

Investigating the Spatial Relationship of Loblolly and Shortleaf Pines Hybridization Using Liquid Chromatography and Geographic Information Systems



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Introduction

- Natural hybridization of loblolly pine (*Pinus taeda*) and shortleaf pine (*Pinus echinata*) in East Texas may lead to improved fitness and fire resilience for pine communities in the warmer and drier climate at the western extent of their ranges (Figure 1).
- Increased use of genetically improved loblolly pine in intensive silviculture has shifted pine community compositions towards loblolly pine dominance, potentially reducing natural hybridization and diminishing pine species adaptability in East Texas.
- This project utilizes spectral high performance liquid chromatography (HPLC) to quantify hybridization for the overstory cohort of pine forests in East Texas.

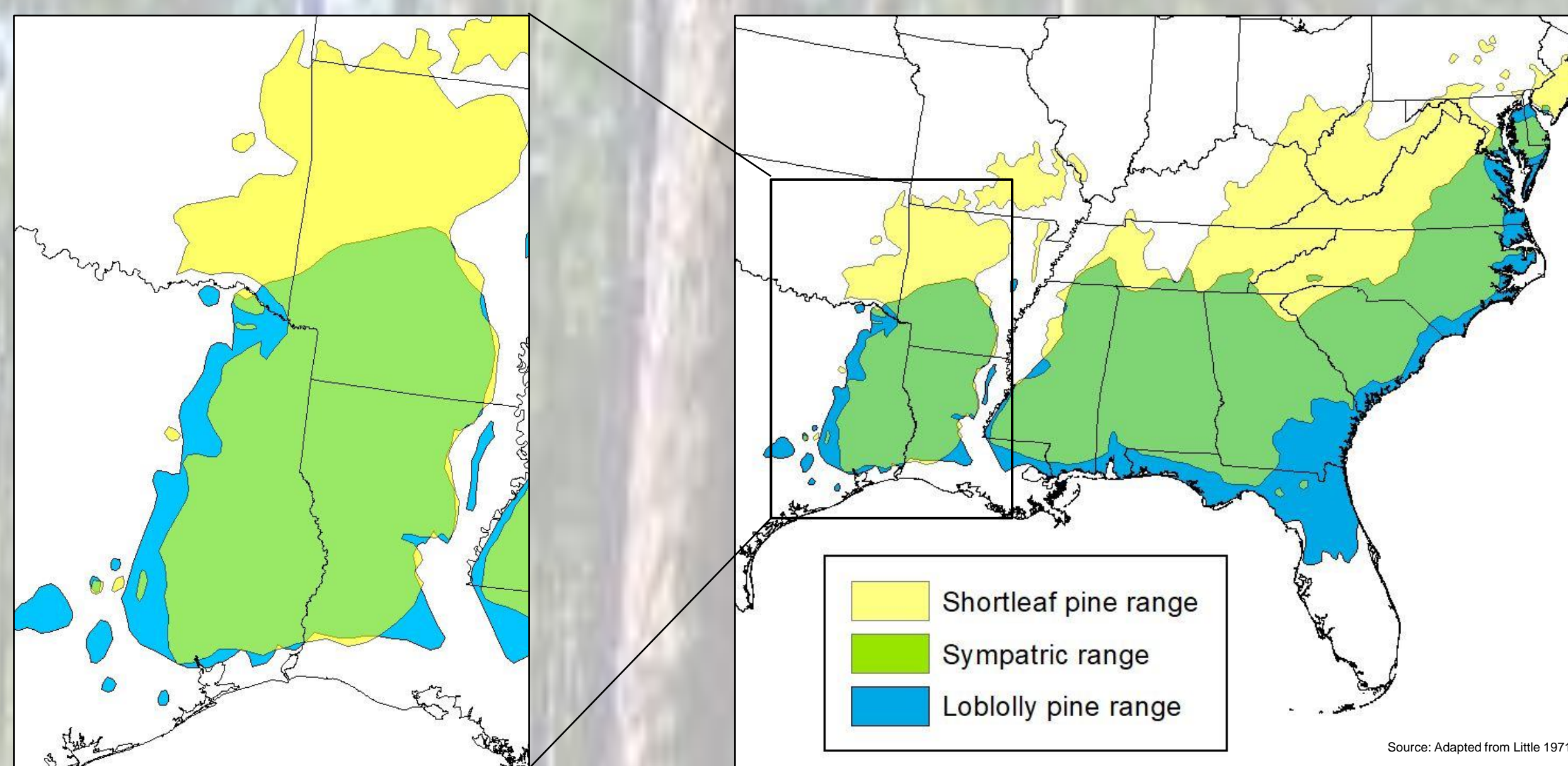


Figure 1: Historical distributions of loblolly pine and shortleaf pine in the southeastern United States, and the study area in the West Gulf Coastal Plain.

