SEED PRODUCTION STRATEGIES FOR SOUTH TEXAS

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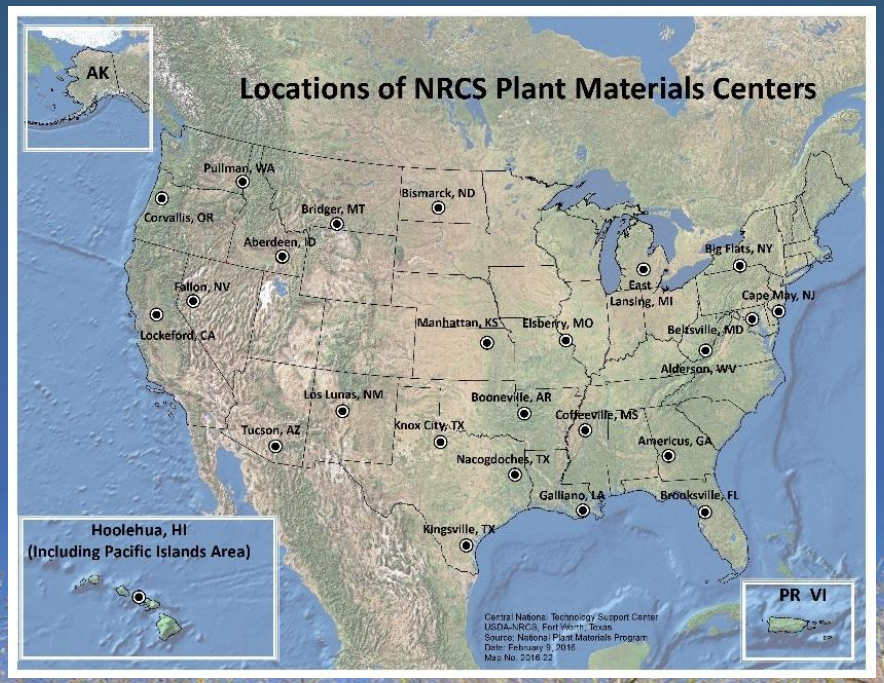
E. "Kika" de la Garza Plant Materials Center

- A Division of the Natural Resources Conservation Service
  - 25 Centers across the US
  - Develop plant releases and technology to meet conservation needs



E. "Kika" de la Garza Plant Materials Center

- Our Program Emphasis:
  - Rangeland Habitat Restoration & Enhancement
  - Soil Health Improvement
  - Insect/Pollinator Habitat
  - Coastal Habitat Restoration & E
  - Erosion Control & Water Quality Improvement
  - Biofuels

South Texas Natives

- Initiated in 2000 to promote and facilitate the commercial availability of native seed for the restoration and reclamation of habitat in South Texas

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South Texas Natives

E. "Kika" de la Garza Plant Materials Center

- Our Role:
  - Store Collections
  - Evaluate Collections/Accessions
  - Select Accessions for Commercial Release
  - Establish Small Seed Increase Nurseries
    - To provide seed to growers for commercial availability

South Texas Natives Model

- Based on the Iowa Ecotype Project
- Working Premise:
  - A Mixture of Seed with Broad Genetic Base from Environments Similar to the Target Environment (Ecoregion) Would Favor Sustainable Adaptation that would be Driven by Natural Selection in the Development of its own Unique Integrated Plant Community

Genetic Considerations

- We are sensitive to the Issues of Genetic Pollution:
  - Breaking-up Local Adapted Gene Complexes
  - Swamping Native Genetic Material with “production-selected” material

