp., *Spirodela polyrhiza*, *Wolffiella gladiata*, *Azolla caroliniana*, *Hottonia inflata*, *Utricularia biflora*, *Utricularia inflata*, *Nymphaea odorata*, and *Brasenia schreberi*. Submersed aquatic plants, particularly *Potamogeton illinoensis*, may also be present. Ponds in more open areas, presumably younger and perhaps more often affected by saltwater, have lower aquatic diversity but may contain *Potamogeton illinoensis* or, in one case, *Ruppia maritima*. In shallower water and drawdown zones on the edge, *Phyla nodiflora*, *Bacopa monieri*, *Limnobium spongia*, *Eleocharis fallax*, or *Eleocharis parvula* may occur. In rare drought conditions, when the pond bed is exposed, opportunistic herbs such as *Bidens laevis* may appear. An edge zone may have wetland herbs such as *Saururus cernuus*, *Hydrocotyle umbellata*, *Hydrocotyle verticillata*, *Fuirena pumila*, *Sparganium americanum*, *Glyceria septentrionalis*, *Echinochloa walteri*, *Erianthus giganteus*, or marsh species such as *Typha latifolia* and *Juncus roemerianus*. Shrubs and trees, including *Decodon verticillatus*, *Salix caroliniana*, *Acer rubrum*, and *Nyssa biflora* may occur around some ponds.

Range and Abundance: Ranked G2 as defined here. About a dozen occurrences are known in North Carolina, widely scattered throughout the coast but with concentrations in the Buxton Woods/Cape Hatteras area and Nags Head Woods. Examples may potentially occur southward to Florida and possibly in Virginia.

Associations and Patterns: Interdune Ponds are small patch communities. Patches tend to be a few acres or less, but one large complex amounting to more than 100 acres is present at Buxton Woods. Patches are usually surrounded by Maritime Evergreen Forest but might be surrounded by Maritime Dry Grassland, Maritime Wet Grassland, Dune Grass, or Maritime Shrub.

Variation: Interdune Ponds are highly variable both among examples, among patches within complexes, and from year to year within examples. Of the three variants recognized in the 3rd Approximation, one has become the Interdune Marsh community type. Variants similar to the other two are retained, though they are renamed and defined slightly differently.

Open Pond Variant occurs in more open landscapes such as sand flats or among open, sometimes discontinuous dunes. Tending to occur in a landscape of Dune Grass, Maritime Dry Grassland, or Maritime Shrub, this variant presumably is younger or more subject to salt spray and occasional overwash. These ponds typically have less diverse flora and contain more salt-tolerant plants. Ponds surrounded by forest but open to saltwater intrusion should be treated as this variant, too.

Interior Pond Variant occurs in older relict dune systems with more relief, generally in a landscape of Maritime Deciduous Forest or Maritime Evergreen Forest. The ponds often tend to be steeper-sided and deeper. Salt spray is less and overwash or saltwater intrusion is less likely. It may have a diverse aquatic flora that includes less salt-tolerant species.

Dynamics: As with all maritime communities, Interdune Ponds are potentially highly dynamic. They may undergo severe natural disturbance by saltwater intrusion or may quickly give way to other communities because of erosion, sand movement, or direct or indirect natural changes in sheltering from salt spray and overwash. However, most occur in stable forested dune fields where such disturbances have not occurred for many decades.

Comments: The *Lemna* spp. Permanently Flooded Herbaceous Vegetation (CEGL003059) association was formerly linked to Interdune Pond. That association was succeeded in this region by *Lemna* spp. Eastern North Americana Aquatic Vegetation (CEGL005451). This association remains unduly broad, covering floating vegetation in a wide range of aquatic environments. Some Interdune Ponds would fall within it, but most do not usually have abundant floating vegetation. That association would also potentially include backwaters on Coastal Plain Rivers and some beaver ponds, at least at certain seasons. It seems best not to link any existing association to this community.

Interdune Ponds have received substantial study over the years. A research project focused on the ponds of Nags Head Woods produced several publications on different biota (Bellis 1988, MacPherson 1988, Schwartz 1988). Interdune Ponds were also recognized in early work on Cape Lookout National Seashore (Au 1976, Snow and Godfrey 1978) and more generally (Odum and Harvey 1988).

Rare species:

Vascular plants: *Eleocharis cellulosa*, *Eleocharis parvula*, *Hottonia inflata*, *Lilaeopsis carolinensis*, *Ludwigia alata*, *Potamogeton illinoensis*, *Rhynchospora microcarpa*, *Rhynchospora odorata*, and *Scleria verticillata*.

Vertebrate animals: *Fundulus confluentus*.

References:

Au S. 1974. Vegetation and ecological processes on Shackleford Banks, North Carolina. National Park Service Monograph Series No. 6.

Bellis, V. 1988. Microalgae of barrier island freshwater ponds, Nags Head, North Carolina. Association of Southeastern Biologists Bulletin 35:164-169.

MacPherson, T.F. 1988. Benthic macroinvertebrates of selected ponds in the Nags Head Woods Ecological Preserve. Association of Southeastern Biologists Bulletin 35:181- 188.

Odum, W.E. and J.W. Harvey. 1988. Barrier island interdunal freshwater wetlands. Association of Southeastern Biologists Bulletin. 35:149-155.

Schwartz, F.J. 1988. Pre- and post-drought fish surveys of selected freshwater ponds located in Nags Head Woods, Nags Head, North Carolina. Association of Southeastern Biologists Bulletin 35:189-198.

Snow, A. and P.J. Godfrey. 1978. The vegetation of Cape Lookout National Seashore. Report No. 41, National Park Service Cooperative Research Unit, Institute for Man and Ecology, University of Massachusetts.

MARITIME SWAMP FOREST (TYPIC SUBTYPE)

Concept: Maritime Swamp Forests are wetland forests of barrier islands and comparable coastal spits and back-barrier islands, dominated by tall trees of various species. The Typic Subtype includes most examples, which are not dominated by *Acer*, *Nyssa*, or *Fraxinus*, not by *Taxodium distichum*. Canopy dominants are quite variable among the few examples.