Objectives

- Establish chemical marker identification for loblolly and shortleaf pines using spectral HPLC data.
- Determine the species composition and hybridization extent at the overstory level.

Methods

Field Sampling

- Sites with target species present in mature overstories were sampled during the summer of 2019 (Figure 2).
- At each site, three variable area sampling units were created. For each unit, needles were collected from three individuals of each species or hybrid identified by morphological characteristics.

Laboratory Analysis

- Needle samples were extracted with ethanol, and were fractionated in water and acetonitrile for HPLC analysis. Fractions were analyzed for stability in determining species identity using an *Agilent 1100* HPLC system.

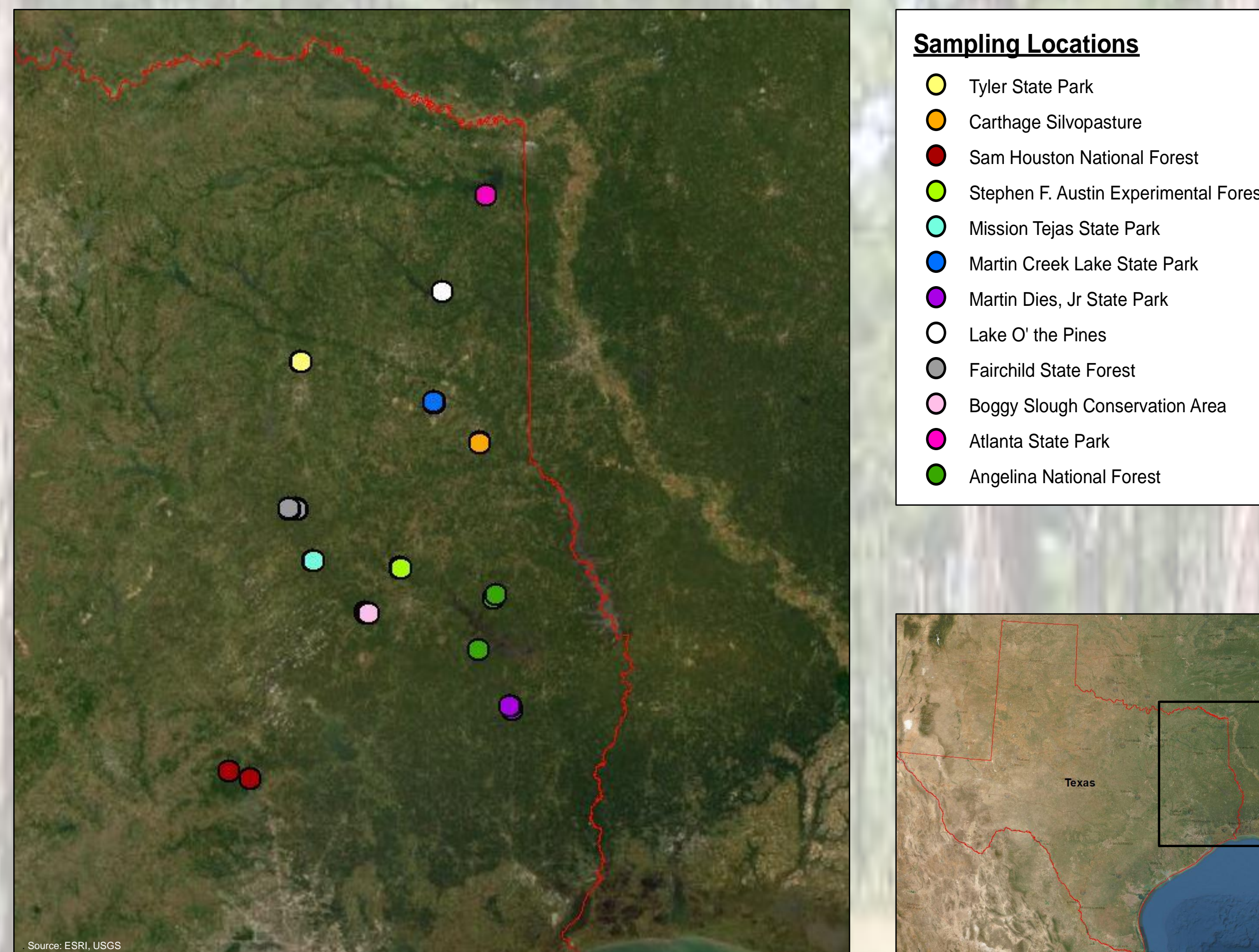


Figure 2: Sampling locations within East Texas. Sites were selected to provide adequate coverage of the natural ranges of loblolly and shortleaf pines.

