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

DRAFT

Mafic Glades and Barrens

Ecosystem Group Description:

The communities in this Ecosystem Group are non-forested communities that occur on relatively flat outcrops of unusual, high pH rock types. All have vegetation kept open by the physical structure and chemistry of the rock and are characterized by unique combinations of widespread plants as well as by rare species.

Ultramafic Outcrop Barrens occur on dunite, peridotite, or serpentinite. These rocks are associated with unusual vegetation and endemic species throughout the world because of their unusual chemistry. NC's only well-developed Ultramafic Outcrop Barrens is an open savanna-like community with a scattered pitch pine canopy and grassy ground cover. The single known High Elevation Mafic Glade community occurs on a flat exposure of amphibolite in Ashe County. Lichens, including a species found nowhere else (Cladonia psoromica), dominate much of the area. Herbs on thin soil mats and in crevices include both lowland species and northern disjunct species. Woody species occur in deeper soils and crevices. Diabase Glades occur in the Piedmont over outcrops of diabase and potentially over other mafic rocks. As with other glade communities, the soil and vegetation are patchy and range from nearly bare rock to patches deep enough to support trees. The vegetation includes many species shared with other high pH soil communities and some species found on Granitic Flatrocks.

Ecosystem Level Effects:

Predicted Impacts of Climate Change:

Climate Change Factor:	Likelihood:	Effect:	Magnitude:	Comments:
Fire	Med	Pos	Med	Low intensity fires may benefit these communities, but climate change may bring higher potential for wildfires to be severe.
Wind Damage	Med	Pos	Low	
Drought	High	Pos	Low	
Increased Temperature	High	Neg	Low	

This group includes communities in both the Piedmont and Mountain regions. Piedmont examples are less rare, but a couple of the community type occur only in the Mountains. The Climate Wizard (Maurer et al., 2007) mid model temperature increase is about 4 degrees by 2050, in the Asheboro area. 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 in the fall.

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.

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

Predicted Ecosystem Reponses:

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Structural Change	Med	Mix	Med	More open canopy is likely.
Compositional Change	Low	Pos	Low	These communities have been substantially altered by fire suppression, and some of these changes may shift them toward more natural composition.
Acreage Change	Low	Pos	Low	May expand into adjacent forests.

All of these communities are tied to specialized sites, and are unable to migrate.

Species adapted to mafic glade habitats are tolerant of drought and heat. These communities have not been substantially damaged by the most severe droughts of recent times, and may weather them better than most. Drought appears to be an important factor keeping these communities from become dense forests. However, these are among the driest sites in the Piedmont region. If droughts become much more extreme, they may be beyond the tolerance of some of the species present. If trees die, it will create more open conditions that may favor herbaceous growth. Because lack of fire has caused increased canopy density, climate change may help offset recent alterations. Drought may also allow them to expand into adjacent forests, though this expansion is likely to be limited by soil conditions.

Trees are likely to die in extreme droughts or high intensity fires. Canopies may become more open, which may cause herb layers to become more vigorous. If fire frequency increases, it will enhance these effects. These communities have been substantially altered by fire suppression, which tends to suppress the herb layer and favor tree growth, so some of the changes associated with climate change may shift them more toward more natural composition, and may even allow these communities to expand.

Fire is believed to be a natural part of these communities. If wild fires increased, it might benefit them. However, fires during severe drought may be too intense and may cause damage to canopy trees. Most examples are now in fragmented landscapes where fires are unlikely to spread. If increased drought inhibits prescribed burning, it will be more harmful than beneficial.

Examples of glades in the Mountains will likely respond differently. Though still drought tolerant, they are adapted to a cooler, moister climate. Though they likely will weather drought well, they may be more susceptible to alteration than Piedmont glades.

Habitat Level Effects:

Natural Communities:

Third Approximation Name:	Comments:
Ultramafic Outcrop Barren	These communities are tied to specialized soils. They may be able to expand a little only marginal areas.
Diabase Glade	The few examples of this community are limited to small areas, but increased drought may allow them to expand at their t margins.
High Elevation Mafic Glade	This is an extremely rare community type, with only 3 examples known globally. All are isolated and will need to adapt in place.

LHI Guilds:

No guilds are currently defined that have a high concentration of their habitat within this Ecosystem Group. For animal species, Mafic Glades and Barrens are probably best regarded as a minor component of the more general Dry-Xeric Mixed Forests, Woodlands, and Barrens Guild.

Species Level Effects:

Plants

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/ Extirpation Prone	Status: US/NC	Comments:
Marshallia sp. 1	G1/S1	Yes		Yes	FSC/SR-L	This species is known from only two sites; 1 is historical, the other is in a protected powerline.
Cladonia psoromica	G1/S1	Yes		Yes	FSC/SR-L	This species is known only from a few sites in NC. The extreme rarity and habitat specialization of this species makes it vulnerable to extinction.
Scleria sp. 1	G1/S1	Yes	Yes	Yes	FSC/SR-L	The extreme rarity of this species makes it vulnerable to extinction.
Symphyotrichum rhiannon	G1/S1	Yes		Yes	FSC/SR-L	The extreme rarity of this species makes it vulnerable to extinction.
Phemeranthus sp. 1	G1?/S1?	Yes		Yes	/E	This species occurs only in very few diabase glades in NC and VA.
Symphyotrichum depauperatum	G2/S1		Yes		/SR-D	This species may benefit from increased burning and canopy openings.
Echinacea laevigata	G2G3/S1S2	Yes			E/E-SC	This species may benefit from increased burning and canopy openings.
Delphinium exaltatum	G3/S2				FSC/E-SC	
Viola appalachiensis	G3/S2				/SR-T	