Distinguishing Features: Maritime Shrub Swamps are distinguished from other barrier island wetlands by dominance by tree species of (at least potentially) large stature. The Typic Subtype is dominated by combinations of *Nyssa*, *Fraxinus*, *Liquidambar*, *Acer*, or *Quercus nigra*, rather than by *Taxodium* or *Salix*. Maritime Shrub Swamps are dominated by tall shrubs or small trees, particularly *Salix*, *Persea*, or wetland *Cornus*. Some portions of Maritime Evergreen Forest are marginally wet, but such areas are distinguished by the characteristic canopy dominants of that type, such as *Quercus virginiana*, *Quercus hemisphaerica*, or *Pinus taeda*. The lower strata also are distinctive, with wetland species occurring in Maritime Swamp Forest; however, some species, such as *Morella cerifera*, may occur in both.

Synonyms: *Acer rubrum* - *Nyssa biflora* - (*Liquidambar styraciflua*, *Fraxinus* sp.) Maritime Swamp Forest (CEGL004082).

Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261).

Sites: Maritime Swamp Forests occur on barrier islands and comparable spits, in well-protected dune swales, edges of dune ridges, and on flats adjacent to freshwater sounds.

Soils: Soils are wet sands or mucky sands, most often mapped as Duckston (Typic Psammaquent) or Conaby (Histic Humaquent).

Hydrology: Most Maritime Swamp Forests have shallow seasonal standing water and nearly permanently saturated soils. Some may rarely be flooded by salt water during severe storms, but areas that are severely or repeatedly flooded do not recover to swamp forest.

Vegetation: Maritime Swamp Forests have closed to somewhat open canopies, where not recently disturbed. *Acer rubrum* (probably var. *trilobum*) and *Nyssa biflora* dominate most examples. In CVS plot data, *Pinus taeda* and *Liquidambar styraciflua* have high constancy but don't tend to dominate. *Fraxinus*, identified as *americana* dominates in one example. The understory may be dominated by *Persea palustris*, *Carpinus caroliniana*, or *Ilex opaca*, and may also include *Magnolia virginiana*. The shrub layer may be dense but more often is sparse to moderate. *Morella cerifera* is the most constant species, followed by *Vaccinium fuscatum*. Other species with fairly high constancy in plot data include *Decodon verticillatus*, *Lyonia lucida*, and *Vaccinium formosum*. Vines are frequent and diverse. *Parthenocissus quinquefolia*, *Toxicodendron radicans*, *Muscadinia rotundifolia*, *Smilax laurifolia*, and *Smilax rotundifolia* have high constancy, while *Berchemia scandens*, *Nekemias arborea*, *Decumaria barbara*, and other species may be present. The herb layer may be sparse to dense, and often is patchy. High constancy species are *Mitchella repens*, *Anchistea virginica*, *Saururus cernuus*, *Steinchisma virginica*, *Thelypteris palustris* var. *pubescens* and *Mikania scandens*, most of which dominate in some plots. Other fairly frequent species include *Osmundastrum cinnamomeum*, *Boehmeria cylindrica*, *Cicuta maculata*,

Hydrocotyle verticillata, *Hydrocotyle umbellata*, *Peltandra virginica*, and a variety of *Carex* species. Species of adjacent Maritime Evergreen Forest or Maritime Deciduous Forest may occur in the edges of the swamps.

Range and Abundance: Ranked G2. Maritime Swamp Forests are rare and widely scattered in North Carolina. They only occur on the wider and more stable barrier islands, and not on all of them. All known examples are from the middle to northern part of the state, from Bogue Banks northward. The association ranges from Virginia to Georgia.

Associations and Patterns: Maritime Swamp Forests are small patch communities in most places, but have substantial aggregate acreage in a few places where they are part of a mosaic in extensive older dune systems. The largest examples are associated in mosaics with Maritime Deciduous Forest, but other examples are surrounded by Maritime Evergreen Forest. A few open onto Freshwater Tidal Wetlands at the back of the barrier island in places such as Currituck Banks.

Variation: Two well-marked variants exist, perhaps distinctive enough to warrant subtypes.

1. Maple-Gum Variant is dominated by *Acer rubrum* and *Nyssa biflora*. It includes most examples. Wentworth, et al. (1990), analyzing woody stem data from early CVS plots, identified separate groups dominated by *Acer* and *Nyssa*. These might warrant recognition as variants, but more investigation is needed. These species appear more intermixed in many examples, so that such variants would be much less distinct than the two recognized here.
2. Ash Variant is dominated by *Fraxinus*. It appears to be unique to Theodore Roosevelt State Natural Area, where it is the only variant.

Dynamics: In contrast to the extensive interest in the dynamics of Maritime Evergreen Forest and Maritime Shrub, little has been written about the dynamics of Maritime Swamp Forests. They are subject to the high levels of stress and natural disturbance common to the Maritime Wetlands and Maritime Upland Forests themes, including the potential for geological processes to create or destroy suitable environments relatively quickly. Heavy salt spray during storms, as well as high winds, can disturb forest canopies.

Maritime Swamp Forests generally do not show sculpting or stunting by chronic salt spray. They occur in the most sheltered parts of wide barrier islands, on the sound side or in deep dune swales where they are protected by high ridges and adjacent forests. Salt spray nevertheless presumably is an important input of nutrients into the swales.

Intrusion by salt or brackish water during storms represents a potential severe natural disturbance in sites that are not fully surrounded by high dunes. Water can penetrate long distances along linear dune swales if one end is open to salt marsh or to the shore line. Some examples are becoming increasingly vulnerable to this as sea level rises. Observations after recent hurricanes show some areas of complete mortality in Maritime Swamp Forests, where roots as well as tops of woody vegetation are killed. Some are recovering through a slow process of secondary succession. Others do not show any woody regeneration after several years. One possible reason may be that salt water may have penetrated during a storm surge but have been unable to drain

out. If salt is trapped in a swale, it may take years of gradual dilution by rainwater before the environment is again suitable for trees.

The Maritime Swamp Forests of the Currituck Banks occur on low sand flats that are not sheltered from the sound. The water in Currituck Sound is oligohaline rather than brackish, and may not be harmful to the species in the swamp forest. If a new inlet formed and Currituck Sound became saltier, these swamps might not survive.

Comments:

Rare species:

References:

Wentworth, T.R., M.P. Schafale, A.S. Weakley, R.K. Peet, P.S. White, & C.C. Frost. 1993. A Preliminary classification of North Carolina barrier island forests. Pages 31-46 in: C. A. Cole and F. K. Turner, editors. Barrier island ecology of the mid-Atlantic coast: A symposium. USDI National Park Service. Technical Report NPS/SERCAHA/NRTR-93/04. Atlanta, GA.

