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

DRAFT

Piedmont and Coastal Plain Mesic Forests

Ecosystem Group Description:

Mesic forests occur on sites that are moist but not wet. In the Piedmont these are generally north-facing slopes, sheltered ravines, or high terraces on the edges of floodplains. In the Coastal Plain, mesic forests occur in similar sites and also on moist portions of broad upland flats and on small island ridges surrounded by swamps. These sites are naturally sheltered from the fires that are a major natural shaper of vegetation in the Coastal Plain.

Mesic sites are among the most favorable environments for plant growth. They tend to support dense forests dominated by moisture-loving nonwetland trees such as beech, tulip poplar, and red oak. They usually have well-developed understory, shrub, and herb layers. They often contain species that are common in the mountain parts of the state or farther north but are rare in the southern Piedmont and Coastal Plain. Some species may be disjunct long distances from cooler areas. At least some of these disjuncts are remnants of wider distributions in the past, such as during the cooler, moister climate of the Ice Age.

Mesic Mixed Hardwood Forest communities occur on mesic sites that have typically acidic soils. The much rarer Basic Mesic Forests occur on soils that are neutral to slightly basic in pH. They are more diverse than the Mesic Mixed Hardwood Forests and they have species that require high pH. The Coastal Plain and Piedmont subtypes cannot be separated by any particular species, but differ in their overall flora. Several distinctive variants are recognized in the Coastal Plain, including the Swamp Island, Mesic Flat, and Bluff/Slope variants of Mesic Mixed Hardwood Forest, and the Terrace Slope and Marl Outcrop variants of Basic Mesic Forests.

Ecosystem Level Effects:

Predicted Impacts of Climate Change:

Climate Change Factor:	Likelihood:	Effect:	Magnitude:	Comments:
Flooding	Med	Neg	Low	Limited in extent, confined to lower portions of mesic sites.
Wind Damage	High	Neg	High	Increased hurricane intensity and number of severe storms
Mild Winters	High	Mix	Low	
Hot Spells	High	Neg	Med	
Drought	High	Neg	Med	

The Climate Wizard mid model temperature increase is about 4 degrees by 2050, in the Asheboro area (Maurer et al., 2007). The cmd model predicts an increase of 4.5 degrees. The mid value rainfall forecast is

for a slight increase, but there is substantial variation among the models: anywhere from a decrease of 13 inches to an increase of 18 inches per year. Some models predict that rainfall will be concentrated during the fall, and there will be increased droughts in the spring and summer. This may reflect an expectation of increased hurricane activity rather than well-distributed rainfall.

The importance of drought and hot spells in mesic sites is unclear. Most of these sites are mesic because of topographic sheltering such as north-facing slopes or deep ravines. These sites are buffered from extremes of weather. However, because they contain many species that are not adapted to hot and dry conditions, they may suffer stress from even slightly drier conditions.

There may be an increase in natural fires (due to increased drought and higher average temperatures), but landscape fragmentation and fire suppression practices likely will continue to prevent most fires from spreading very far in the Piedmont and in the dissected lands in the Coastal Plain where mesic forests occur. Mesic forests occur in sites sheltered from most fires, but wild fire during drought may increase the likelihood or severity of fires in them.

An increase in hurricanes or other severe storms likely would increase wind damage in forests.

Predicted Ecosystem Reponses:

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Compositional Change	Med	Mix	Low	
Structural Change	High	Neg	Med	
Exotic species invasion	Med	Neg	Low	The disruptions caused by climate change are likely to exacerbate existing invasive species problems.
Acreage Change	High	Neg	Low	Mesic microsites are likely to shrink.

The severity of climate change effects on these sheltered sites is uncertain. It is expected that the boundary with drier communities will shift, so that peripheral portions are lost, smaller or more marginal examples may be lost, and the total acreage will shrink. Under more natural conditions, the boundary between mesic and drier communities was likely determined by fire. It is likely that both Piedmont and Coastal Plain mesic forests have expanded into marginal sites since fire has been suppressed, and thus some shrinkage probably represents a return to more natural conditions. This also suggests that the resulting smaller patches may be more resilient than might otherwise be expected. Changes may be gradual, resulting from shifts in competitive relationships. Established individuals have substantial ability to weather stressful periods if they are not too long. However, fire or severe wind damage may cause more rapid shifts in some places.

