

North Carolina Ecosystem Response to Climate Change: DENR Assessment of Effects and Adaptation Measures

DRAFT

Maritime Wetland Forests

Ecosystem Group Description:

Maritime Wetland Forests occur in wet sites on barrier islands and near the sounds on the mainland. Maritime Swamp Forests and Maritime Shrub Swamps occur on barrier islands in dune swales which are sheltered from the most extreme salt spray and from seawater overwash. The soils are saturated for much of the year and may be flooded for substantial periods. Maritime Swamp Forests have a canopy of tall wetland trees which varies from place to place. Dominants include swamp black gum, red maple, ash, water oak, sweetgum, loblolly pine, and bald cypress. Maritime Shrub Swamps have a canopy of tall shrubs or small trees, usually red bay or swamp dogwood, which may be tangled together with vines. They are apparently wetter than Maritime Swamp Forests but also may be kept in shrub dominance by periodic disturbance. Estuarine Fringe Loblolly Pine Forests occur on wet flats adjacent to salt or brackish marshes along the sounds. There is often a fairly dense layer of shrubs and greenbriars. All of the dominant plants are species that occur in disturbed wet sites elsewhere in the Coastal Plain, but these communities appear to be of natural origin. It may be that periodic natural disturbances such as salt water intrusion prevent succession to hardwoods. It has been suggested that fire occurred naturally in these communities and that the natural aspect was open and grassy rather than shrubby.

Ecosystem Level Effects:

Predicted Impacts of Climate Change:

Climate Change Factor: Likelihood: Effect: Magnitude: Comments:

Sea Level Rise -- Salt Intrusion	Med	Neg	High	
Sea Level Rise -- Inundation	High	Neg	High	
Storm Surge	High	Neg	High	
Wind Damage	High	Neg	High	
Coastal Erosion	High	Neg	High	

The Climate Wizard mid range model predicts an average increase in temperature of about 3.4 degrees along most of the NC coastline, and rainfall change estimates vary widely (Maurer et al., 2007). However, the most important effects on these systems will be rising sea level and an increase in storms. Most occur on the widest, oldest, and most stable parts of the barrier islands. They are in the least likely places to become new inlets. Riggs (2010 presentation to the Sea Level Rise symposium) showed maps indicating that even if the Outer Banks collapses and most of it is lost, the wide areas that support most of the Maritime Forests will remain as islands. However, erosion of foredunes and the resulting increased salt spray may be a significant impact. Intrusion of salt water into perched aquifers may be a problem even for swales that remain intact, but the likelihood of this is quite uncertain.

Many of these systems occur in wet areas in well-protected swales, edges of relict dunes, and edges of freshwater sounds and have a high potential for disturbance by storm winds, salt spray, and migrating sand dunes, which are all likely to increase with climate change. Rising sea level and erosion of dunes are likely to cause inundation of many examples, converting them to marshes, wet grasslands, or open water. Rising water tables may allow them to spread to higher elevations at the expense of Maritime Upland Forests, and possibly even cause new examples to appear. But the net change is likely to be a loss of acreage. The largest expanses of Maritime Wetland Forests are on the low-lying sound side of Currituck Banks, where they exist only because of the fresh water in Currituck Sound. If the banks are breached, much of this area will likely be converted to salt or brackish marsh. Likewise, the extensive examples along the sounds (Estuarine Fringe Loblolly Pine Forest) are low-lying and are very likely to be inundated or affected by increased salinity.

Predicted Ecosystem Responses:

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Structural Change	Med	Neg	Med	
Acreage Change	High	Neg	High	

Increased natural disturbance by wind, salt spray, and storm surge intrusion will be significant. Some of these communities consist of species that can recover from these disturbances, but increased frequency will result in death and regeneration, more time spent in recovery stages, and shifts toward the most tolerant species. If erosion breaches swales and exposes them to sea water intrusion or overwash in storms, they likely will become Maritime Grasslands. If they are low enough have irregular tidal inundation, they will become brackish marshes.

The acreage completely lost from this system by community shifts and destruction may be catastrophic. Any loss will be very significant for these already-rare communities. New sites for these communities may be generated as the coastal landscape changes, but only in places not already destroyed by development.

Many maritime plants disperse readily and occur commonly in wetlands in the Coastal Plain, but the naturally and artificially fragmented distribution of wet maritime forests may limit such latitudinal migration.