MARITIME SWAMP FOREST (CYPRESS SUBTYPE)

Concept: Maritime Swamp Forests are wetland forests of barrier islands and comparable coastal spits and back-barrier islands. The Cypress Subtype covers the rare examples dominated or codominated by *Taxodium distichum*, occurring in North Carolina only at Southern Shores and in Kitty Hawk Woods.

Distinguishing Features: The Cypress Subtype is distinguished from all other communities by the dominance of *Taxodium* in a non-tidal, barrier island setting.

Synonyms: Synonyms: *Taxodium distichum* / *Cephalanthus occidentalis* / *Boehmeria cylindrica* - *Ceratophyllum muricatum* Maritime Swamp Forest (CEGL004079).
Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261).

Sites: This community occurs in well-protected dune swales.

Soils: Soils in the known examples are mapped as Conaby (Histic Humaquept).

Hydrology: The swales containing this subtype have fluctuating water levels that may be several feet deep for an entire season, or may draw down and be unflooded but saturated. These swales are wetter than those supporting the Typic Subtype.

Vegetation: The forest is dominated by *Taxodium distichum*. A few other species may be codominant, especially *Acer rubrum*, probably var. *trilobum*. Other abundant trees may include *Liquidambar styraciflua*, *Pinus taeda*, *Nyssa biflora*, and *Fraxinus profunda*. The understory usually is not well developed. It consists of canopy species, frequently along with *Persea palustris* or *Carpinus caroliniana*. Shrub cover is generally low. Species fairly frequent in CVS plots include *Morella cerifera*, *Eubotrys racemosa*, *Decodon verticillatus*, *Cephalanthus occidentalis*, and *Rosa palustris*. Vines are frequent and occasionally extensive, with *Parthenocissus quinquefolia*, *Muscadinia rotundifolia*, *Berchemia scandens*, *Smilax rotundifolia*, and *Toxicodendron radicans* frequent in plots. Herbs generally have low cover, may be confined to edges, and may vary in cover with water levels. Frequent herbaceous species in the plots are *Boehmeria cylindrica*, *Saururus cernuus*, *Mikania scandens*, *Osmunda spectabilis*, and *Peltandra virginica*. Also fairly frequent are *Galium tinctorium*, *Hydrocotyle prolifera*, *Hypericum virginicum*, *Limnobium spongia*, *Lorinseria areolata*, *Lycopus virginicus*, and *Persicaria hydropiperoides*.

Range and Abundance: Ranked G1. In North Carolina this community is known only in Kitty Hawk Woods and Southern Shores. A few more examples exist in Virginia.

Associations and Patterns: The known examples are small patches surrounded by Maritime Deciduous Forest.

Variation: Examples are somewhat heterogeneous in composition and are zoned by water depth.

Dynamics: Nothing specific is known about the dynamics of this subtype. Examples occur in well sheltered areas where salt water intrusion is unlikely under current circumstances.

Unlike most of the drier maritime communities, Maritime Swamp Forest may be susceptible to invasion by exotic plants. The dramatic invasion of a South Carolina example by *Triadica sebifera* (Conner, et al. 2005) demonstrates the potential for alteration. Though this species is more widespread to the south, and only sparsely present in North Carolina, the moderate climate of the barrier islands likely is suitable for it.

Comments: While it may be reasonable to question whether this subtype is more distinct than the variants within the Typic Subtype, the Cypress Subtype was recognized as the most distinct cluster in Wentworth, et al. (1990) and in Virginia Natural Heritage Program data analysis. The flora suggest it is wetter than the Typic Subtype. Maritime Shrub Swamp appears similarly wet, and it is unclear what ecological factors separate it from the Cypress Subtype. Dispersal limitation in the remote locations may be a sufficient explanation.

Rare species:

References:

Conner, W.H., W.D. Mixon II, G.W. Wood. 2005. Maritime forest habitat dynamics on Bulls Island, Cape Romain National Wildlife Refuge, SC, following Hurricane Hugo. *Forest Ecology and Management* 212: 127-134.

Wentworth, T.R., M.P. Schafale, A.S. Weakley, R.K. Peet, P.S. White, & C.C. Frost. 1993. A Preliminary classification of North Carolina barrier island forests. Pages 31-46 in: C. A. Cole and F. K. Turner, editors. *Barrier island ecology of the mid-Atlantic coast: A symposium*. USDI National Park Service. Technical Report NPS/SERCAHA/NRTR-93/04. Atlanta, GA.

MARITIME SHRUB SWAMP (DOGWOOD SUBTYPE)

Concept: Maritime Shrub Swamps are barrier island wetlands persistently dominated by large shrubs or small trees. The Dogwood Subtype encompasses rare examples dominated or codominated by *Cornus foemina*. It is known only from Buxton Woods and Salter Path.

Distinguishing Features: The Dogwood Subtype is readily distinguished from all other communities by the combination of barrier island dune swale setting and dominance or codominance by *Cornus foemina*. *Persea palustris* may be abundant or codominant in this subtype but always with *Cornus stricta*, which is largely absent from the Red Bay Subtype. *Pinus taeda* may be present as emergent trees or a supercanopy on edges of patches.

Synonyms: *Cornus foemina* / *Berchemia scandens* Forest (CEGL007384).

Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261).

Sites: Maritime Shrub Swamps occur in wet dune swales. In the best known occurrence, at Buxton Woods, they occupy numerous swales in the extensive forested dune system but are not in the deepest swales.

Soils: Soils are sands with a shallow muck surface layer. They are mapped as Conaby (Histic Humaquept).

Hydrology: Swales containing this community have fluctuating water levels that may be several feet deep for an entire season or may draw down and be unfllooded but saturated. The water levels represent the water table.

