

Which seed sources for longleaf pine ecosystem restoration?

Joan L. Walker

USFS Southern Research Station



Need for ecologically suitable seed for restoring longleaf pine communities



- Plant materials that will thrive in a restoration project
- Plant materials that do not threaten indigenous populations, conserve genetic resources
- Functional traits of interest are those that affect capacity to establish from seed in restoration projects

The safe solution

- Select seed sources from the closest possible location and collect from a site that physically matches the target site. ('Local is Best')
- May minimize risks of getting individuals maladapted to the restoration site, but provides no guidance for seed sources for wider distribution.

Recipe for success...

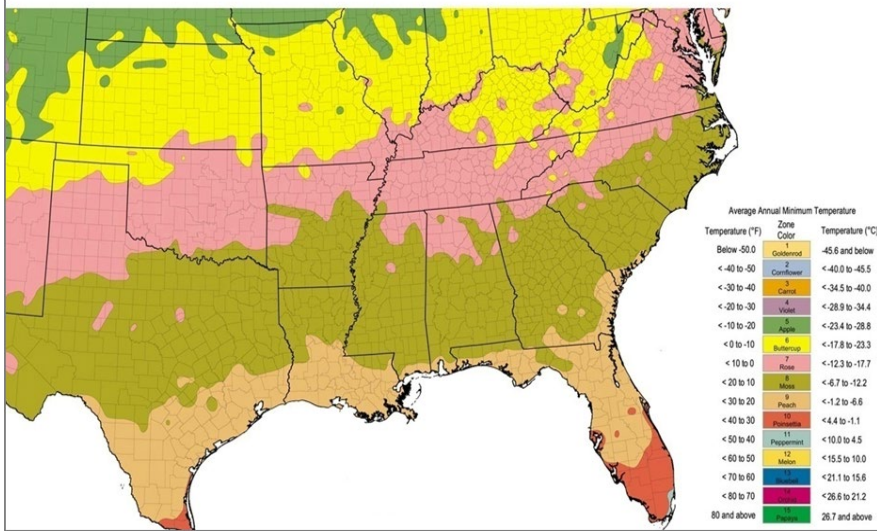
Dry
upland