Genetic Pollution

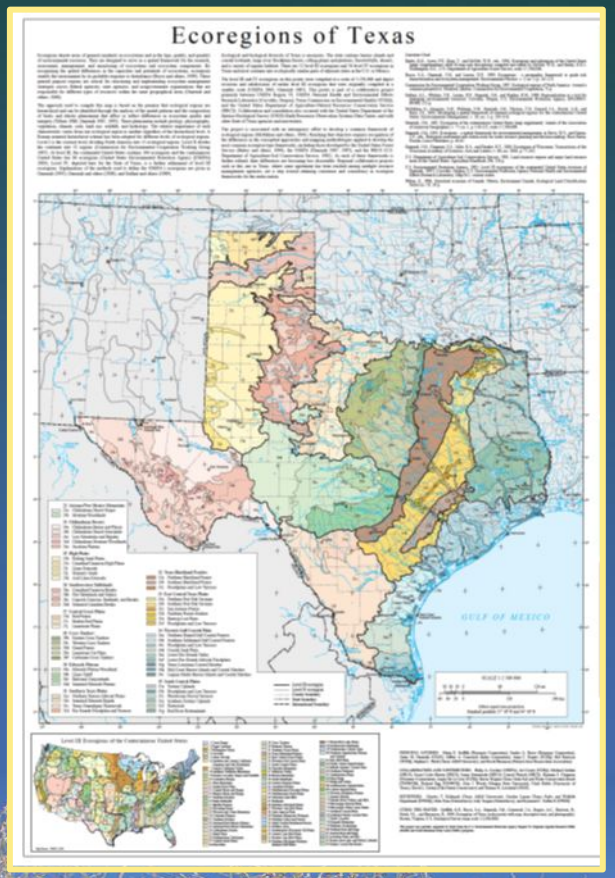
- Most Threatening
  - Annual Species
    - Short Life History
  - Small Isolated Populations
    - Greater Gene Exchange
- Less Threatening
  - Long-lived Perennials
  - Out-crossing Wind Pollination
  - Large, continuous range (Prairies)
    - Gradual genetic variation

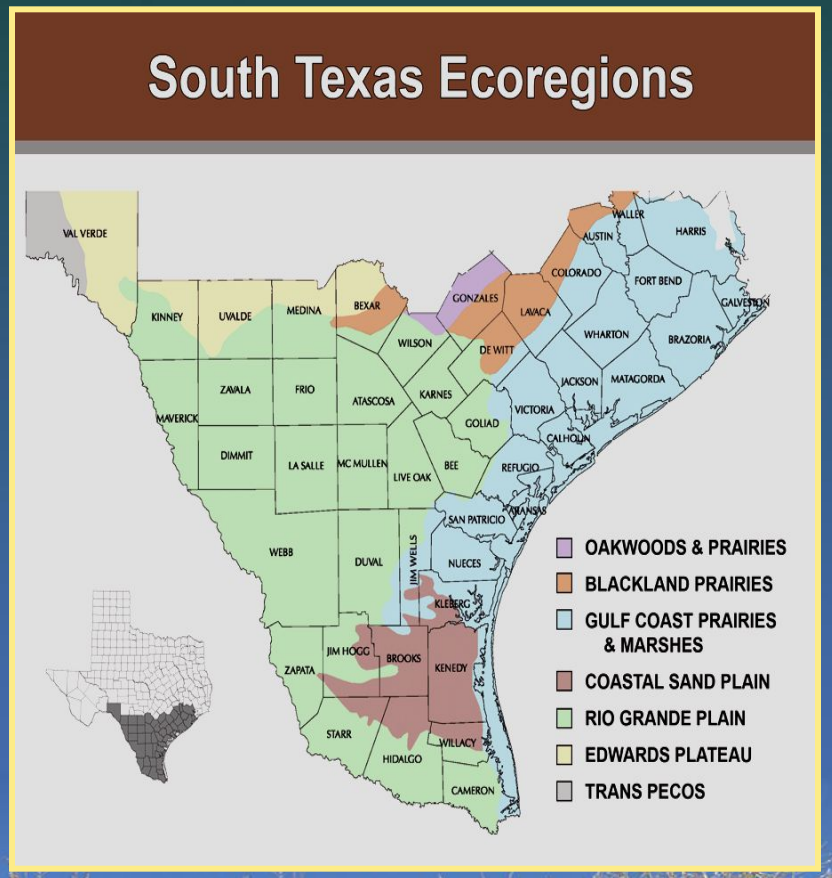
Prairies

- Natives
  - Competitive Edge
    - Well Established
    - Long-lived
    - Locally Adapted
- Non-Native
  - Find a Void
    - Establish from Seed