Habitat Level Effects:

Natural Communities:

Third Approximation Name:	Comments:
Estuarine Fringe Loblolly Pine Forest	These communities occur on low-lying areas along the sounds. Most are probably near or under a meter above high tide, and are likely to turn into marshes. Where the gradient inland is gradual, some examples may be able to migrate inland. Examples may form in new locations. Because all the known species in these communities occur in other communities as well, they should form readily as sites become suitable. Examples on marsh islands, such as those at Swanquarter National Wildlife Refuge, and those adjacent to higher uplands, as at Goose Creek State Park, are likely to be lost. Because low-lying sound-side sites are likely to remain common, the net change in acreage of this type will likely be drastic only if sea level rises faster than new examples can develop.

Maritime Shrub Swamp

Most examples are in stable areas of higher dunes, and are less likely to be catastrophically destroyed. Water table shifts may cause some interchange of community types, between these, Maritime Swamp Forest, and Interdune Pond, but the net direction is not clear.

Maritime Swamp Forest

Large expanses on the Currituck Banks are vulnerable to increased salinity in the sound if new inlets form anywhere on the Currituck Banks. With limited dune development in many parts, they are also quite vulnerable to erosion of the foredunes and increased overwash. Examples in Buxton Woods, Nags Head Woods, and other areas with more topography are better protected and may well survive.

LHI Guilds:

No animals have been identified as specialists of the communities represented by this Ecosystem Group, although *Euphyes dukesi*, currently assigned to the Freshwater Marsh Guild, appears to be restricted to habitats where marshes are closely bordered by coastal forests. All guilds linked to this group have their highest acreage of habitats in other Ecosystem Groups.

Species Level Effects:

Plants

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	Status: US/NC	Comments:
<i>Malaxis spicata</i>	G4?/S1				/SR-P	
<i>Plagiochila miradorensis</i> var. <i>miradorensis</i>	G4T4/SH				/SR-P	
<i>Cheilolejeunea rigidula</i>	G5/S2				/SR-P	
<i>Ceratophyllum australe</i>	G5TNR/S1				/SR-P	

Very few rare plant species occur in these natural communities, and the ones that occur there are considered globally secure. However, these species are extremely rare in North Carolina and are likely to be extirpated in NC due climate change. The naturally fragmented nature of the habitat, combined with dense coastal development, result in a lack of opportunities for colonization of new areas as climate-related changes occur at existing sites.

Combined Threats and Synergistic Impacts:

Importance of Climate Change Factors Compared to Other Ecosystem Threats:

Threat:	Rank Order:	Comments:
Climate Change	1	
Impoundments	2	
Groundwater Depletion	2	
Development	2	

While less threatened by development than most maritime communities, Maritime Wetland Forests may be destroyed by impoundment, ditching, and by lowering of the water table resulting from extensive well pumping. Overall, sea level rise may be the biggest threat, outside of development.

Recommendations for Action:

Interventive Measures:

Intervention:	Importance:	Feasibility:	Comments:
Restore/Maintain Hydrology	High	High	
Restore/Maintain Landscape Connections	Mediu	Low	Most are naturally isolated but some existing local connections may be vulnerable.
Reduce groundwater extraction	Mediu	Medium	
Protect/Expand Remaining Examples	Mediu	Medium	Mix of feasibility and opportunity for protection.

Most of the maritime swamps on the barrier islands are under conservation, as are many of the estuarine fringe communities. Substantial opportunities to protect additional examples are limited. There is value in protecting additional examples in the broader, more stable parts of barrier islands such as Kitty Hawk Woods, where these communities have the best chance of surviving. There is value in protecting estuarine fringe examples where there is opportunity for them to migrate inland.

Hydrological alteration is seldom a concern in estuarine fringe communities but is significant on the barrier islands. Ground water pumping, ditching, and impoundment associated with development are threats which can be mitigated. Control of ground water extraction is likely to be difficult, as coastal towns seek water sources from perched aquifers that are shrinking by erosion and salt water intrusion.

Landscape connectivity may be a concern locally. Most barrier island examples occur in complexes that are distant from each other, but connections within the complexes can be threatened both naturally by rising sea level and by human actions such as hydrological alteration.

Ecosystem Group Summary:

Climate change may be the biggest threat to remaining examples, especially in places where topography or development limits potential for elevational migration. Restoring the hydrology in areas of heavy development and protecting the few remaining examples and migration corridors would allow an opportunity to migrate inland. New sites for these communities may be generated as the coastal landscape changes, but only in places that are not already developed.

References:

Maurer, E.P, L.Brekke, T.Pruitt, and P.B. Duffy. 2007. Fine-resolution climate projections enhance regional climate change impact studies. *Eos Trans. AGU*, 88(47), 504.

N.C. Coastal Resources Commission's Science Panel on Coastal Hazards. 2010. North Carolina Sea Level Rise Assessment Report. NC Department of Environment and Natural Resources, Raleigh, NC.