Vegetation: The vegetation is a closed to open tall shrubland dominated by *Cornus foemina* (*Cornus stricta*), alone or codominant with *Persea palustris*. There often is a visible gradient in vegetation within the community from the edge of the swale to the center. *Pinus taeda* may be present as an open supercanopy or as sparser emergent trees in the transition to adjacent forests. *Carpinus caroliniana* is frequent and may be abundant on edges. In CVS plot data, *Morella cerifera*, *Ilex vomitoria*, and *Sabal minor* are frequent and may be abundant on edges, and a number of other species shared with Maritime Evergreen Forest may be present. *Smilax laurifolia*, *Berchemia scandens*, *Muscadinia rotundifolia*, *Parthenocissus quinquefolia*, *Smilax rotundifolia*, *Nekemias arborea*, *Smilax bona-nox*, and *Gelsemium sempervirens* are fairly constant and may have substantial cover, and *Hydrangea (Decumaria) barbara*, *Toxicodendron radicans*, and *Vitis aestivalis* are also fairly frequent. Herbs are sparse and patchy, sometimes confined only to edges, and no species has as much as 50% constancy in CVS plots. *Thelypteris palustris* var. *palustris*, *Boehmeria cylindrica*, *Chasmanthium laxum*, *Hydrocotyle verticillata*, and *Carex* spp. are the most frequent in plots, but seldom have high cover. Other species noted as abundant locally include *Leersia virginica*, *Leersia oryzoides*, *Rhynchospora miliacea*, *Persicaria* sp., *Sparganium americanum*, *Limnobium spongia*, and *Carex lupulina*. An unusual shrubby wetland dominated by *Decodon verticillatus* but with abundant *Cornus foemina* is tentatively included in this subtype.

Range and Abundance: Ranked G1. The only well-developed example of this community is at Buxton Woods, with a marginally developed example in Salter Path. This subtype apparently is endemic to North Carolina.

Associations and Patterns: The Dogwood Subtype occurs in small but numerous patches at Buxton Woods. Patches are surrounded by Maritime Evergreen Forest, and some may be on the edges of Interdune Marsh or Interdune Pond communities in deeper swale areas.

Variation: Many patches show a distinct zonation or gradient along the sloping bottoms of the swales.

Dynamics: Little is known specifically about the dynamics of this subtype. It is subject to the same natural disturbances as the other woody Maritime Wetlands.

The author's observations in the 2000s suggest some substantial changes in the ecotonal (drier) parts of patches. Many large *Pinus taeda*, often all of the emergent or supercanopy trees, had died standing. It is unclear if they died in the same hurricane that caused catastrophic mortality of pines in the surrounding Maritime Evergreen Forest, or if they died later as a result of prolonged high water levels. The large size of the trees suggests the cause was a very rare event. The lack of substantial pine regeneration and the apparent uniform size of the trees suggest that establishment of pines may also be a rare event, perhaps associated with prolonged drought. The author has observed substantially different, but long lasting, water levels in this community at different times from the 1980s through the 2010s.

Comments: The Wentworth, et al. (1990) analysis of CVS woody stem data found the Maritime Shrub Swamps to be a distinctive cluster, with Dogwood and Red Bay subtypes substantially different.

Rare species:

References:

Wentworth, T.R., M.P. Schafale, A.S. Weakley, R.K. Peet, P.S. White, & C.C. Frost. 1993. A Preliminary classification of North Carolina barrier island forests. Pages 31-46 in: C.A. Cole and F.K. Turner, editors. Barrier island ecology of the mid-Atlantic coast: A symposium. USDI National Park Service. Technical Report NPS/SERCAHA/NRTR-93/04. Atlanta, GA.

MARITIME SHRUB SWAMP (RED BAY SUBTYPE)

Concept: Maritime Shrub Swamps are barrier island wetlands persistently dominated by large shrubs or small trees. The Red Bay Subtype encompasses examples dominated by *Persea palustris*, with *Cornus foemina* scarce or absent.

Distinguishing Features: The Red Bay Subtype is distinguished from all other communities by the combination of barrier island wet dune swale setting and dominance by *Persea palustris* without *Cornus foemina* as a codominant. *Persea palustris* may be codominant with *Cornus* in the Dogwood Subtype.

Synonyms: Synonyms: *Persea palustris* / *Morella cerifera* Maritime Forest (CEGL004635). Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261).

Sites: The Red Bay Subtype occurs on the lower flanks of dunes and on low-lying flats on the sound side of barrier islands.

Soils: The few examples are mapped as Duckston (Typic Psammaquent) and Conaby (Histic Humaquent). The Duckston examples may be on inclusions of mucky soil more like Conaby.

Hydrology: This subtype appears to have saturated soils, with a water table near the surface, but may not have the deep ponding characteristic of the Dogwood Subtype. The Nags Head Woods example may have significant seepage from the adjacent higher dunes.

Vegetation: The Red Bay Subtype has a canopy of short trees, dominated by *Persea palustris*. Some examples have smaller amounts of *Acer rubrum*. A few other trees, such as *Carpinus caroliniana*, *Magnolia virginiana*, or *Liquidambar styraciflua*, may be present. A lower shrub layer dominated by *Morella cerifera* may be sparse to moderately dense. Vines are often abundant, particularly *Smilax laurifolia*, but also including *Smilax rotundifolia*, *Berchemia scandens*, *Toxicodendron radicans*, *Parthenocissus quinquefolia*, and other species. Herbs are patchy. *Steinchisma areolata*, *Thelypteris palustris* var. *palustris*, *Boehmeria cylindrica*, and *Leersia virginica* may dominate patches. Other notable species include *Osmunda spectabilis*, *Rhynchospora miliacea*, *Osmundastrum cinnamomeum*, *Persicaria hydropiperoides*, *Cicuta maculata*, and *Peltandra virginica*. Extensive *Sphagnum* cover was noted in one site.

Range and Abundance: Ranked G1. Only three examples are known in North Carolina, widely scattered in the northern half of the coast. The association is reported to also be in South Carolina, but the identification of examples there is unclear.

Associations and Patterns: The examples of the Red Bay Subtype are small patches associated with Maritime Deciduous or Maritime Evergreen Forest on the upland side, and often with tidal marshes nearby.

Variation: Documentation of this community remains somewhat partial and the variation is confusing. Some descriptions of the Nags Head Woods example make it sound different from the other examples. It occurs just below the sound side slope of the dunes, adjacent to marshes.

It has extensive *Sphagnum* cover and a high diversity of herbs. It may receive significant seepage, but it may also be transitional to a marsh ecotone community. The other two examples, at Pine Island and Hatteras Island, are on sand flats, also on the back of barrier islands and near marshes, but without evidence of seepage. They have lower species richness and appear to be less wet.