Geographic Divisions

EPA -III vs. Ecoregions





Genetic Pollution

- Swamping the Gene Pool causing Out-breeding Depression
  - Is acknowledged but not well documented
- Inbreeding Depression
  - Well documented in small populations
  - Collecting seed from these small highly in-bred populations, simply because they are the closest, may cause more problems than choosing seed from further afield
  - Constraining oneself to a local site because of geography ignores the more critical environmental factors of microclimate, soil, topography and other biotic and abiotic influences

South TX Restoration Sites

- Abandoned Agricultural Fields
- Oil & Gas Sites
- Roadways
- Many of these sites have been so altered that local native material may not be the most adapted.
- Finding local, native stands for harvest
  - Availability is limited
  - Contamination with aggressive introduced species, i.e. KR bluestem, bermudagrass

Regional Ecotype Approach

- A Seed Mix with Broad Genetic Base From a Similar Ecoregion Which Provides for On-Site Natural Selection
  - Model – Iowa Ecotype Project
  - Study on Genetic Variation in Blue Wildryes in California (Knapp, 1996)

Regional Ecotype Approach

- Knapp concluded:

  " Collecting seed from different subpopulations within a region is advised in order to maximize the potential for evolutionary response and thus the sustainability of restored populations…The presence of genetic variation is especially critical for germplasm used in restoration and revegetation because this seed may be planted across an array of local habitats where selection may favor different combinations of genes."

Accession Selection

- Evaluations:
  - 50 plant groupings of each accession
    - 1-2 replications per site
    - Multiple sites, 3-4
    - Multiple years, 2-3
    - Factors:
      - Survival, Regrowth, Vigor, Foliage Density, Uniformity, Resistance, Development stage, Seed shatter, Origin
      - Quantitative: Seed Yield & Seed Germination

Accession Selection

- We are not employing hybridization or selecting for productivity
- We do believe in using an agronomic approach to facilitate the availability of “reasonably priced “ seed
- Genetic Drift is Controlled through harvest timing and limiting seed generations

Ecotype Release

- Regional Ecotype Seed allows for Genetically Adaptable Material as well as the Development of Readily Available Native Seed at Reasonable Prices.
- Cost and Availability are Issues that Cannot be Ignored.

Ecotype Release

- As Burton And Burton sadly point out,

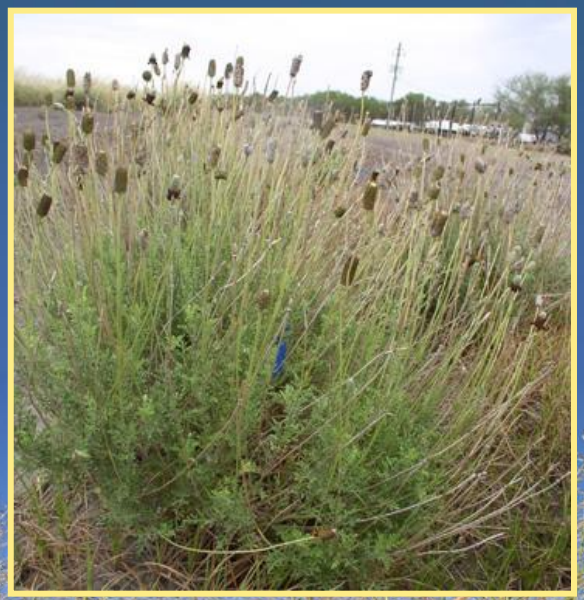
"most land managers simply default to using easily obtained low priced introduced species in their revegetation programs if native, reasonably priced seed is not available."