seed



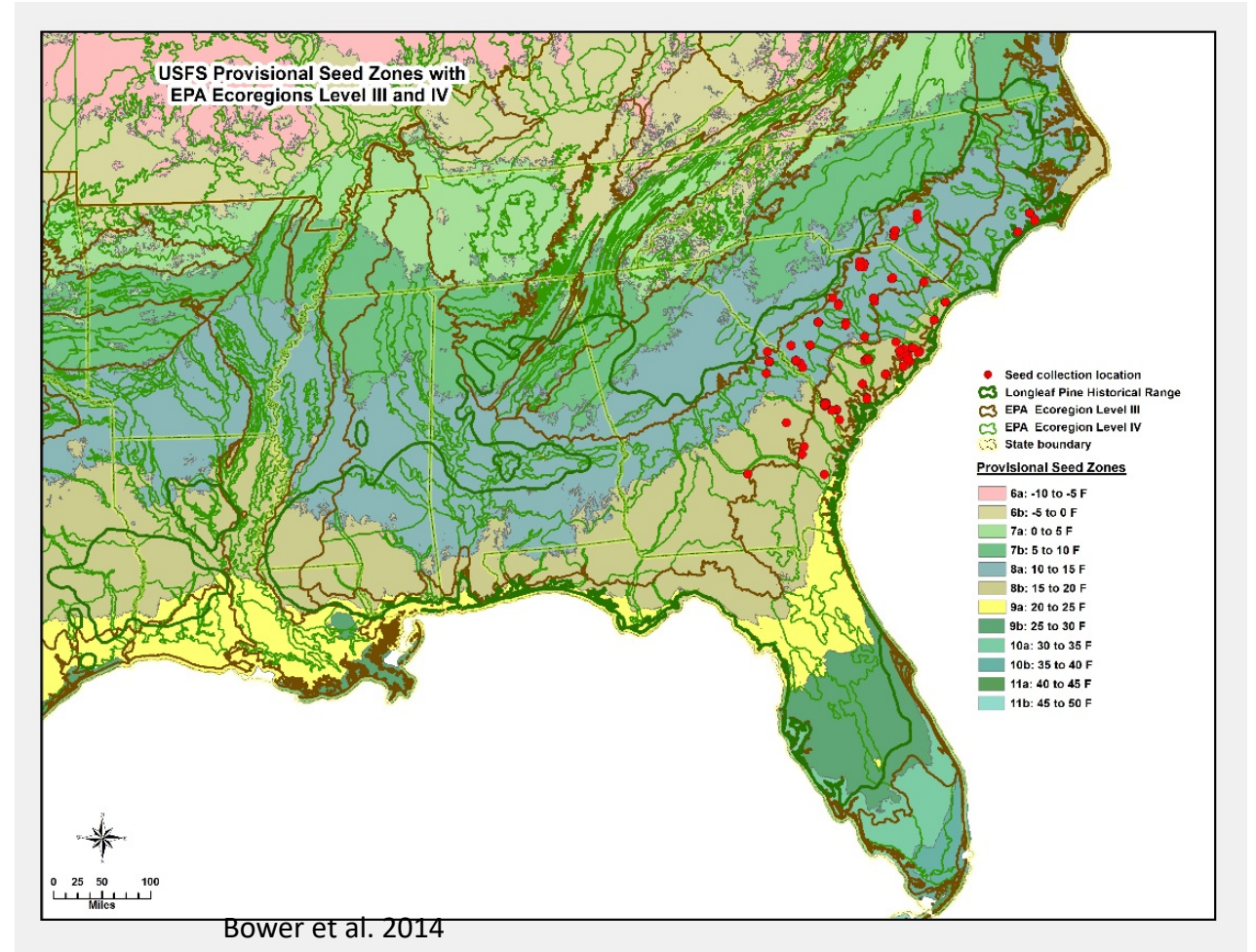
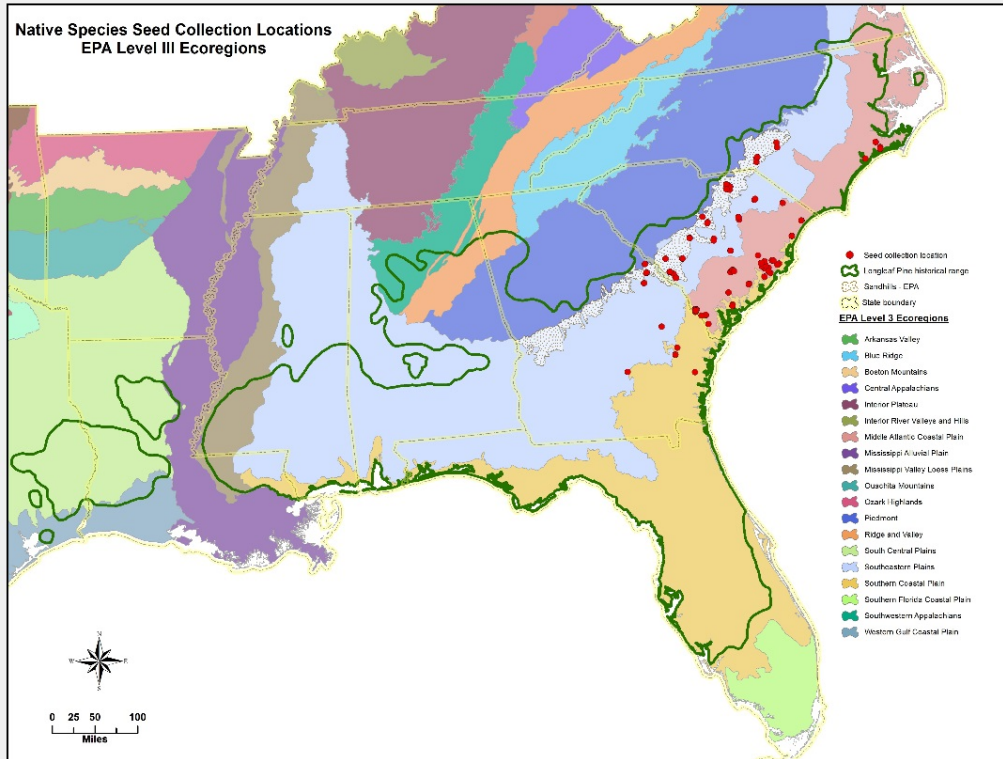
Nearby
dry
upland
site



USDA Plant Hardiness Zone Map for the Southeastern United States



General Seed Zones



Applicability in SEUS to be determined with garden studies

Patterns in Endemism may be telling us something important...

An ecoregion model for biodiversity conservation planning... The Nature Conservancy

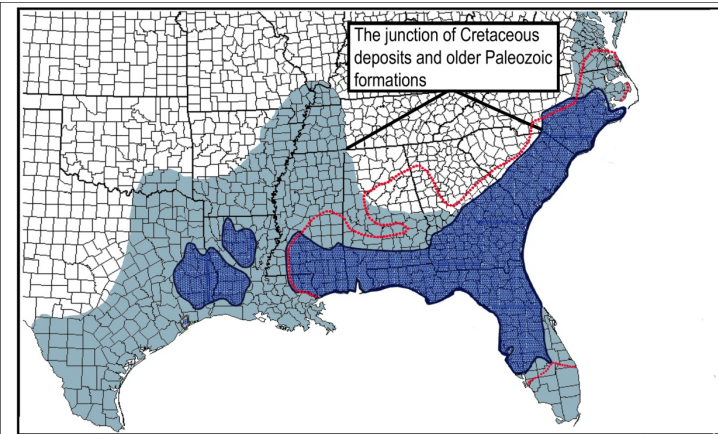


Figure 8. Phytogeographic pattern #18. Dark blue stippled area: core region of longleaf pine (*Pinus palustris*). Red dotted line: area of discontinuous or disjunct occurrences of longleaf pine. After Ware, Frost, and Doerr (1993). Light blue: Atlantic Coastal Plain, Gulf Coastal Plain, including the entire Mississippi Embayment. Adapted from Sorrie & Weakley (2001).