Dynamics: The natural dynamics of this subtype are particularly poorly known. All examples are in locations exposed to potential flooding from the sound side of the islands, so they may be subject to significant natural disturbance. It is possible they represent a successional stage leading to Maritime Swamp Forest, which occurs in similar settings. However, where both communities occur together, Maritime Shrub Swamp occurs in discrete patches that appear to be slightly lower and wetter.

Comments: This community remains poorly understood. The Nags Head Woods occurrence has been known for many years and has been characterized in several reports, but older and newer descriptions appear rather different. The other occurrences are more newly discovered and are limited in extent. CVS plot data do not characterize the community well, with some plots misclassified and others ecotonal. However, the Wentworth, et al. (1990) analysis identified a distinct group of bay-dominated wetland plots. There is no other published literature on the Red Bay Subtype.

Rare species: None known.

References:

Wentworth, T.R., M.P. Schafale, A.S. Weakley, R.K. Peet, P.S. White, & C.C. Frost. 1993. A Preliminary classification of North Carolina barrier island forests. Pages 31-46 in: C.A. Cole and F.K. Turner, editors. Barrier island ecology of the mid-Atlantic coast: A symposium. USDI National Park Service. Technical Report NPS/SERCAHA/NRTR-93/04. Atlanta, GA.

MARITIME SHRUB SWAMP (WILLOW SUBTYPE)

Concept: Maritime Shrub Swamps are barrier island wetlands persistently dominated by large shrubs or small trees. The Willow Subtype encompasses examples dominated or codominated by *Salix caroliniana*.

Distinguishing Features: The Willow Subtype is readily distinguished from all other communities by the combination of barrier island dune swale setting and dominance by *Salix caroliniana*. *Salix* may be present in small amounts in Maritime Swamp Forest or on edges of Interdune Ponds, but does not dominate in these communities.

Synonyms: Synonyms: *Salix caroliniana* / *Sacciolepis striata* - *Boehmeria cylindrica* Woodland (CEGL004222).

Ecological Systems: Central Atlantic Coastal Plain Maritime Forest (CES203.261).

Sites: The Willow Subtype occurs in wet dune swales in sheltered parts of barrier islands.

Soils: Soils are sands, potentially with a shallow muck surface layer. They may be mapped as Conaby (Histic Humaquept) or Duckston (Typic Psammaquept), or may be inclusions of these soils in other map units.

Hydrology: Hydrology is probably similar to that of the Dogwood Subtype, with fluctuating water levels that may cover the surface for entire seasons or may drop to saturated but not flooded conditions.

Vegetation: The Willow Subtype is an open to potentially closed tall shrubland dominated by *Salix caroliniana*. Associated vegetation is not well characterized. Some *Acer rubrum* or other swamp tree species may be present in small numbers, and other trees rooted in adjacent communities may overhang. *Morella cerifera* or other shrubs may be present on the edges. Associated herbs may include *Thelypteris palustris* var. *pubescens*, *Chasmanthium laxum*, *Hydrocotyle prolifera*, *Mikania scandens*, *Persicaria punctata*, *Boehmeria cylindrica*, and potentially additional species shared with other subtypes.

Range and Abundance: Ranked G2?. The range and abundance of this community are not well understood. Only a handful of examples are known, but others may have been overlooked or not reported. The equivalent association was described in North Carolina and is also attributed to South Carolina.

Associations and Patterns: The Willow Subtype occurs in small patches, associated with other Maritime Shrub Swamp (Dogwood Subtype), Interdune Marsh, or Interdune Pond. It may be surrounded by Maritime Upland Forest or Maritime Grassland communities.

Variation: Nothing is known of variation.

Dynamics: Dynamics are not known. Because *Salix* is often an early successional species, it is conceivable that this subtype represents an earlier stage of primary succession than the other

woody Maritime Wetlands. The Buxton Woods example is in the younger, more seaward part of the site. However, it is associated with other woody wetlands.

Comments: This subtype is particularly poorly understood. It was described as an association in the NVC, but the description there says little other than that the community is dominated by *Salix*. The few CVS plots attributed to the association are uncertain representatives. Examples have been observed by the author in the Buxton Woods area and on Currituck Banks, but description is limited. High water levels hampered observation, and may have prevented plots being collected for the initial NVC description. More work is needed to characterize the community and to determine its conservation status, but it appears to represent vegetation that occurs naturally in North Carolina and cannot readily be classified as another community.

Rare species: None known.

References:

ESTUARINE FRINGE PINE FOREST (LOBLOLLY PINE SUBTYPE)

Concept: Estuarine Fringe Pine Forests are strongly pine-dominated forests and woodlands adjacent to sounds or marshes, whose lower strata are indicative of estuarine influence rather than consisting of species of Coastal Plain Nonalluvial Wetlands or Peatland Pocosins. The Loblolly Pine Subtype covers examples in which *Pinus taeda* dominates.

Distinguishing Features: Estuarine Fringe Pine Forests are distinguished from Pond Pine Woodland and Nonriverine Swamp Forest by having a shrub layer dominated or codominated by *Morella cerifera*. *Persea palustris* and *Ilex glabra* may be abundant in all, but other typical pocosin shrubs such as *Cyrilla racemiflora* are largely or completely absent. *Osmunda spectabilis* or *Lorinseria areolata* are generally the dominant herbs, though *Woodwardia virginica* may be present. Other species shared with Tidal Freshwater Marshes or not typical of pocosins are usually present.

The Loblolly Pine Subtype is distinguished from the rarer Pond Pine Subtype by the dominant canopy species. The Loblolly Pine Subtype may be difficult to tell from successional loblolly pine forests or plantations, and the two can occur adjacent to each other. Estuarine Fringe Pine Forest may be recognized by wet, mucky soil and by vegetation as described below which shares species with tidal marshes and does not contain upland species.

Synonyms: *Pinus taeda* / *Morella cerifera* / *Osmunda regalis* var. *spectabilis* Forest (CEGL006137). Ecological Systems: Attributed to Central Atlantic Coastal Plain Maritime Forest (CES203.261), somewhat problematically.

Sites: Estuarine Fringe Pine Forests occur on the shoreline of estuaries or behind tidal marshes, on flats that are low-lying but are above the level of tidal flooding.

Soils: The Loblolly Subtype occurs on a variety of organic-rich soils. Most are mapped as mucky mineral soils such as Stockade (Umbric Endoaqualf), Icaria (Typic Umbraquult), Wasda (Histic Humaquept), Conaby (Histic Humaquept), and Murville (Typic Haplaquod). A few are mapped as true organic soils such as Ponzer or Currituck (Terric Haplosaprist).

