

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

DRAFT

Coastal Plain Nonalluvial Mineral Wetlands

Ecosystem Group Description:

Nonalluvial mineral wetlands occur on flat, poorly drained areas of the outer Coastal Plain and occasionally in shallow depressions such as Carolina bays. The soils in these sites are saturated in the wetter seasons, may have shallow standing water, and do not experience overflow flooding. The wetness comes from poor drainage and sheet flow from adjoining peatlands. The soils are less acidic and infertile than the peat soils of pocosins, but they do not have the regular nutrient input of river floodplains. Organic deposits are generally lacking, though occasional examples are found on organic soils where some other factor offsets the tendency of these soils to support pocosins.

The three community types differ in wetness and in the nature of the soil. Nonriverine Swamp Forests occur in the wettest sites. They are dominated by trees tolerant of extreme wetness, such as bald cypress, swamp black gum, and red maple. A distinctive variant, transitional to peatland communities, has these species mixed with loblolly pine, pond pine, and Atlantic white cedar. Nonriverine Wet Hardwood Forests occur in less wet areas. They are dominated by trees typically called "bottomland hardwoods". The undergrowth is usually open beneath the closed canopy, but sometimes dense cane or shrubs occur. The Wet Marl Forest type occurs where marl or limestone occurs near the surface and affects the soil. Although they are wet, these soils are not acidic and are more fertile than most Coastal Plain soils. The vegetation is dominated by a diverse mixture of tree, shrub, and herb layers. Dwarf palmetto is an abundant and distinctive part of the shrub layer.

Ecosystem Level Effects:

Predicted Impacts of Climate Change:

Climate Change Factor:	Likelihood:	Effect:	Magnitude:	Comments:
Mild Winters	High	Mix	Low	Mild winters may allow more southern species to move in.
Flooding	Med	Mix	Low	Increased storm intensity may create local rainwater flooding but is unlikely to have much effect in these flood-tolerant communities.
Fire	Low	Neg	High	Droughts may increase the risk of wild fire, but most examples are not very flammable.
Drought	Med	Neg	Low	Increased drought may allow upland species to invade, but this likely will be offset by wet periods.
Wind Damage	High	Neg	Med	Increased hurricane and severe storm intensity would increase canopy damage.
Sea Level Rise -- Inundation	High	Neg	High	Substantial areas are at low elevations and may be submerged or changed to other communities by rising sea level.

The Climate Wizard median temperature model (Maurer et al., 2007) predicts a rise in average annual temperature in northeastern North Carolina of around 3.5 degrees by 2050. The average annual rainfall

model predicts a decrease of only 2 inches. The rainfall values in the different models range from an increase of 16 inches to a decrease of 16 inches. An increase in severe storms and in droughts may also be important.

Rising sea level will be important for some sites and not for others. The large expanses of nonriverine wetlands around the Alligator River and in other places around the sounds lie at low elevation. Rising sea level will bring tidal waters into much of this area, turning it into tidal wetlands and causing a large net loss of area of nonalluvial wetlands. More inland examples are unlikely to be affected by rising sea level, but some may be indirectly affected by reduced drainage or rising water tables in the surrounding areas.

Warmer temperatures are likely to have only limited impact. Most of the species in these communities range well to the south, and their occurrence here is not limited by temperature. A few more southern species may be able to migrate into them, if the warmer winter temperatures are accompanied by a reduction in the severity of extreme cold events.

Nonriverine wetland hydrology is driven by rainfall, sheet flow, and seasonal high water table. Water is never limiting, and droughts would have to be extremely severe to create water stress in them. However, chronic drought, if not punctuated with wet periods, would allow upland species to invade. The species pool is tolerant of wetness, but increased wetness during major storms might stress some species. Drought may increase the risk of wild fire. Most of the vegetation is not very flammable, and fire is not very likely, but uncontrollable wild fire in severe drought could do substantial damage to forests.

Increased severity of wind in storms would create more canopy gaps and reduce the average age of canopy trees. Storm-related impacts to the Wayne's race of the black-throated green warbler could be particularly severe, since it is canopy-dwelling species that is often found in the vicinity of tall conifers, probable nesting sites, that emerge above a canopy of hardwoods (Fussell et al., 1995).

Predicted Ecosystem Reponses:

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Structural Change	Med	Neg	Med	Increased wind disturbance will create more canopy gaps and lower canopy tree age.
Compositional Change	Med	Mix	Low	
Acreage Change	High	Neg	High	Substantial acreage will be lost, particularly in the northern Coastal Plain

Impacts to the non-riverine swamps and hardwood stands in the Albemarle-Pamlico Peninsula, which include the largest blocks of habitats of this Ecosystem Group in the state, are likely to be catastrophic. These stands are unlikely to be replaced by the development of new stands located farther inland.