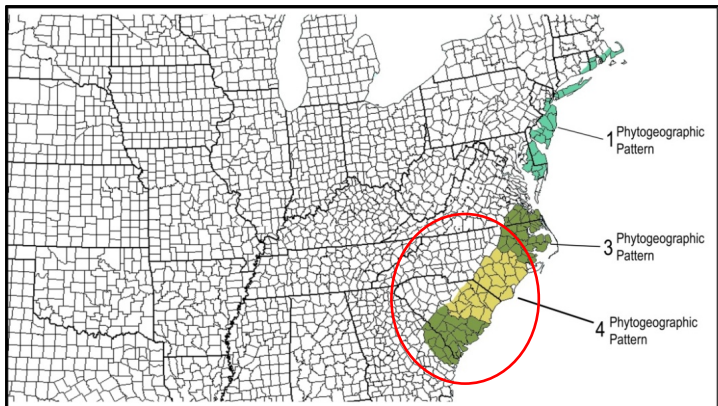


Figure 2. Phytogeographic patterns #1, #3, and #4. #1 (light blue): southeastern Massachusetts to southern New Jersey and adjacent Delmarva Peninsula. #3 (green): southeastern Virginia to southeastern Georgia. #4 (tan): southeastern North Carolina to northeastern South Carolina. Adapted from Sorrie & Weakley (2001).