Hydrology: Estuarine Fringe Pine Forests are permanently or semipermanently saturated and may sometimes have shallow surface water. The water table is probably kept near the surface by the flat topography and their location near sea level. They are not flooded by regular or extreme tides, but they may be flooded by brackish or oligohaline water during storm surges. They probably are wetted primarily by rainwater but may receive sheet flow from inland. All examples are associated with estuaries with wind tides or limited tidal range, and it is possible that this is crucial for their development.

Vegetation: The Loblolly Pine Subtype is strongly dominated by *Pinus taeda*, in a canopy that may be dense or open. Small amounts of *Nyssa biflora*, *Acer rubrum*, or *Liquidambar styraciflua* often are present. Occasional examples have a few *Pinus serotina*, *Quercus nigra*, or *Quercus virginiana*. The understory is usually dominated by *Persea palustris*. Sometimes no other species are noted, but *Magnolia virginiana* is fairly frequent and *Ilex opaca* may occur. The shrub layer

may be dense or sparse. *Morella cerifera* is constant and usually dominates. Other frequent shrubs include *Arundinaria tecta*, *Vaccinium fuscatum*, *Ilex glabra*, and *Lyonia lucida*. Less frequent but notable species include *Baccharis halimifolia*, *Decodon verticillatus*, and *Sabal minor*. Vines are sometimes dense. *Smilax rotundifolia*, *Gelsemium sempervirens*, and *Muscadinia rotundifolia* are most frequent, and *Nekemias arborea*, *Toxicodendron radicans*, *Berchemia scandens*, *Campsis radicans*, and other species of *Smilax* may occur. The herb layer may be sparse or dense. The most frequent species are *Chasmanthium laxum*, *Osmunda spectabilis*, *Lorinseria areolata*, and *Osmundastrum cinnamomeum*. One example that had burned recently had a dense herb layer of *Carex hyalinolepis*. Other herbs that may occur include *Anchistea virginica*, *Centella erecta*, *Pluchea purpurascens*, *Pluchea foetida*, *Hydrocotyle verticillata/triradiata/umbellata*, *Saururus cernuus*, *Pteridium pseudocaudatum*, *Juncus effusus*, *Echinochloa walteri*, *Samolus parviflorus*, *Persicaria* spp., and *Bacopa monnieri*. *Sphagnum* clumps are occasional. Various other species shared with tidal marshes may be present at low frequency.

Range and Abundance: Ranked G3. Estuarine Fringe Pine Forests of the Loblolly Pine Subtype are scattered throughout the northern half of the tidewater zone of the Coastal Plain, around Currituck, Albemarle, and Pamlico Sounds and the Neuse River estuary. They are not known farther south. About 20 occurrences are known and a few more are likely to be found. The equivalent association is found northward to New Jersey.

Associations and Patterns: Estuarine Fringe Pine Forests are large patch communities. Most examples are tens to hundreds of acres in size, but they are not a regular or predictable part of the landscape mosaic. They occur inland of Brackish Marsh or Tidal Freshwater Marsh or on the shoreline. Inland, most examples are bordered by altered vegetation, but they may naturally grade to Nonriverine Swamp Forest or to various upland communities.

Variation: The Loblolly Pine Subtype is a relatively uniform community, with less variation among and within examples than most communities. Examples may vary somewhat with wetness and with time since natural disturbance.

Dynamics: The natural dynamics of the Loblolly Pine Subtype are not well documented. These communities are dominated almost exclusively by species that tend to establish after severe disturbance but that do not do well with chronic stress or disturbance such as frequent fire. They occur adjacent both to communities that naturally burned and to tidally flooded communities. Rare saltwater intrusion during storm surges is thought to act as a natural disturbance that causes canopy regeneration and that prevents less salt-tolerant species from persisting. Because they occur on exposed edges of open water and are not dominated by trees resistant to wind throw, wind is also an important disturbance. It may thus be one of the few natural communities in North Carolina that is regularly maintained by catastrophic disturbance. At the same time, the rarity of such disturbances allows the canopy to mature and prevent shrub or herb species from dominating.

The role of fire in the Loblolly Pine Subtype is unclear. Cecil Frost, who wrote site reports for multiple examples, believed that they naturally burned very frequently and existed as open savannas, as he believed about the marshes that adjoined many of them. Several examples he saw had been burned along with the adjacent marshes for wildlife management. He emphasized the vigorous response of *Carex hyalinolepis* to fire, but this species was not found in other burned

examples. Many other examples have sparse enough herbaceous fuel that they seem unlikely to burn. Not all examples are connected to large contiguous marshes. Some may have been connected to upland longleaf pine communities or canebrakes which burned frequently, but others are associated with Nonriverine Swamp Forest and other communities that are not as flammable.

Given the ongoing rise in sea level, any given occurrence of Estuarine Fringe Pine Forest may be transient on the scale of decades, though all appear to have persisted since the community was first recognized. Because of their marginally greater elevation, they appear to be less transient than the exposed edges of Tidal Swamp.

Comments: The NVC association synonymized to this subtype appears to be a broader concept, including barrier island and marsh island sites in states to the north.

This community was newly recognized, under the name of Estuarine Fringe Loblolly Pine Forest, shortly before publication of the 3rd Approximation. It was not obviously documented in earlier site descriptions before that time, though the similarity to artificial successional vegetation may make it difficult to recognize in earlier literature. It has been well documented since that time in site reports and several CVS plots.

Rare species: No rare species are known to be associated with this community.

References:

ESTUARINE FRINGE PINE FOREST (POND PINE SUBTYPE)

Concept: Estuarine Fringe Pine Forests are strongly pine-dominated forests and woodlands adjacent to sounds or marshes, whose lower strata are indicative of estuarine influence rather than consisting of species of Coastal Plain Nonalluvial Wetlands or Peatland Pocosins. The Pond Pine Subtype covers examples with *Pinus serotina*-dominated canopies.