These communities occur in specialized microsites and are unlikely to migrate. However, in natural landscapes, patches occur fairly close together and species can migrate among patches. Mesic communities currently occur well to the south, in much warmer climates. It is likely that some species may be able to move into our examples from the south. However, in the current fragmented landscape of the Piedmont and of Coastal Plain uplands, it is unclear how much migration will occur. These communities often support species disjunct from cooler areas, and some of these species may be lost. However, many of these populations appear to be Pleistocene relicts that survived the Hypsithermal period, and appear to have potential to persist.

If severe storms and intense hurricanes increase, increased wind damage to canopy trees may change the structure of the communities, reducing average tree size and age and leaving more of the forest in canopy

gaps. These changes are likely to be small compared to the effects of logging, but will exacerbate them. If wind throw stimulates salvage logging, this will further increase the damage to natural areas.

Exotic plants are presently a problem in some mesic forests but not most. Japanese honeysuckle (Lonicera japonica), Japanese stiltgrass (Microstegium vimineum), Autumn olive (Eleagnus umbellata), princess tree (Paulownia tomentosa), and tree-of-heaven (Ailanthus altissima) are often present in nearby floodplains or disturbed areas, and have been known to invade mesic forests following canopy opening. The disruptions caused by climate change may accelerate this effect.

Although we are not aware of any identified problems from phenological disruption, there may be higher potential for it in these communities than others, because they have many spring ephemeral plants.

Habitat Level Effects:

Natural Communities:

Third Approximation Name:	Comments:
Basic Mesic Forest (Coastal Plain Subtype)	These communities are very rare and most examples are widely separated. Little migration of their distinctive species is likely to be possible.
Basic Mesic Forest (Piedmont Subtype)	Basic Mesic Forests support more species than Mesic Mixed Hardwood Forests, and are more likely to contain Pleistocene relicts. Because basic sites are rarer, occurrences are more isolated from each other and their characteristic species are less likely to be able to migrate. Basic Mesic Forests are much more susceptible to invasion by exotic plants, and to any increase caused by increased natural disturbance.
Basic Mesic Forest	
Mesic Mixed Hardwood Forest (Coastal Plain Subtype)	Coastal Plain Mesic Mixed Hardwood Forests occur in a variety of settings. Some are driven by topography, but even in these, seepage may be as important as microclimate in creating mesic conditions. They are sheltered from drought, but may be stressed by it anyway. Other examples are on low-lying flats or swamp islands, where drought may have more effect on them.
Mesic Mixed Hardwood Forest (Piedmont Subtype)	Most of these communities are driven by topographic microsites. They are likely to shrink from the edges but few will completely disappear.

LHI Guilds:

Guilds with Significant Concentration in Ecosystem Group:	Comments:
Rich Bottomland and Basic-Mesic Hardwood Forests	
Piedmont Wet-Mesic Hardwood Forests	
Mesic Hardwood Forests	

The Piedmont Heath Bluff Guild (also discussed under Low Elevation Cliffs and Rock Outcrops) is likely to be severely affected by increased temperatures, drought, and fire. Other guilds are also likely to be adversely affected but are less subject to local extirpations.

Species Level Effects:

Plants

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/ Extirpation Prone	Status: US/NC	Comments:
Schisandra glabra	G3/S1		Yes		/T-SC	Only two occurrences are known in NC.
Eurybia mirabilis	G3/S3				FSC/SR-T	
Brachythecium rotaeanum	G3G4/S1				/SR-D	
Trillium pusillum var. virginianum	G3T2/S1				FSC/E	
Magnolia macrophylla	G5/S2				/SR-P	
Hexalectris spicata	G5/S2				/SR-P	
Euonymus atropurpureus	G5/S2				/W7	
Corallorhiza wisteriana	G5/S1S2				/SR-O	
Carex basiantha	G5/S1				/SR-D	
Solidago radula	G5?/S1				/SR-P	

Plants associated with this Ecosystem Group are expected to be particularly vulnerable to droughts and invasive species invasion. The sites where they occur are topographically quite sheltered, so this may mitigate the effects of droughts somewhat.