Ruellia purshiana	G3/S2	/SR-O	
Parnassia grandifolia	G3/S2	FSC/T	
Weissia sharpii	G3/S1?	/SR-O	
Allium allegheniense	G3?/S1	/SR-T	
Pseudognaphalium helleri	G3G4/S3	/SR-P	
Parthenium auriculatum	G3G4/S2	/SR-T	This species might particularly benefit from droughts that would reduce competition from woody species.
Echinacea pallida	G4/S1	/SR-D	
Crocanthemum propinquum	G4/S1	/SR-P	
Liatris squarrulosa	G4G5/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Liatris aspera	G4G5/S1	/SR-P	This species may benefit from increased burning and canopy openings.
Polygala senega	G4G5/S2	/SR-D	
Silphium terebinthinaceum	G4G5/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Dichodontium pellucidum	G4G5/S2	/SR-P	
Scutellaria leonardii	G4Q/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Gentianopsis crinita	G5/S1	/E-SC	
Scirpus pendulus	G5/S1	/SR-O	
Rhytidium rugosum	G5/S2	/SR-P	
Phlox subulata	G5/S1	/SR-P	
Crocanthemum bicknellii	G5/S1	/SR-P	
Muhlenbergia glomerata	G5/S1	/SR-P	
Fleischmannia incarnata	G5/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Ruellia humilis	G5/S1	/T	This species may benefit from increased burning and canopy openings.
Gillenia stipulata	G5/S2	/SR-P	
Lithospermum canescens	G5/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Matelea decipiens	G5/S3	/SR-P	This species may benefit from increased burning and canopy openings.
Packera paupercula var. appalachiana	G5/S1	/SR-P	
Packera paupercula var. paupercula	G5/S1?	/SR-P	
Sporobolus heterolepis	G5/S1	/E	
Poa saltuensis	G5/S1	/SR-P	
Solidago ptarmicoides	G5/S1	/E	This species may benefit from increased burning and canopy openings.

Solidago rigida var. glabrata	G5T4/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Symphyotrichum laeve var. concinnum	G5T4/S2	/SR-P	This species may benefit from increased burning and canopy openings.
Lilium philadelphicum var. philadelphicum	G5T4T5/S2	/SR-P	
Linum sulcatum var. sulcatum	G5T5/SH	/SR-P	
Elymus trachycaulus ssp. trachycaulus	G5T5/S1	/SR-P	
Deschampsia cespitosa ssp. glauca	G5T5/S1	/SR-P	This species may benefit from increased burning and canopy openings.

Most or all rare plants in this group are likely to benefit from more canopy openings and more fire. Climate change is not expected to be a significant threat, and may even improve or create more habitat. Most are tolerant of drought. It is not known how close the characteristic species are to their tolerance limits in the most extreme sites. Given that more mesophytic species invade many examples, they probably could tolerate more severe conditions than currently occur. However, extreme weather might be a threat to some species on some sites.

Cladonia psoromica grows in moist depressions in amphibolite flatrock primary successional area, but requires seasonally saturated thin soils. Hydrologic changes may pose a threat, either through increased wetness leading to shrub invasion, or more likely, through drought. The tolerance of this species to hydrologic changes is not known.

Many rare species associated with this habitat are tied to basic soils and are unlikely to migrate far.

Combined Threats and Synergistic Impacts:

Importance of Climate Change Factors Compared to Other Ecosystem Threats:

Threat:	Rank Order:	Comments:
Development	1	
Logging/Exploitation	2	
Fire	3	Fire suppression has been a major factor degrading some of these communities.
Climate Change	4	Low threat.

Climate change is not expected to be a major threat for these communities. Development, logging, habitat fragmentation, and changes caused by fire suppression are the most severe threats. In some areas, excessive deer browse is also a major threat. Climate change appears less of a threat.

Recommendations for Action:

Interventive Measures:

Intervention:	Importance:	Feasibility:	Comments:
Conduct Prescribed Burns	Mediu	High	Burning will restore more natural forest structure, and will favor species that will tolerate drought and wild fire better.
Protect/Expand Remaining Examples	High	High	Protect remaining examples and surrounding forests.

Burning will restore more natural forest structure, and will favor species that will tolerate drought and wild fire better. Fire suppression has shifted these communities toward denser vegetation and more mesophytic plant composition than would naturally occur, making them more susceptible to climate change. Burning would increase their resilience to warmer climate and drought, as well as make them less prone to destruction by wild fire. Prescribed burning will have to account for younger canopies whose trees may be more susceptible to fire than in the past.

Ecosystem Group Summary:

Mafic Glades and Barrens may actually benefit from a changed climate, at least among the Piedmont examples This benefit will only be realized if sites are protected from other forms of destruction, and for most, if fire is restored to them. These communities are naturally rare in North Carolina, due to limited availability of suitable habitat. Examples need to be protected and managed appropriately.

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.