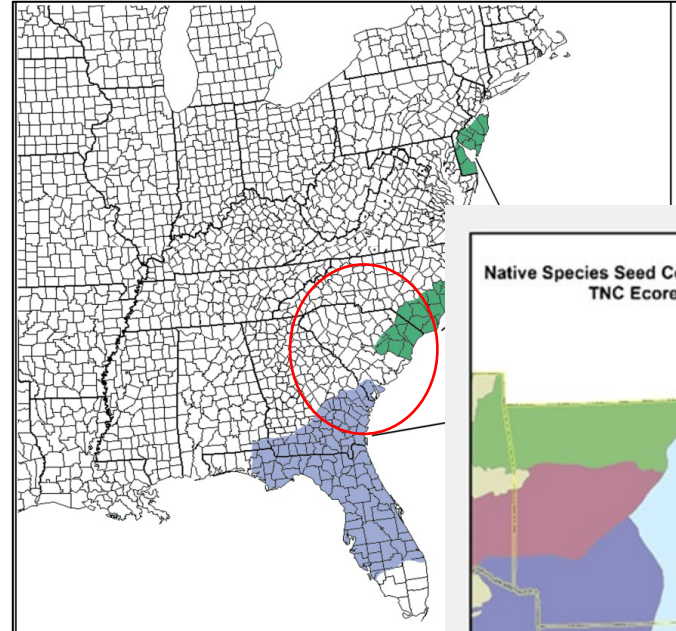
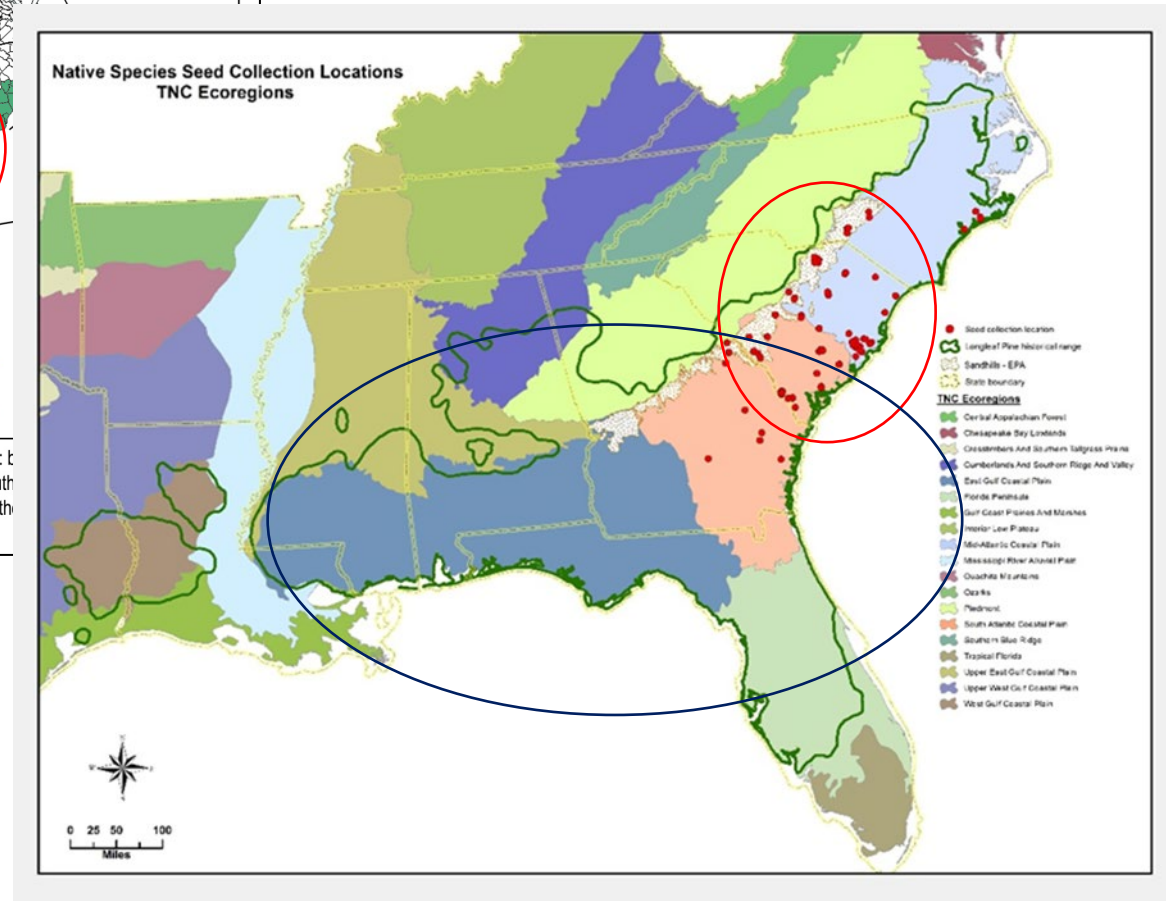
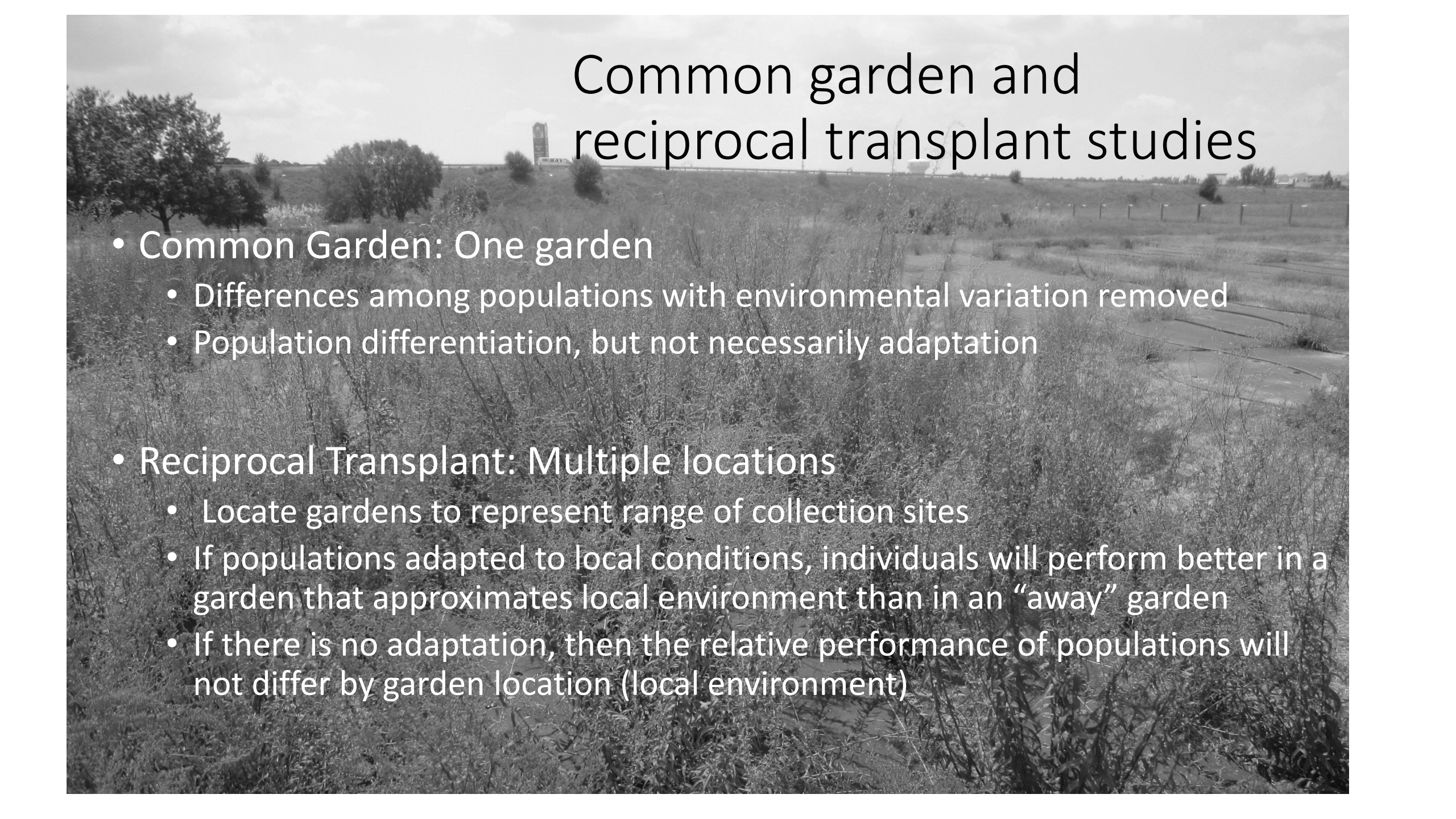


Figure 3. Phytogeographic pattern #2 and #6. #2 (green): Delaware/eastern North and South Carolina. #6 (blue): south Florida westward to the central panhandle of Florida and south. Adapted from Sorrie & Weakley (2001).





Common garden and reciprocal transplant studies

- Common Garden: One garden
 - Differences among populations with environmental variation removed
 - Population differentiation, but not necessarily adaptation
- Reciprocal Transplant: Multiple locations
 - Locate gardens to represent range of collection sites
 - If populations adapted to local conditions, individuals will perform better in a garden that approximates local environment than in an “away” garden
 - If there is no adaptation, then the relative performance of populations will not differ by garden location (local environment)

Common garden and reciprocal transplant studies

- Which species? What are selection criteria?
- Which populations? How many?
- Seed collection? Who will do it? Field protocols?
- How will be seed be stored, cleaned, tested?
- How to produce plant materials for the garden?
- Where is/are the gardens? Criteria? How many?
- What traits will be measured? Methods? Timing?