Preliminary Results & Discussion

- To determine the viability of utilizing HPLC, an initial analysis was performed using 54 samples compared to a loblolly and shortleaf pine controls from ArborGen and Weyerhaeuser respectively. From analysis, a suspected loblolly X shortleaf pine hybrid sampled at Mission Tejas State Park was selected for comparison (Figure 3).
- From preliminary analysis, differentiation based on terpene expression appears promising. Terpenes at the three, 14, and 21 minute marks may be especially useful in species separation.
- HPLC analysis of samples from remaining sites will further quantify hybridization on a regional scale by providing a larger pool for comparison.

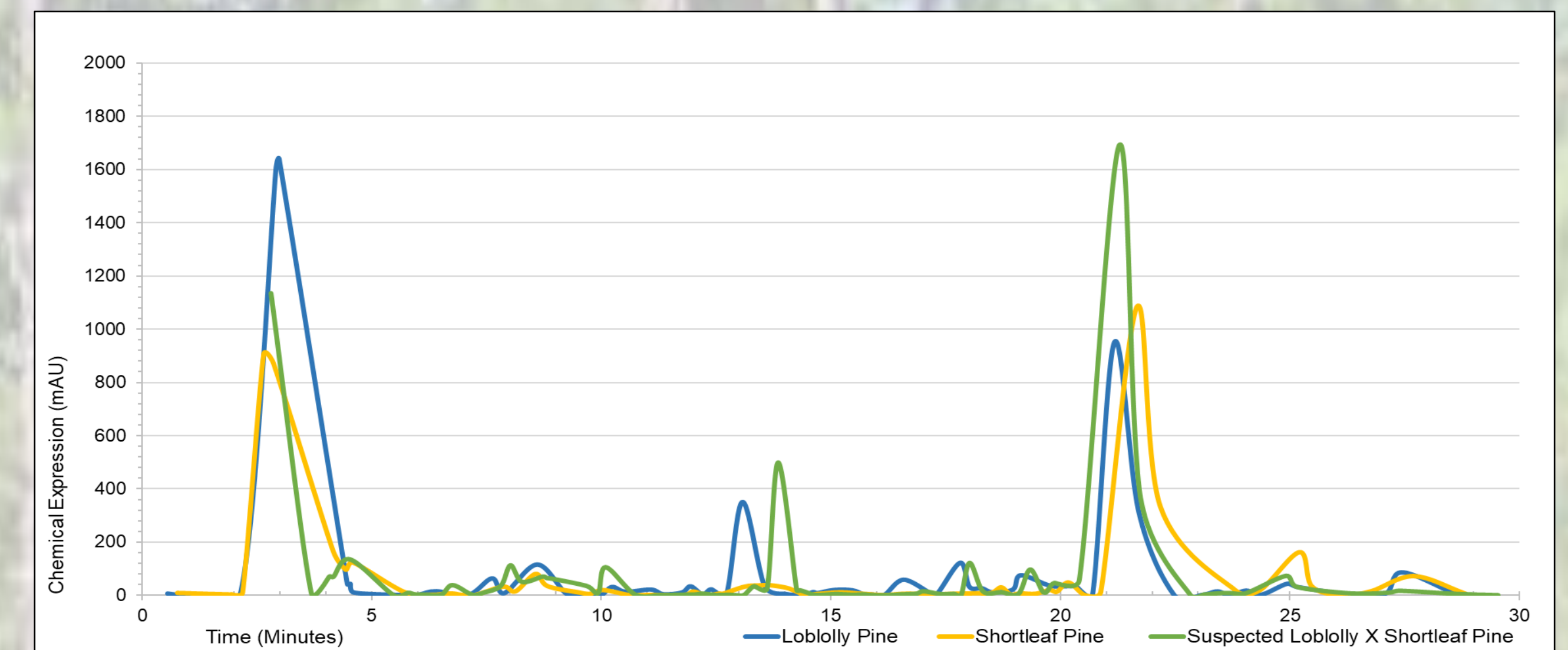


Figure 3: Plotted chromatograms of a genetically improved loblolly pine, a genetically improved shortleaf pine and a suspected loblolly pine X shortleaf pine hybrid sampled at Mission Tejas State Park.

Future Work

- Complete analysis on remaining 182 samples and establish chemical identification for longleaf pine (*Pinus palustris*) and Sonderegger pine (*Pinus x sondereggeri*).
- Utilize ArcMap 10.6.1 to display signatures and elucidate species demarcations in relation to climate parameters and stand strata.

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