Habitat Level Effects:

Natural Communities:

Third Approximation Name:	Comments:
Nonriverine Swamp Forest	These communities are the most extensive in the group. Large expanses lie near sea level and would be affected by rising water. However, large acreage is inland and is not threatened by rising sea level.

Nonriverine Wet Hardwood Forest

Examples are very rare, isolated, and are threatened more by human actions than by climate change. Because they are the driest communities in this group, drought may be more likely to allow invasion of off-site species into them. This community type is somewhat threatened by invasive plants, and reduced wetness may allow this to increase.

Wet Marl Forest

This extremely rare community is completely isolated, and is fragmented. Increased drought may exacerbate the damage done by drainage of the surrounding area, which has so far not caused severe damage. This community type is highly threatened by invasive plants, but it is unclear that climate change would make this problem any worse.

LHI Guilds:

Guilds with Significant Concentration in Ecosystem Group: Comments:

Wet-Mesic Hardwood Forests

Wet Hardwood Forests

Wet Acidic Shrublands

Forested Floodplains and Non-Riverine Wet Flats

Forest Canebrakes

Cypress-Gum Swamp Forests

The guilds associated with this Ecosystem Group have significant amounts of habitat along river floodplains and peatlands. With the exception of a small number of guild members, loss of non-riverine swamps and hardwoods would constitute major losses of habitat but would probably not imperil the guilds overall.

Species Level Effects:

Plants

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	Status: US/NC	Comments:
Chasmanthium nitidum	G3/S1				/SR-T	The two populations in NC are at the northern range limit of this species. The total number of known occurrences globally is below 100. This Southeastern Coastal Plain endemic is rare at the northern and westernmost edges of its range in North Carolina, South Carolina and Alabama.
Trillium pusillum var. pusillum	G3T2/S2	Yes		Yes	FSC/E	
Scirpus lineatus	G4/S2				/SR-P	
Cornus asperifolia	G4/S1				/SR-P	
Carya myristiciformis	G4/S1				/E	
Ruellia strepens	G4G5/S1				/SR-P	
Ponthieva racemosa	G4G5/S2				/SR-P	
Arenaria lanuginosa var. lanuginosa	G5T4T5/S1				/SR-P	

Many rare species in this Ecosystem Group reach their northern range limits in NC, and are extremely rare in NC. Extirpation within NC could significantly reduce the overall ranges of these species.

The extreme rarity of some of the species in this theme makes them vulnerable to extirpation, however, climate change is not expected to contribute more of a threat than other existing pressures.

Terrestrial Animals

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/ Extirpation Prone	Status: US/NC/WAP	Comments:
<i>Anacamptodes cypressaria</i>	G2G4/SU				/SR/	Appears to be primarily associated with non-riverine stands of cypress
<i>Hypomecis longipectinaria</i>	G2G4/S3S4				/W3/	
<i>Catocala lincolnana</i>	G3/S2S3		Yes		/SR/	
<i>Argillophora furcilla</i>	G3G4/S2S3				/W3/	
<i>Orgyia detrita</i>	G3G4/S2S3				/SR/	
<i>Myotis austroriparius</i>	G3G4/S3				FSC/SC/P	
<i>Cerma cora</i>	G3G4/S2S3				/SR/	
<i>Franclemontia interrogans</i>	G3G4/S3?				/SR/	
<i>Dysgonia similis</i>	G3G4/S2S3				/SR/	
<i>Corynorhinus rafinesquii macrotis</i>	G3G4TNR/S3				FSC/T/	
<i>Callosamia securifera</i>	G4/S2S3				/SR/	
<i>Catocala orba</i>	G4/S2S3		Yes		/SR/	
<i>Cisthene kentuckiensis</i>	G4/SU				/W3/	
<i>Acrapex relictus</i>	G4/S3				/W3/	
<i>Dasychira atrivenosa</i>	G4/S3?				/W3/	
<i>Dendroica cerulea</i>	G4/S2B				FSC/SR/P	
<i>Limnothlypis swainsonii</i>	G4/S3B				/W2,W5/P	
<i>Papaipema sp. 3</i>	G4/S3S4				/W3/	
<i>Spilosoma dubia</i>	G4/S3S4				/W3/	
<i>Tolype minta</i>	G4/S2S3				/W3/	
<i>Cleora projecta</i>	G4/S3?				/W3/	
<i>Xestia youngii</i>	G5/S3S4				/W3/	
<i>Pseudacris brimleyi</i>	G5/S3S4				/W1/P	
<i>Rana sylvatica</i>	G5/S5		Yes	Yes	//	A relict population of this primarily montane and northern species occurs on the Albemarle-Pamlico Peninsula, where it appears to be associated with non-riverine hardwood forests.
<i>Anhinga anhinga</i>	G5/S3B				/W2/P	
<i>Ambystoma opacum</i>	G5/S5				//P	
<i>Catocala blandula, Southeastern form</i>	G5T3/S1S3				/W3/	
<i>Dendroica virens waynei</i>	G5TU/S2S3B	Yes		Yes	FSC/SR/P	Appears to be restricted to non-riverine swamp forests. Populations in the Albemarle-Pamlico Peninsula are under high threat of extirpation due to sea-level rise. Populations in the southern Coastal Plain are probably more secure.