Distinguishing Features: Estuarine Fringe Pine Forests are distinguished from Pond Pine Woodland and Nonriverine Swamp Forest by having a shrub layer dominated or codominated by *Morella cerifera*. *Persea palustris* and *Ilex glabra* may be abundant in all, but other typical pocosin shrubs such as *Cyrilla racemiflora* are largely or completely absent. *Osmunda spectabilis* or *Lorinseria areolata* are generally the dominant herbs, though *Woodwardia virginica* may be present. Other species shared with Tidal Freshwater Marshes or not typical of pocosins are usually present. The Pond Pine Subtype is distinguished from the more common Loblolly Pine Subtype by the canopy dominant.

Synonyms: *Pinus serotina* / *Morella cerifera* / *Osmunda regalis* var. *spectabilis* Woodland (CEGL003669). Pond Pine Woodland (3rd Approximation).

Ecological Systems: Attributed to Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267), somewhat problematically.

Sites: Estuarine Fringe Pine Forests occur on the shoreline of estuaries or behind tidal marshes, on flats that are low-lying but are above the level of tidal flooding. The Pond Pine Subtype generally occurs where large or medium sized peatlands lie near the sound.

Soils: Soils in the Pond Pine Subtype are often organic soils such as Belhaven (Terric Haplosaprist), Dorovan, Dare, or Pungo (Typic Haplosaprist). They may also often be organic-rich mineral soils such as Hyde (Typic Umbraquult) or Wasda (Histic Humaquept). Some are mapped as less organic soils such as Leon (Aeric Haplohumod), but these may be inclusions.

Hydrology: Estuarine Fringe Pine Forests are permanently or semipermanently saturated and may sometimes have shallow surface water. The water table is probably kept near the surface by the flat topography and this community's location near sea level. Though not flooded by regular or extreme tides, they may be flooded by brackish or oligohaline water during storm surges. These forests probably are wetted primarily by rainwater but may receive sheet flow from inland. All examples are associated with estuaries with wind tides or limited tidal range, and it is possible that this is crucial for their development.

Vegetation: The Pond Pine Subtype is universally dominated by *Pinus serotina*, usually strongly, but the canopy may be fairly dense or very open. The understory is dominated by *Persea palustris*. Small numbers of *Acer rubrum* var. *trilobum* or *Nyssa biflora* may be present in the canopy, or more often, in the understory. Other understory species that occur with moderate frequency in CVS plot data and site descriptions are *Magnolia virginiana* and *Liquidambar styraciflua*. The shrub layer is dominated by *Morella cerifera*, sometimes exclusively, sometimes with *Ilex glabra* codominant. Other frequent shrubs include *Vaccinium fuscatum*, *Aronia arbutifolia*, *Lyonia lucida*, and *Baccharis halimifolia*. Less frequent shrubs include *Eubotrys racemosa*, *Vaccinium*

formosum, *Lyonia ligustrina*, *Rosa palustris*, and *Decodon verticillatus*. A variety of vines may be present, most frequently *Toxicodendron radicans*, *Smilax glauca*, *Smilax rotundifolia*, *Gelsemium sempervirens*, and *Parthenocissus quinquefolia*, sometimes *Smilax laurifolia*. The herb layer may be sparse to dense. *Anchistea virginica* and *Osmunda spectabilis* are highly constant and one or both are usually dominant. *Sphagnum* spp. may be present in small or large amounts. Other herbs may include *Peltandra virginica*, *Thelypteris palustris*, *Cladium jamaicense*, *Hydrocotyle verticillata/umbellata*, *Carex striata*, *Boehmeria cylindrica*, *Lorinseria areolata*, *Persicaria punctata*, *Proserpinaca palustris*, *Centella erecta*, and *Hypericum virginianum*.

Range and Abundance: Ranked G2? The Pond Pine Subtype is scattered throughout the northern half of the tidewater zone of the Coastal Plain, around Currituck, Albemarle, and Pamlico Sounds. There are about a dozen occurrences in the state. This community may potentially occur in adjacent Virginia. The NVC association is questionably attributed to South Carolina, but occurrence there is much less likely.

Associations and Patterns: Estuarine Fringe Pine Forests are large patch communities. Examples of the Pond Pine Subtype may be hundreds of acres in size, with the larger up to 2000 acres. They occur inland of Brackish Marsh or Tidal Freshwater Marsh or on the shoreline. Inland, most examples are bordered by Pond Pine Woodland or other pocosin communities.

Variation: The Pond Pine Subtype is a relatively uniform community, with less variation among and within examples than most communities. Examples vary with the stage of transition from Pond Pine Woodland and to marsh.

Dynamics: The dynamics of the Pond Pine Subtype are somewhat different from the Loblolly Pine Subtype. The Pond Pine Subtype appears to represent a more short-lived transitional community, developed from Pond Pine Woodland by rising sea level and increasing estuarine influence, and clearly undergoing slow-to-fast transition to marsh. The *Pinus serotina* canopy is relict and never appears to regenerate under current conditions. Instead, as trees are lost, it becomes more open and ultimately disappears. *Nyssa biflora* and *Acer rubrum* var. *trilobum*, more tolerant of current conditions, could potentially come to dominate the site, but the fate of most examples appears to become Tidal Freshwater Marsh (Wax Myrtle Subtype). The shrub layer often shows the transition clearly. *Morella cerifera*, largely absent in pocosins but quick to establish in suitable sites, is codominant or dominant. Shrubs retained from the earlier Pond Pine Woodland community are often represented as standing dead stems if they are no longer alive. *Lyonia lucida* dies first, while *Ilex glabra* persists longer. Shrubs more characteristic of tidal communities, such as *Baccharis halimifolia* and even *Rosa palustris*, may be starting to establish. The vine and herb layers show the transition too, with the *Anchistea virginica* and *Smilax laurifolia* characteristic of pocosins present along with the *Osmunda spectabilis*, *Thelypteris palustris*, and *Toxicodendron radicans* typical of tidal communities.

The crucial environmental factors that drive the transition are not definitively known. Increasingly permanent surface saturation as sea level drives a rise in the water table may be important, despite the saturation tolerance of all the plant species involved. Tidal waters do not appear to penetrate these communities and they are not normally influenced by salt, but intrusion of saltwater during

storm surges may stress or kill intolerant plants. The increased nutrient levels can also favor competitive opportunist species such as *Morella cerifera*.

Fire may potentially be important in the Pond Pine Subtype. Examples are usually connected to flammable marsh and pocosin communities. Most of the plants present are able to sprout after fires, so recovery may be rapid in some cases. However, a surface fire may result in more fern dominance, slowing the establishment of *Morella*. In contrast, a more intense fire may kill the pines and hasten the development of marsh.

