

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

DRAFT

Maritime Upland Forests

Ecosystem Group Description:

Woody vegetation on the barrier islands includes well-developed forests with canopies typically dominated by live oak, sand laurel oak, and loblolly pine; cabbage palms are a distinctive component in the Cape Fear area. It also includes the distinctive scrubby woody growth of stabilized sand dunes, dune swales, and sand flats. A few areas on the mainland shore of the sounds share the characteristic species of the barrier island maritime forests. The much rare Maritime Deciduous Forests are dominated by beech, American holly, loblolly pine and hickory on the northern barrier islands. Maritime forests have relatively low species richness, but a number of species are largely confined to these communities, at least in North Carolina. Such specialized species include yaupon, Carolina laurel cherry, and devilwood.

Salt spray is a major ecological influence on these communities. Where the vegetation is frequently exposed to salt spray, it is significantly stunted. The forest cannot persist in areas with the most severe salt spray and are dependent on the shelter of dunes for their occurrence. Maritime forests are also subject to the catastrophic disturbances of coastal storms, including high winds, erosion, and salt water flooding from storm tides and overwash.

Ecosystem Level Effects:

Predicted Impacts of Climate Change:

Climate Change Factor:	Likelihood:	Effect:	Magnitude:	Comments:
Coastal Erosion	High	Neg	High	Erosion of dunes may remove salt spray protection.
Wind Damage	High	Neg	High	
Storm Surge	High	Neg	Med	
Sea Level Rise -- Inundation	High	Neg	High	

While the climate is expected to be warmer, and rainfall change estimates vary widely, the most important effects on these systems will be rising sea level and an increase in storms. Most Maritime Upland Forest sites are more than 1 meter above sea level, and are unlikely to be directly inundated. Most occur on the widest, oldest, and most stable parts of the barrier islands. They are in the least likely places to be affected by new inlets. Riggs (2010 presentation to the Sea Level Rise symposium and personal communication 2010) indicates 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. Coastal erosion will likely reduce their extent. Increased hurricane activity, with storm surge into the lower portions, heavy salt spray, and wind throw, will increase mortality of trees and other components.

Predicted Ecosystem Responses:

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Latitudinal Change	High	Mix	Low	
Acreage Change	High	Neg	Med	
Structural Change	High	Neg	Med	Much uncertainty about magnitude of effect.

Increased natural disturbance by wind, salt spray, and storm surge intrusion will be significant, but the magnitude is quite uncertain. These communities consist of species that can recover from these disturbances, but increased frequency will result in younger canopies, more time spent in recovery stages, and shifts toward the most tolerant species. Some Maritime Forests will likely become Maritime Shrub and some Maritime Shrub will become grassland.

The acreage completely lost from this system by community shifts and destruction is very uncertain. It most likely will be moderate rather than catastrophic, but any loss will be very significant for these already-rare communities.

Warmer temperatures and milder winters may allow some species to migrate into these communities from the south. Species that reach their northern range limits in North Carolina, such as cabbage palm, rain lily, and coralbean, may appear in new sites. Species not now native here, such as slash pine, could potentially enter the state first in maritime forests. The arrival of new species native to these communities farther south should not be regarded as a negative effect. Some of North Carolina's species and community types may extend their ranges northward in Virginia. Many maritime plants disperse readily, but the naturally and artificially fragmented distribution of maritime forests may limit such latitudinal migration.

We may see inland spread of some characteristic maritime forest species, such as live oak and yaupon. This may allow communities such as Coastal Fringe Evergreen Forest to spread geographically. However, the widespread development in the coastal zone will limit opportunities for this.

Habitat Level Effects:

Natural Communities:

Third Approximation Name:	Comments:
Coastal Fringe Evergreen Forest	These communities occur on the mainland, in areas with little salt spray. They are mostly in the southern part of the state, where catastrophic loss of barrier islands is less likely. They may possibly spread inland with warmer temperatures, displacing longleaf pine communities or other hardwood forests, to the extent that land is available to them. Because many are low-lying, rising sea level may turn some into marshes or swamps.
Maritime Deciduous Forest	These communities are composed of less salt tolerant plants than the other maritime forests, and will be more susceptible to increases in salt spray.
Maritime Evergreen Forest	There will be net loss of these communities due to loss of protection from salt spray and other natural disturbances. The magnitude of loss is unclear, but these communities are already quite rare.