Terrestrial Animals

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/ Extirpation Prone	Status: US/NC/ WAP	Comments:
Hypomecis longipectinaria	G2G4/S3S4				/W3/	
Papaipema rutila	G4/S1S3		Yes		/W2/	Currrently known in North Carolina from a record from Island Creek in the Croatan National Forest
Cordulegaster erronea	G4/S3?				/W2/	
Autochton cellus	G4/S2				/SR/	
Scopula ordinata	G5/S2S3		Yes		/W3/	Trillium feeder. Known in the Coastal Plain only from Greenbank Bluff. Occurs more widely in the mountains.
Hemidactylium scutatum	G5/S3				/SC/P	
Eurycea guttolineata	G5/S5				//P	
Pyreferra ceromatica	GU/S1S3				FSC/SR/	

Coastal Plain populations of two Pleistocene relict moths are likely to be strongly affected by increased drought, heat, windthrows, and fire associated with climate change.

Combined Threats and Synergistic Impacts:

Importance of Climate Change Factors Compared to Other Ecosystem Threats:

Threat:	Rank Order:	Comments:
Development	1	
Logging/Exploitation	1	
Invasive Species	2	
Climate Change	3	

The greatest threats to mesic forests are those coming from ongoing land use. While a number of examples are protected in parks or other natural areas, or have limited use because of steep slopes, the majority of examples remain under threat. Destruction and indirect effects such as fragmentation and edge effect result from land development in suburban areas and even in many rural areas. Many of the known examples in the outer Coastal Plain have been destroyed in the last several decades. Logging severely alters canopy structure and composition, and is a threat to all but the steepest unprotected examples. Invasive plants are a present and increasing threat. Both development of nearby areas and logging increase the potential for invasion.

Climate change is less of a threat than these ongoing concerns, but will exacerbate some of them. Wind damage is often more severe in forests if there are adjacent openings such as logged or developed areas. If more intense storms increase flood heights, this will affect lower lying mesic forests. Increased storm disturbance will increase the potential for exotic plant invasion, especially if a seed source is present in nearby developed or disturbed areas, or has already entered the community.

Recommendations for Action:

Interventive Measures:

Intervention:	Importance:	Feasibility:	Comments:
Preservation of Riparian Buffers/Floodplains	Low	High	Will help protect lower portions of mesic sites from excessive flooding
Restore/Maintain Landscape Connections	Mediu	Medium	
Control Invasive Species	High	Medium	
Protect/Expand Remaining Examples	High	High	

For unprotected examples, protection from development and logging is the most important measure that can be taken. Without it, many, if not most, examples will be degraded or lost well before the climate has changed appreciably. Protection of larger natural areas that include adjacent communities will lead to greater viability for all communities present. For protected and unprotected sites, control of exotic plants that are present or may potentially invade is very important.

Protection or restoration of adjacent areas and of landscape connections, often adjacent stream corridors, will benefit protected examples and will help improve their viability in the face of the changing climate. As mesic forests shrink, connection to other patches will become more important for species that need large areas of habitat and those that have fluctuating populations. Landscape connections may also facilitate the

movement of native species from farther south. Having natural vegetation free of exotic species as buffer will reduce the likelihood that natural disturbances will lead to invasion.

Protection of riparian buffers and floodplains and protection of mesic forests will be mutually beneficial. In the Piedmont, mesic forests often occur in the riparian buffer and most others occur on slopes near streams. Protection of mesic forests will also increase protection of streams. In addition, better protection of streams from the extremes of rainfall will reduce the increase in flood disturbance in the lower portions of mesic forests. Floodplain forests have more severe invasion by exotic plants, but reducing artificial disturbance in them will help reduce the severity of invasion there.

Ecosystem Group Summary:

The greatest threats to Piedmont and Coastal Plain Mesic Forests are those from development and logging. Although expected threats associated with climate change are the least significant to these forests, increased wind damage, droughts, and warmer temperatures may alter their structure and size. To reduce the possible impacts from climate change, protection or restoration of landscape connections to allow migration is most important. These sites often occur in riparian areas and floodplains, and protection of these sites which will be dually beneficial to nearby streams.

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.