Quantifying species diversity, carbon sequestration, and drought tolerance in regenerating Tamaulipan thorn forests

Abstract: The decades-long initiative (since early 1960s) to reforest abandoned old fields in the LRGV began as direct-seeding with a handful of species and at present represents a large-scale operation involving hundreds of thousands of individuals representing ~70 species transplanted annually. This initiative has met with varying degrees of success, with key bottlenecks related to the high susceptibility of seedlings to drought and heat stress, herbivory, and competition with invasive grasses. Here I report on our field and laboratory efforts to quantify key ecosystem services (biodiversity and carbon sequestration), species performance (growth and survival), and drought tolerance of species in these regenerating forests. Our results show that while reforestation does have a pronounced impact on the carbon fixed relative to abandoned self-regenerating forests, increases in biodiversity with time are severely limited by the presence of invasive grasses. Moreover, the majority of species surviving to maturity in these forests are mostly deep-rooted, nitrogen-fixing species. The use of tree shelters and supplemental moisture has detectable positive impacts on survival in the short term (1 year) but these may not persist into the long term, except for more drought-sensitive species. Seedling drought experiments reveal surprising relationships between fine root length density and drought sensitivity. These results highlight how coupling of field-based quantification of differential species success with detailed ecophysiological knowledge of plant traits can be used to enhance reforestation and restoration of biodiversity within the LRGV.