Seed Production Challenges
Genetic Diversity vs Reasonable Price

- Growth Form
- Seed Maturity
- Seed Storage

Seed Production Challenges

- There may be multiple growth forms within an ecoregion
- All accessions in a release may not be uniformly ripe



Seed Storage

- Separate lines may mean
  - Separate harvests
    - More cleaning of equipment
  - Separate drying
  - Separate processing/ cleaning
  - More storage space until mixing

Ecotype Mixes (The Benefits)

- Represent populations throughout the ecoregion
- Obtain desirable traits without breeding
  - Different collections may stand out in vigor, seed production, or active seed germination
  - It may be that no collection has all of the desirable traits
  - Lines can be produced separately, and seed can be blended before sale

Ecotype Seed Release Problems

- On farm site logistics of seed mixes
- Mode of reproduction
- Ploidy levels
- Genetic diversity and integrity

STN Approaches to Seed Release Problems

- Arizona Cottoptop
- Orange Zexmenia
- Bristlegrass

Arizona Cottontop

- 12 accessions
  - From across the Rio Grande Plain
  - Each breeder line produced separately
  - Blended before the seed producer

Orange Zexmenia

- 7 accessions
  - From across the Rio Grande Plain
    - 3 top performers on a clay site
      - Root rot resistance
    - 4 top performers on a sandy site
  - All 7 will be planted side-by-side and harvested for breeder seed
    - Isolated plots for replacement plants
    - Reduces the number of plots needed
    - Assures contribution from all lines

Ecotype Blend

- Why mix multiple species releases in a blend?
  - A blend of species within the same genus may be more practical to meet a vegetative need
    - If they all occur within the ecoregion of use, but on slightly different micro-sites
    - Avoids the necessity of choosing the correct species when seeding a site
    - 2+ are included and one or more should thrive

Catarina Bristlegrass Blend

- *Seteria leucopila & S. vulpiseta*
  - A blend of 4 accessions, 2 species
  - 2 high active germination, but lower seed production
  - 2 high seed producers, but very high dormancy (<2% active germination)

Ecotype Release

- Genetic Pitfalls
  - Original samples must be representative and non-selective to maintain genetic diversity
  - Are we matching the ploidy levels of the seed source with the local population
  - Is the species self-pollinating or cross-pollinating?
    - To avoid inbreeding or outbreeding depression

Ploidy Example: Switchgrass

- 2n = 18, 21, 25, 30, 32, 36, 54, 70, 72, 90, 102
  - Number of pairs of chromosomes
- Mating between 4x (usually lowland) and 8x (usually upland) resulted in high number of inviable seeds

- From Table 10.4 - Region 2 native plant species that have variable ploidy levels. In: Genetically Appropriate Choices for Plant Materials to Maintain Biological Diversity, USDA Forest Service, 2004

Ploidy Examples: Grasses

- From Table 10.4 Region 2 native plant species that have variable ploidy levels.
  - In: Genetically Appropriate Choices for Plant Materials to Maintain Biological Diversity, USDA Forest Service, 2004

  - Big bluestem
  - Blue grama
  - Side-oats grama
  - Buffalo grass
  - Canada wildrye
  - Switchgrass

Ploidy Examples: Forbs

- From Table 10.4 Region 2 native plant species that have variable ploidy levels.
  - In: Genetically Appropriate Choices for Plant Materials to Maintain Biological Diversity, USDA Forest Service, 2004
  - Common Yarrow (2x, 7x, 9x)
  - Late goldenrod

Determining Mode of Reproduction

- Using DNA marker loci
- Paternity analysis of offspring
- Plant cytology
- Field variability
- Plant isolation
- Growth chamber

