

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

DRAFT

## Granitic Flatrocks

### Ecosystem Group Description:

Granitic Flatrock communities occur on flat to gently sloping exfoliated outcrops of granitic rocks in the Piedmont. They are scattered along the Piedmont from Virginia to Alabama. The rock outcrop is generally flush with the surrounding soil and has only minor irregularities. These communities are somewhat related to the Granitic Dome communities of the upper Piedmont and Mountains. Like them, the vegetation of the flatrocks is sparse and very patchy. On bare rock, soil mats that accumulate in moss clumps undergo a gradual development, deepening and being invaded by a succession of plants.

A number of characteristic plants, some found in no other communities, occur in flatrocks. Typical species include Selaginella, Small's portulaca, sandwort, ragwort, elf orpine, and Talinum. A number of species are also shared with eroded old fields, including broomsedge, buttonweed, and ragwort. Deeper soils may support woody species such as eastern red cedar, Virginia pine, and fringe tree. Developing soil mats are apparently periodically pulled up by uprooted trees, recreating open bare rock surface and allowing the flatrock to maintain itself in the long term. Small depressions in the rock surface hold water in the winter but become dry in summer. They contain their own characteristic specialized flora, including Isoetes piedmontana, Utricularia juncea, and a peat moss. More permanently wet areas occur in seepage zones at the edge of adjacent soils.

### Ecosystem Level Effects:

#### Predicted Impacts of Climate Change:

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

Wind Damage	Med	Pos	Med	
Drought	Med	Pos	Med	
Fire	Med	Neg	High	
Increased Temperature	High	Pos	Med	

The Climate Wizard mid model temperature increase is about 4 degrees by 2050 (Maurer et al., 2007), in the Asheboro area, midway between the two major clusters of granitic flatrocks. 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.

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.

**Predicted Ecosystem Responses:**

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Exotic species invasion	Med	Neg	High	
Structural Change	Med	Pos	Low	
Compositional change	Med	Pos	Low	

Granitic Flatrocks are tied to specialized sites and cannot migrate. Communities will change in situ but it is uncertain how much.

Species adapted to granitic flatrock habitats are relatively tolerant of drought and heat. Drought will kill trees on edges and soil islands. This already happens in current droughts, and is part of the mechanism keeping flatrocks open. Increased length or severity of droughts might cause flatrocks to expand at the expense of adjacent shallow-soil woodlands. Increased frequency of droughts without increased severity would presumably prevent trees on edges from getting as old, but allow them to persist in the same zones. Amount of bare outcrop and shallow soil mats may increase at the expense of deeper mats. A few additional flatrocks may be opened up by wind throw or drought mortality. Increased storms may blow down trees and pull up soil mats more frequently.

An important question is whether drought will harm the characteristic herbs. These species tolerate drought at present, or grow in the moist early growing season. It is unclear if they are at the margin of their tolerance, or whether they could withstand longer or more severe droughts. This could be determined by observing the effect of droughts under current climate. Seasonal distribution of rainfall may be important, and may affect different species differently. Drought in spring would be detrimental, while drought in other seasons might not be.

Granitic Flatrocks have significant problems with invasive plants, at least in edge zones. Climate change will probably not make invasion worse, but drought disturbance of surrounding woodlands and edges may make them more susceptible. It is possible that some of the invasive species, such as *Lonicera japonica* and *Murdannia keisak*, will be harmed by drought more than the native species.

The central parts of Granitic Flatrocks are unlikely to burn even in droughts. Fire could affect the dry woodlands that form the edge zone of the flatrocks. However, most flatrocks occur in fragmented landscapes where fire is unlikely to spread. They are likely altered by lack of fire.

**Habitat Level Effects:**

**Natural Communities:**

Third Approximation Name:	Comments:
Granitic Flatrock	

## LHI Guilds:

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

## **Species Level Effects:**

<u>Plants</u>	Element Rank:	Endemic	Major Disjunct	Extinction/Extirpation Prone	Status: US/NC	Comments:
Campylopus oerstedianus	G1G3/S1		Yes	Yes	/SR-D	Found in the US only in Wake County, NC. Vulnerable due to extreme rarity and specialized habitat.
Panicum lithophilum	G2G3Q/S1				FSC/SR-T	Restricted to granite outcrops in NC, SC, and ec. GA; extremely rare, but taxonomy is in dispute.
Sedum pusillum	G3/S1				/E	Drought stress in spring a concern. There may be some risk of disruption of phenology and de-coupling of pollinators.
Portulaca smallii	G3/S2				/T	Drought stress in summer is a concern. Possibly a risk of disruption of phenology and de-coupling of pollinators.
Isoetes piedmontana	G3/S2				/T	Uses wet pools. Drought stress is a concern.
Phacelia maculata	G3G4/S1				/SR-P	This species has been found in NC only one time. May be extremely vulnerable due to rarity and specialized habitat.
Cyperus granitophilus	G3G4Q/S2				/SR-T	Occurs on outer margins of flatrocks. May be secure if ecotone moves, but may be subject to drought-induced tree death or wind throw on margins. This may be harmful, if it destroys soil mats, or may be beneficial if it kills trees and offers less competition.
Minuartia uniflora	G4/S1				/E	Shallow soil mats. Drought stress in spring a concern. Possibly a risk of disruption of phenology and de-coupling of pollinators.
Trichostema setaceum	G5/S2				/SR-T	
Isolepis carinata	G5/S1				/SR-P	

An important question is whether drought will harm the characteristic herbs. These species tolerate drought at present, or grow in the moist early growing season. It is unclear if they are at the margin of their tolerance, or whether they could withstand longer or more severe droughts. This could be determined by observing the effect of droughts under current climate. Seasonal distribution of rainfall may be important, and may affect different species differently. Drought in spring would be detrimental, while drought in other seasons might

not be.

More southerly flatrock species could find their way to our flatrocks. Flatrocks are naturally isolated, so migration is presumably very limited. However, presence of characteristic species across a number of widely separated outcrops suggests some potential for dispersal. Because we don't know the mechanism of such low-probability dispersal, we don't know how, or whether, to facilitate it. Planting of species to facilitate movement of species to new locations is probably not appropriate. It is more important to protect good quality flatrocks, with the goal of protecting the range of variability, as well as the locations for future colonization and dispersal.

## **Combined Threats and Synergistic Impacts:**

### **Importance of Climate Change Factors Compared to Other Ecosystem Threats:**

Threat:	Rank Order:	Comments:
Mining	1	
Development	1	
Invasive Species	2	
Climate Change	3	

Other threats include recreational damage (trampling), loss of ecotones, and loss of surrounding forest matrix.

## **Recommendations for Action:**

### **Interventive Measures:**

Intervention:	Importance:	Feasibility:	Comments:
Control Invasive Species	High	Medium	
Protect/Expand Remaining Examples	High	High	Recreational damage threatens protected sites.

In addition to bringing more examples into conservation status, there is a need for further protection of some conserved flatrocks from trampling, trash dumping, and other damage.

## **Ecosystem Group Summary:**

The effects of climate change are very uncertain. Extreme droughts and bad timing of droughts may cause the shallow soil pockets to become unsuitable for rare species.

## 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.

---