Grasses, composites, legumes



Schizachyrium
scoparium



Sorghastrum elliotii



Pityopsis graminifolia



Aristida stricta



Lespedeza capitata

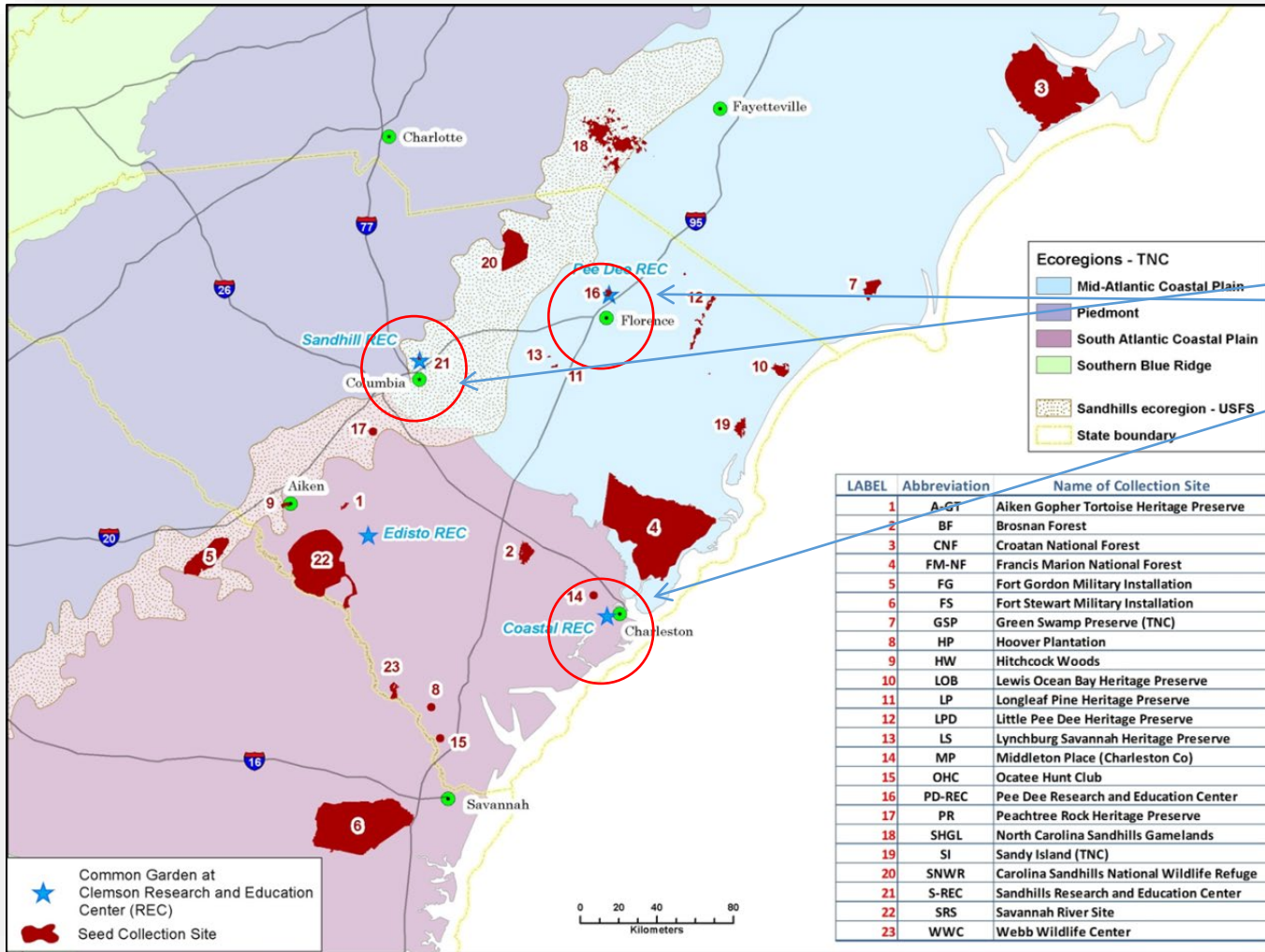


Solidago odora



Tephrosia virginiana

3 Gardens



3 Garden locations

- MACP, middle coastal plain
- MACP, sandhills
- SACP, outer coastal plain
- Clemson University Research and Education Centers (REC)