Apameine, New Genus 4, Species 1	GNR/S2S3	/SR/	Recently described as <i>Lascopia roblei</i> . Only known from the North Carolina Coastal Plain and an adjoining area of the Great Dismal Swamp in Virginia.
Apameine, New Genus 2, Species 3	GNR/S2S3	/SR/	Only known from the North Carolina Coastal Plain and the Dismal Swamp in Virginia.

The Wayne's race of the black-throated green warbler (*Dendroica virens wayneii*) is nearly confined to non-riverine swamp forests throughout its narrow range from Virginia to South Carolina. This taxon is declining throughout its range and loss of the population on the Albemarle-Pamlico Peninsula, believed to be the largest remaining, due to rising sea-levels would significantly reduce the chances of its survival overall.

Even more likely to become extirpated is the sole population of wood frogs (*Rana sylvatica*) known to occur in the Coastal Plain of North Carolina. This population exists on the Albemarle-Pamlico Peninsula in the vicinity of the Scranton Hardwoods and likely represents a relict from the Pleistocene, as do several other animals and plants recorded in this area (e.g., cranberry, sundew moth, undescribed shrew). The reasons for its restricted range in this area are unknown, but it may not be able to migrate inland to keep pace with sea-level rise.

Other terrestrial vertebrates and invertebrates associated with this Ecosystem Group occupy other types of habitat, including floodplain forests and peatlands, and are more likely to survive impacts associated with climate change. Two species of canebrake moths, however, are endemic to the North Carolina Coastal Plain plus the portion of the Great Dismal Swamp in Virginia: *Lascopia roblei* and the still-undescribed Apameine, New Genus 2, Species 3. Some of their largest known populations are associated with non-riverine habitats, the loss of which would be significant, if not as damaging as for the black-throated green warbler.

Combined Threats and Synergistic Impacts:

Importance of Climate Change Factors Compared to Other Ecosystem Threats:

Threat:	Rank Order:	Comments:
Climate Change	1	
Flood Regime Alteration	1	
Logging/Exploitation	1	
Invasive Species	2	
Conversion to agriculture/sylvicu	2	

Unprotected examples continue to be destroyed or degraded by logging, with or without conversion to pine plantation. While conversion to agriculture and pine plantation was a major destroyer of many kinds of communities in the past, it remains more of an ongoing threat for these than for most wetlands. Logging and conversion are threats to most examples that are not formally protected from them, including to some on public lands. The effect of increased wind damage with climate change will exacerbate the alteration in canopy structure caused by logging.

Much of the protected acreage is in low elevation areas that are particularly threatened by rising sea level. Areas in Dare and Tyrrell Counties are already being converted to tidal communities and this effect is likely to

accelerate. Hydrological alteration, in the form of ditches, increases the threat of rising sea level. Ditches bring tidal water into low-lying examples, causing it to penetrate inland into the nonalluvial wetlands.

Invasive species are currently a significant problem only in the rarer community types. It is unclear if the changing climate will be suitable for additional invasive species. Several potential threats, including Chinese tallow tree (*Triadica sebifera*) and gypsy moth (*Lymantria dispar*) may become significant even if the climate does not change.

Recommendations for Action:

Interventive Measures:

Intervention:	Importance:	Feasibility:	Comments:
Control Invasive Species	High	Medium	Highly important for the minority of examples that are severely affected.
Protect/Expand Remaining Examples	High	High	There is a special need to protect more inland examples, as much of the protected acreage is threatened by rising sea level.
Restore/Maintain Hydrology	High	High	Control of tide water penetration with tide gates is one of the most feasible protective measures for any community. Restored drainage will also reduce the risk of damaging wild fires.

Ecosystem Group Summary:

Climate change is a significant threat to Coastal Plain Nonalluvial Mineral Wetlands primarily because of the likelihood of inundation from sea level rise. However, other threats such as logging and the alteration of hydrology in the form of ditches, pose equal threats to these systems. Rising sea level will be more of a concern in the larger riverine wetlands at lower elevations, such as those around the Alligator River, than wetlands further inland. Recommendations to restore or maintain hydrology, protect remaining Coastal Plain Nonalluvial Mineral Wetlands, and control invasive species in these areas in order to intervene against climate change effects are all relatively feasible.

References:

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- 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.