### Background 1:

- Xeric to subxeric coniferous forests and woodlands of the Southern Appalachian Mountains with a substantial component of yellow pine species have declined in area during recent decades because of fire suppression, drought, and outbreaks of southern pine beetle.
- The net result of these processes has been a shift in many yellow pine stands to dominance by drought-tolerant broadleaved trees and shrubs. More widespread decline of yellow pine communities from vulnerable to imperiled prompted us to reconsider their existing classification, given the important supporting role of classification in conservation efforts.
- Even prior to widespread decline of yellow pine communities, classification efforts were hampered by their dynamic nature and their trend to intergrade with a variety of other communities.

### Methods 1 – Data compilation:

- **NC State University Data-Base:** 20,000+ vegetation inventory plots
  - Plots from Mountains (plus a few from Blue Ridge foothills in NC)
  - Plots from SC, GA, TN, NC, and VA
  - Plots with >= 10% combined cover of four yellow pines
- **CVS Database:** 554 plots meeting all criteria
  - Soil plots from CVS data base
  - Topographic homogeneity (554 plots with 87% topographic homogeneity)
  - 117 plots with 87% topographic homogeneity
  - Editing using supervised fuzzy clustering
  - Editing using unsupervised fuzzy clustering
  - Plot management using unsupervised fuzzy clustering results as a guide
- **Additional data sources:**
  - Extract subset of Associations CEGL025500, CEGL077215, CEGL077077, and CEGL065605 for more intensive study of “core” types
  - 157 plots with 273 core

### Methods 2 – Analytical:

- **Fuzzy clustering:** A non-hierarchical numerical clustering method that determines the probability that a given plot belongs to a predefined set of classes, including a “noise” class for outliers (Table 3).

### Background 2:

- We seek to maintain, to the extent possible, the existing Associations that were based on professional best judgement, but using quantitative data and modern analytical tools: outlier analysis and editing
- Our purpose is to refine the US National Vegetation Classification’s treatment of dry coniferous forests and woodlands (of the Southern Appalachian Mountains: A reassessment [ESA OPS-1-13])
- The net result of these processes has been a shift in many yellow pine stands to dominance by drought-tolerant broadleaved trees and shrubs. More widespread decline of yellow pine communities from vulnerable to imperiled prompted us to reconsider their existing classification, given the important supporting role of classification in conservation efforts.
- Even prior to widespread decline of yellow pine communities, classification efforts were hampered by their dynamic nature and their trend to intergrade with a variety of other communities.

### Results:

- **Table 1:** Study of tree species of the Southern Appalachian Mountains: the four species illustrated, all in the “yellow pine” subgenus except white pine. The four yellow pines, singly or in combinations, are dominants and co-dominants of the plant communities of interest.

### Background 3:

- The U.S. National Vegetation Classification for dry coniferous forests and woodlands (USNVC) as shown in the “Core plot” column. We used supervised fuzzy clustering to cast the plots into the 14 Associations, resulting in a posteriori (final) classification in which some plots were retained in their original Association (“in” column), assigned to other Associations (“other” column), or assigned to the noise class (“noise” column). Fuzzy clustering was used in the vegclus package in R (© 2017 The R Foundation for Statistical Computing).

### Conclusions:

- Many prior plot assignments were erroneous; fuzzy clustering is an objective tool for plot reassessment of these plots to existing classes and recognition of plots that are either transitional or not representative of existing Associations.
- Both NMS ordination and hierarchical clustering revealed that the four “core” yellow pine Associations are broadly overlapping in compositional space, but that they also supported existing concepts for these Associations.

- The principal compositional trends among the four “core” yellow pine associations appear associated with elevation. This and other environmental relationships will be further investigated using the available environmental data for these plots.