Garden Installation

Sites were
experimental fields

Fallow at least 1 year
prior to garden
establishment

Not tilled

Landscape fabric laid
down for weed
control, moisture
retention



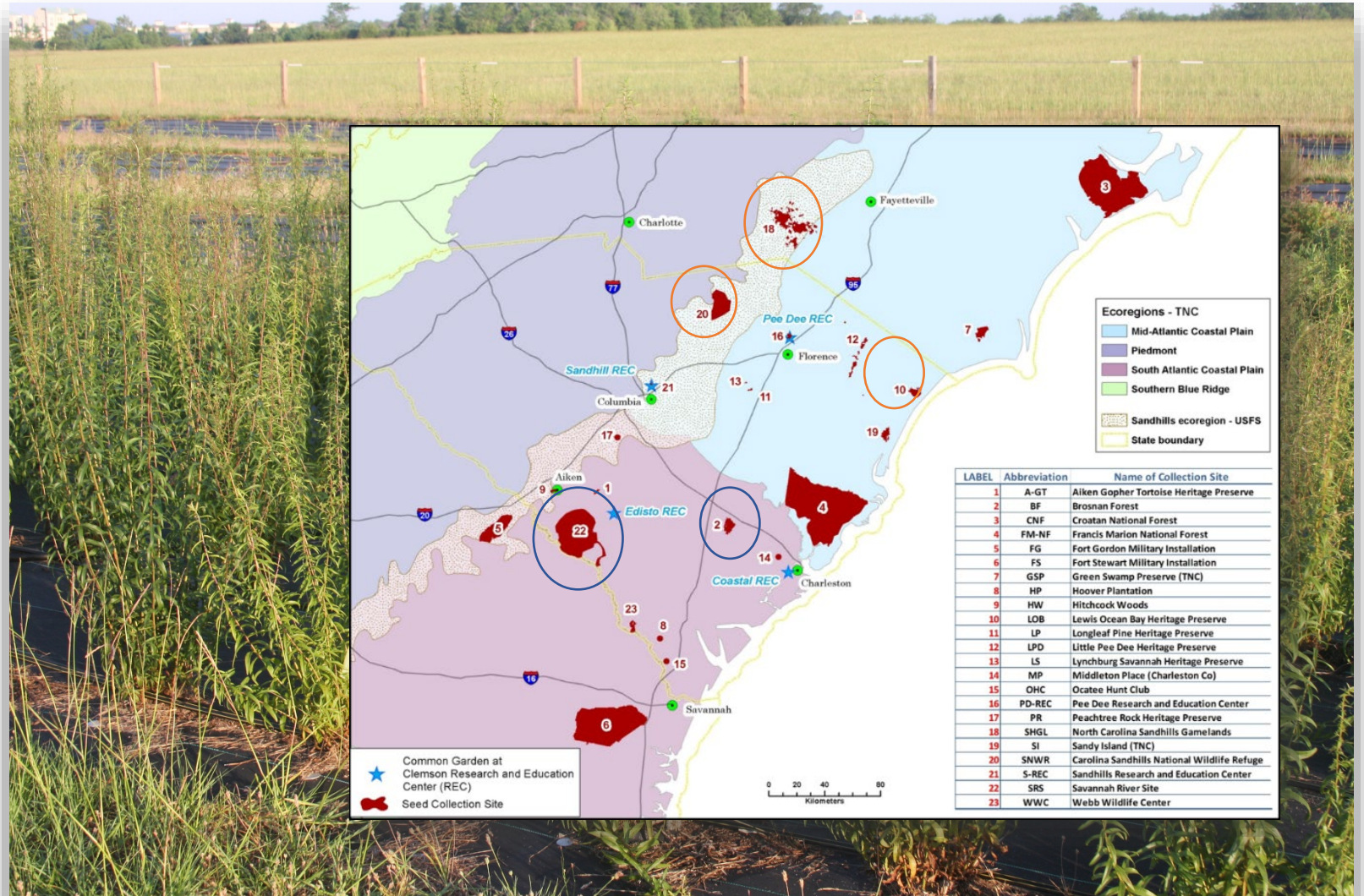
What to measure?

- Traits that may be related to success in the target planting area
 - Height growth (competitive edge), growth rates, seed size (estb success), drought tolerance (WUE, isotope ratios), phenology (growth season),
 - response to fire (bud bank, morphology)
- Phenology
- Reproduction
- Growth form/size
- Leaf metrics-Physiology