Managing Genetics

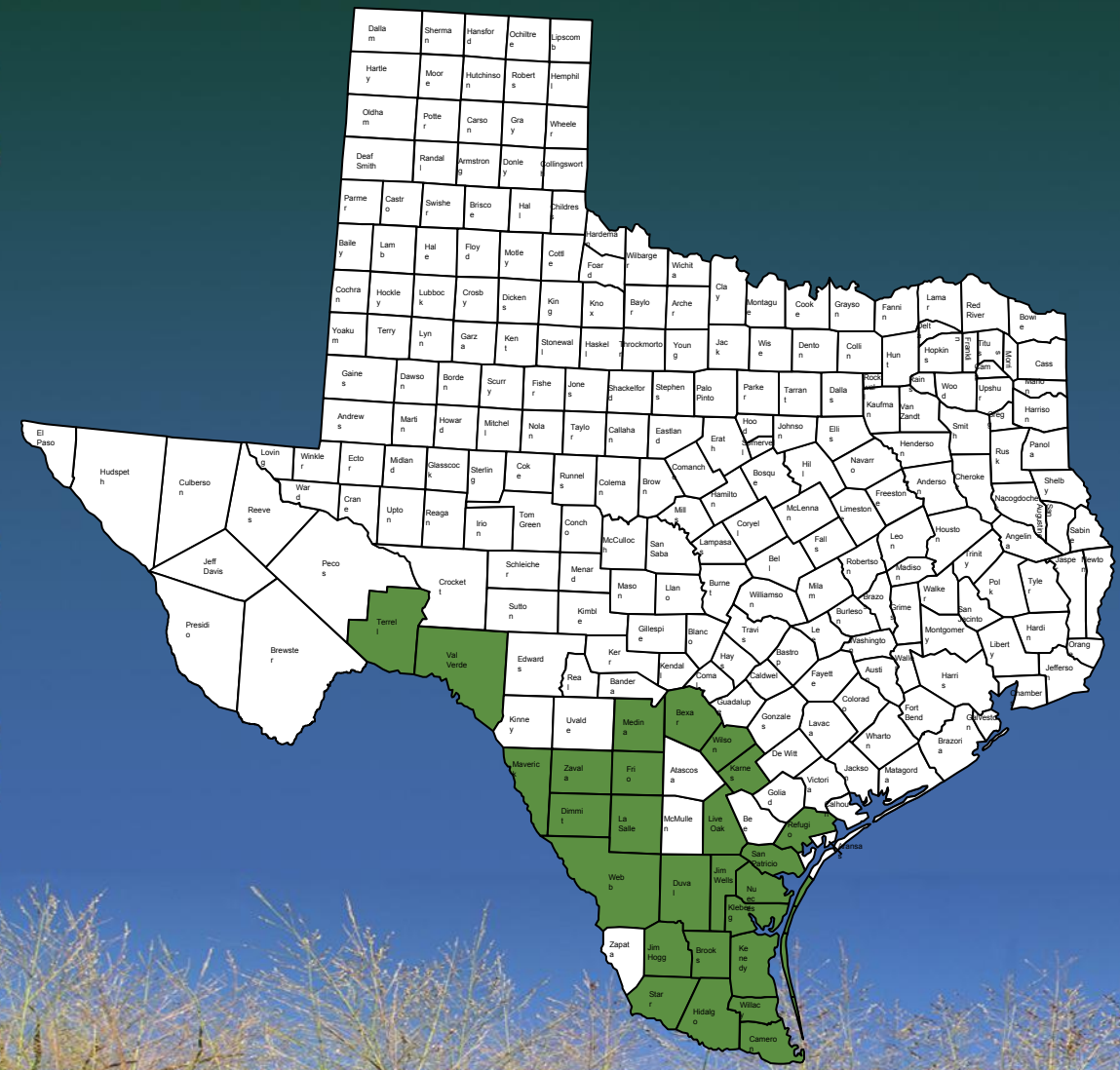
- Working relationship with the US Forest Service Genetics Lab (Valerie Hipkins)
  - Ploidy levels
  - Genetic diversity within and between collections
- Use data to determine appropriate number of collections
  - To reflect local species adaptation and diversity

Multi-flowered False Rhodesgrass

- 26 collections of (*Trichloris pluriflora*)
  - DNA Extraction and Isozyme Evaluation
  - Ploidy Analysis

# Samples Prepped for DNA Analysis	# Samples Prepped for Ploidy Analysis	# Samples Prepped for Isozyme Analysis
415 total	144 total	390 total
26 collections	26 collections	26 collections

Counties of Four-Flower Occurrence



Multi-flowered False Rhodesgrass

- 26 collections of (*Trichloris pluriflora*)
  - Genetically uniform set of collections:
    - 22 of the 27 accessions had the same genotype (330 seed)
    - Only 22 seeds had variation that distinguished them from the common genotype.
    - Accession 9086184 had the only fixed allelic difference from the other accessions.
  - Ploidy Analysis
    - All Collections had the same ploidy level

Genetic Goal

It is with this carefully managed Ecotype Approach and Genetic Screening that STN and the PMC hope will improve our efforts to release commercial seed that is adapted, diverse, and appropriate for the landowners of South Texas.

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