Comments: This subtype was formerly treated within Pond Pine Woodland. However, despite the canopy, it appears to be more ecologically similar to *Pinus taeda*-dominated examples than to most Pond Pine Woodlands. Nevertheless, it is unclear how ecologically similar the two subtypes are. The Loblolly Pine Subtype appears to be stable, having occupied sites for many years. All well-known examples of the Pond Pine Subtype appear to be transitional communities, developing from true Pond Pine Woodland communities as rising sea level brings occasional storm flooding and salt influence. However, at present rates of sea level rise, this community apparently can persist for years and can occupy sizeable areas. This subtype might conceivably succeed to the Loblolly Pine Subtype in time, but it is more likely that continued sea level rise will gradually convert it to a marsh.

Rare species:

Vascular plants: *Peltandra sagittifolia*.

References:

ESTUARINE BEACH

Concept: Estuarine Beach covers communities of chronically disturbed shorelines of freshwater or oligohaline estuaries, with vegetation that is more open than Tidal Swamp, Estuarine Fringe Pine Forest, or Tidal Freshwater Marsh. These communities likely are not frequently flooded by tides, though they are wet, but are more influenced by storm waves.

Distinguishing Features: This type is distinguished conceptually by occurrence on a chronically disturbed estuarine shoreline that is above regular high tides and has wetland vegetation that is more indicative of severe disturbance than any other freshwater tidal or estuarine community type. Vegetation may include young trees or sparse relict trees, sand binding species such as *Sporobolus pumilus* (*Spartina patens*), or a mix of oligohaline or brackish marsh species with ruderal species.

Synonyms: *Acer rubrum* / *Sambucus canadensis* / *Ampelopsis arborea* - *Sicyos angulatus* Forest (CEGL004698).

Ecological Systems: Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240).

Sites: Shorelines of estuaries, subject to period wave action or disturbance too severe to allow persistence of other marsh or swamp communities. Sites may have the form of a berm, slightly raised above an adjacent marsh or swamp, but potentially could occur along the edge of a higher shoreline.

Soils: Soils may be quite variable, consisting of sand or organic material present before being exposed to the estuary by erosion, reworked by wave action.

Hydrology: Generally saturated or with a permanent water table near the surface because of low elevation, but not frequently flooded by lunar or wind tides.

Vegetation: This community is defined conceptually at present, and potentially is highly variable in structure and composition. Vegetation may also change substantially with time in a given site. Species of marshes, especially *Sporobolus pumilus* (*Spartina patens*), may be present at low to moderate density. One of the few well-described examples has the grass sparsely mixed with ruderal species such as *Melothria pendula*, *Physalis walteri*, *Cynodon dactylon*, *Eupatorium capillifolium*, *Phytolacca americana*, and *Diodia virginica*, as well as *Panicum amarulum*, sparse *Morella cerifera*, *Amorpha fruticosa*, and young *Pinus taeda* and *Taxodium distichum*. The other example, at the mouth of the Roanoke River, has a vegetation plot with an open canopy of *Acer rubrum* and *Acer negundo*, with smaller amounts of *Nyssa biflora* and *Taxodium distichum* (Rice and Peet 1997). However, a later visit to the same vicinity, several years after a hurricane, found only a few young trees, along with an overall composition that was different in many ways. This site has extensive cover of vines, with *Nekemias* (*Ampelopsis*) *arborea* dominant, and *Parthenocissus quinquefolia*, *Muscadinia rotundifolia*, *Smilax rotundifolia*, *Clematis crispa*, and *Berchemia scandens* abundant. In the plot, *Sicyos angulata* also was abundant. *Sambucus canadensis* was the most abundant shrub. Herbs include *Laportea canadensis*, *Boehmeria cylindrica*, *Impatiens capensis*, *Elymus* sp., *Saururus cernuus*, *Onoclea sensibilis* var. *sensibilis*, *Viola* spp., *Dichanthelium* sp., *Rumex verticillatus*, *Commelina virginica*, *Persicaria punctata*, *Peltandra virginica*, *Physalis* sp., *Xanthium strumarium*, and a

wide variety of others, all at low density. Other examples may be quite different from either of these.

Dynamics: These communities are subject to significant natural disturbance by wind, wave action in storms, and potentially salt intrusion in storms. Disturbance is frequent enough that closed swamp or marsh vegetation does not form, though the environment would otherwise be capable of supporting them. Trees may seldom live long, though the Roanoke River plot contained a few trees up to a foot in diameter. These may be regarded as primary successional communities, or as a cyclic succession caused by periodic severe disturbance. As with other chronically disturbed communities, they may be particularly susceptible to invasion by exotic plants.

Range and Abundance: Ranked G2, but with substantial uncertainty. Though this community is potentially present on any exposed estuarine shoreline, conditions for its occurrence apparently are quite rare. However, examples may be overlooked and not described in reports. At present, this community is known only in the wind tidal areas. The equivalent NVC association occurs only in North Carolina.

Associations and Patterns: Examples may grade inland to Tidal Swamp, Estuarine Fringe Pine Forest, or potentially to upland communities. In the best known example, the offshore side is bordered by sparse trees rooted in the water.

Variation: This community is defined conceptually, and examples may vary substantially in vegetation structure and composition, both among sites and temporally at a single site. Variation reflects that accidents of establishment of species after natural disturbances, but also reflects that seed rain from adjacent communities. Species composition may vary with the setting, associated with brownwater or blackwater rivers or with isolated estuarine shorelines.

Comments: This is one of the least well known communities in the 4th approximation, yet its environment and vegetation appear to justify its recognition. It was initially defined and added to the NVC on the basis of the single Roanoke River plot. It may be that no other example with that particular vegetation will be found, but a conceptual community, based on the distinctive environment and more general characteristics of the flora, seems appropriate at least for the present. Based on that plot, this community was initially called Estuarine Beach Forest. However, the more typical condition is probably sparse vegetation, as the plot location now has. A rather different community was described by Frost (1989) on lower Albemarle Sound has sparser trees.

This community does not fit cleanly into any theme. It is placed in the Maritime Wetlands theme because of its wetland hydrology but lack of regular tidal flooding. However, it appears to be closely associated with Freshwater Tidal Wetlands communities and might as readily be placed there.

References:

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