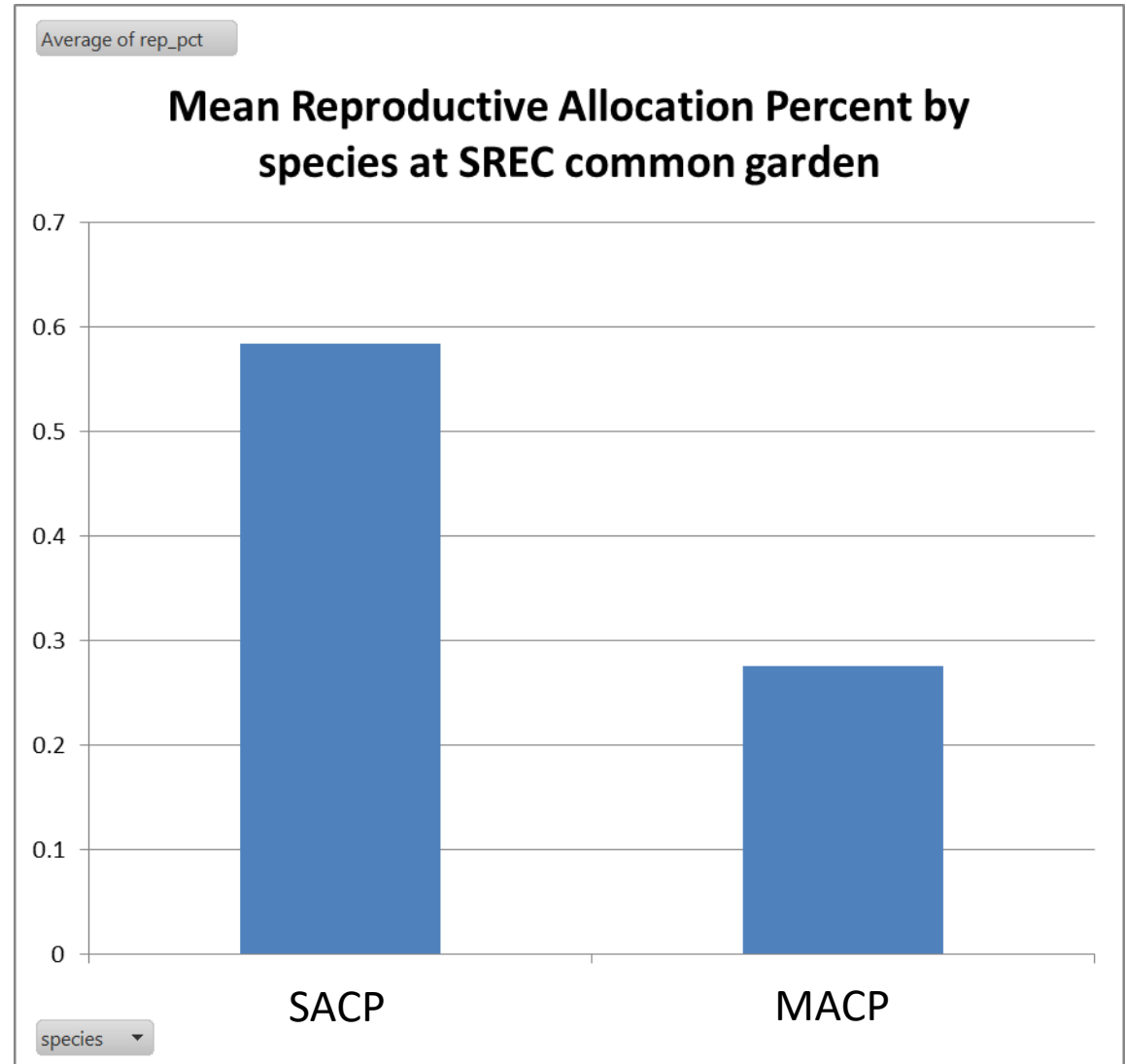
Results – Northern *Solidago* populations flower earlier

- 9 populations in the garden
 - 4 Middle Atlantic CP
 - 5 Southern Atlantic CP
- LOB, SHGL, SNWR flower mid-July
- Initiated flowering
 - PDREC, FG, WC, AGT
- Veg only - SRS, BF



Results – *Aristida* spp reproductive effort

- Northern wiregrass (*A. stricta*) - MACP
- Southern wiregrass (*A. beyrichiana*) - SACP



More information, more of the LLP range

RESEARCH ARTICLE

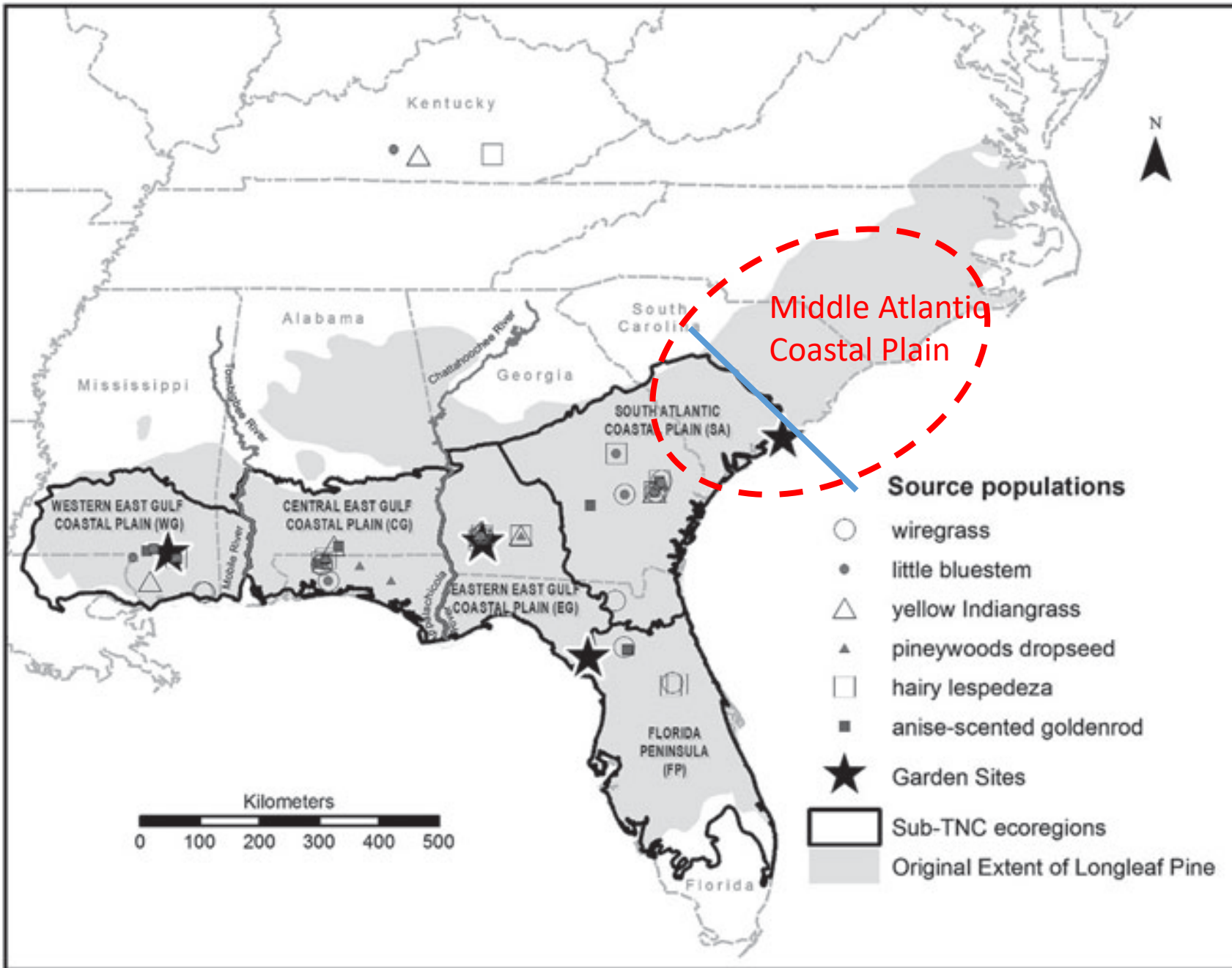
Seed sourcing for longleaf pine ground cover restoration: using plant performance to assess seed transfer zones and home-site advantage