Maritime Shrub

Unlike the other communities, much Maritime Shrub occurs on narrow barrier islands that are likely to migrate rapidly or erode away completely. Many of these examples will be lost. They can develop rapidly, and may be able to re-form on some migrating islands. Even on more stable islands, there may be substantial movement of these communities, with those nearest the foredunes destroyed by erosion and storms and new ones appearing in the most exposed portions of Maritime Evergreen Forests. There will be a significant net loss of acreage of Maritime Shrub, but many examples should remain.

LHI Guilds:

Guilds with Significant Concentration in Ecosystem Group: Comments:

Dry-Xeric Maritime Forests and Scrub Thickets

Species Level Effects:

Plants	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	Status: US/NC	Comments:
Solidago villosicarpa	G1/S1	Yes		Yes	FSC/E	Extreme rarity makes this species particularly vulnerable.
Lejeunea dimorphophylla	G2G3/S1	Yes			/SR-L	
Zephyranthes simpsonii	G2G3/S1S2		Yes		FSC/E	
Carex calcifugens	G2G4/S2?				/SR-T	
Sideroxylon tenax	G3?/S1				FSC/SR-P	
Parietaria praetermissa	G3G4/S1				/SR-P	
Crocianthemum georgianum	G4/S1				/SR-P	
Cyperus tetragonus	G4?/S1				/SR-P	
Crocianthemum corymbosum	G4G5/S1				/SR-P	
Oplismenus hirtellus ssp. setarius	G5/S1				/SR-P	
Erythrina herbacea	G5/S2				/SR-P	This species is at the northern limit of its range in NC and may expand northward with milder winters, to the extent that landscape connections and habitat distribution allow it.
Syrrophodon incompletus	G5/S1				/SR-P	
Sabal palmetto	G5/S1				/SR-P	This species is at the northern limit of its range in NC and may expand northward with milder winters, to the extent that landscape connections and habitat distribution allow it.
Elymus virginicus var. halophilus	G5T5/S1				/SR-P	

Many rare species associated with this habitat are adapted for high light conditions and may benefit from increased wind damage by taking advantage of canopy gaps. Some species associated with this Ecosystem Group are at the northern end of their ranges in NC, but are more common farther south (though their habitat is threatened by climate change and development throughout the South). These species may expand

their populations and move northward with warmer winters, if seeds can be distributed to suitable habitat.

Terrestrial Animals

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/ Extirpation Prone	Status: US/NC/ WAP	Comments:
Litoprosopus futilis	G4/SU				/W3/	May spread northward with expansion of its host plant, cabbage palmetto.
Drasteria graphica	G4/S2S3				/SR/	A single population is known from the state at Carolina Beach State Park. The taxonomic status of this species needs work.
Catocala messalina	G4/S2?				/SR/	
Zale declarans	G5/S2S3				/SR/	
Papilio crespontes	G5/S2				/SR/	
Passerina ciris ciris	G5T3T4/S3B				FSC/SR/P	

Combined Threats and Synergistic Impacts:

Importance of Climate Change Factors Compared to Other Ecosystem Threats:

Threat:	Rank Order:	Comments:
Climate Change	1	Main threat to protected examples, and a major threat for unprotected examples.
Development	1	Biggest threat to unprotected examples.

Unprotected examples are likely to be destroyed by development before climate change effects become drastic. However, with most unprotected areas already destroyed, climate change effects are the greatest threats for most remaining examples.

Recommendations for Action:

Interventive Measures:

Intervention:	Importance:	Feasibility:	Comments:
Restore Extirpated Areas	Mediu	Low	Most extirpated areas are developed.
Protect/Expand Remaining Examples	Mediu	Medium	Limited intact unprotected examples remain, but these could be protected. [MFB: I would rate this high importance]

Humans may directly destroy most examples of this system in North Carolina before climate change has much of an effect. Protecting remaining examples will allow ecosystem processes related to climate change to gradually influence natural community composition and structure, and reduce the amount of catastrophic change resulting in outright destruction.

Ecosystem Group Summary:

While most Maritime Upland Forests are elevated enough that they are not subject to direct inundation under moderate sea level rise scenarios, associated effects of climate change are a major threat to them. For sites in conservation status, it is the greatest threat. But it is likely that some substantial portion of examples can survive. For areas not in conservation status, land development and conversion is the greatest threat and is likely to destroy all before climate change effects become substantial.

References:

Godfrey, P.J., and M.M. Godfrey. 1976. Barrier island ecology of Cape Lookout National Seashore and Vicinity. National Park Service Scientific Monograph Series No. 9.

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.