Lisa M. Giencke^{1,2}, R. Carol Denhof³, L. Katherine Kirkman¹, O. Stribling Stuber¹, Steven T. Brantley¹

Seed sourcing is a concern for restoration practitioners in all regions and habitats. The possibility that plants are most suited to their home environments due to genetic adaptations to local biotic and abiotic conditions prompts questions of how far plant material can be moved from home sites and remain ecologically appropriate in a restoration setting. We tested a suite of provisional seed transfer zones at multiple geographic scales to assess their ability to capture potentially adaptive genetic variability among populations in the southeastern United States. Furthermore, we examined the effects of seed source and phenotypic plasticity on plant performance and whether locally sourced individuals have adaptive advantages relative to more distantly sourced individuals. With a reciprocal transplant and a common garden study, we show that, although seed source is the best predictor of differentiation in plant performance, performance differences among populations across larger seed transfer zones within the longleaf pine ecosystem are relatively minor. These findings suggest that consideration of larger seed zones within the longleaf pine ecosystem that are also more logistically and economically viable is warranted. However, earlier flowering of individuals from seed sourced outside the longleaf pine ecosystem suggests that moving plant material greater distances is more likely to result in phenological mismatches between plants and pollinators. Species-specific differences, however, indicate there is insufficient evidence to support a recommendation for a single set of seed transfer zones within the southeastern United States for all species.

Key words: common garden, ecotype, genetic variation, longleaf pine ecosystem, reciprocal transplant experiment, seed transfer zones

- Similar species
 - 4 grasses (wiregrass, pineywoods dropseed, little bluestem, yellow Indiangrass)
 - 1 legume (Hairy lespedeza hirta)
 - 1 composite (anise-scented goldenrod)
- Similar traits measured
- Overlapping time frame
- East-West gradient, 4 ecoregions



Some results

- Populations differed, but differences across zones relatively minor
- Found that “northern” populations flowered much earlier

The “new” seed zone map & Restoration

- Most variation occurs within populations, less across zones
- Some observed differences likely related to differences in local habitats
- Differences North-South strong, even within LLP range
- Implications for Restoration
 - Relatively broad seed transfer zones are probably fine for most species
 - Select source materials from habitat similar to project site
 - Moving long N-S distances may result in phenological mismatches between species and pollinators

Factors that influence seed source decisions

More conservative/LOCAL



- Narrow endemic species
- Little long distance gene flow
 - Insect pollinated
 - Gravity dispersed
- Historically fragmented
- High quality habitat

More relaxed/LONGER DISTANCE

- Widely distributed species
- Extensive long-distance gene flow
 - Wind pollinated
 - Wind dispersed
- Recently fragmented
- Highly disturbed/degraded

What seed is available?

- **Collect your own**

- Suitable source site available
 - Nearby, similar environment, relatively undisturbed, abundant desirable species
- Time to prepare site
 - Burn in spring prior to collection
- Equipment to collect larger quantities?

- **Purchase native seed**

- Source-identified
- Collection date, cleaning and storage procedures



Is it okay to mix seed sources? Yes...

Type	Definition	Uses
Strictly local	Within restoration site	
Relaxed local	Multiple sites matched environmentally	
Composite sourcing	Mixing seed from near and intermediate distance (or habitat match) within natural gene flows	
Admixture sourcing	Mixing many populations from across range and habitat types	

Take home lessons about seed sourcing from longleaf groundcover restoration...

- Provisional seed zones have been developed
 - North – South differences are most evident
 - Take care in moving seed from south to north
- Conservative seed sourcing is more important for some plants than others: narrowly endemic species, rare species, insect-pollinated, gravity dispersed species
- Using multiple seed sources in the same project is okay (e.g. from multiple sites)
- Sometimes you just have to take what you can get: collect your own, purchase source-identified seed from reputable producers



QUESTIONS?