PROJECT SUMMARY

Texas A&M University System

0-6973: Predictive Mapping of Rare Plants

Background

Rare plants are essential components of a functioning ecosystem. These species are often phenotypically unique or provide a specific ecosystem function. Rare plants may be limited in range, limited in population numbers, or a combination of both. These plants are often imperiled due to a combination of factors that includes changing ecological conditions, human intervention, habitat loss, low recruitment rate, or competition with non-native species. We conducted this research to identify priority rare plant species and develop distribution models for selected species in Texas. The research team identified 17 species in consultation with biologists from the Texas Department of Transportation, Texas Parks & Wildlife Department, and Botanical Research Institute of Texas (BRIT). We gathered ecological information on these species and developed distribution models using historical presence-only data. While we evaluated all models statistically, we also validated models for four species utilizing independent field data collected by BRIT as a part of this project.

What the Researchers Did

BRIT collated available historical presence data and present-day location data for all 17 species from the Texas Natural Diversity Database, the BRIT herbarium, SEINet, and citizen science observations from iNaturalist (Figure 1). We used the presence data points to develop preliminary models. We selected environmental predictor variables for developing preliminary models based on existing literature and previous plant studies conducted throughout the United States and similar ecosystems worldwide. Because only presence records were available for all the species, we ran Maxent models for the various sets of predictor variables at 1-km grain size across Texas. We then provided the best performing preliminary models to BRIT for field surveys.

Using the preliminary models, BRIT performed field surveys for four species (Eriocaulon koernickianum, Physostegia correllii, Salvia pentstemonoides, and Trillium texanum) across two field seasons (2020, 2021). BRIT used a stratified random sampling approach to select survey locations and divided survey locations into four habitat suitability classes. The classes ranged from least likelihood of plant detection to highest likelihood of plant detection. They selected 50 random locations to survey for each of the four species. Additionally, they visited four known locations to confirm species presence.

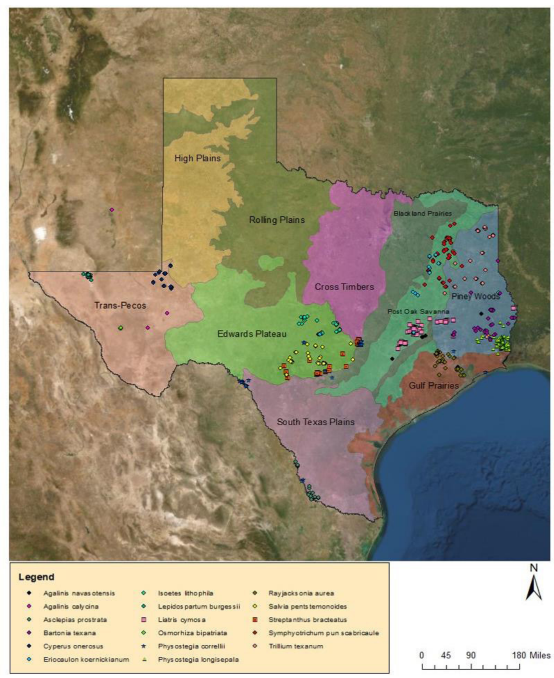

Figure 1. Presence-only locations used for modeling

Research Performed by:
Tarleton State University

Research Supervisor:
Hemanta Kafley, PhD

Researchers:
Jordan Craven
Marissa Pensirikul
Mandira Sharma
Lane Pressler
Darrel Murray
Heather Mathewson

Project Completed:
10-31-2021

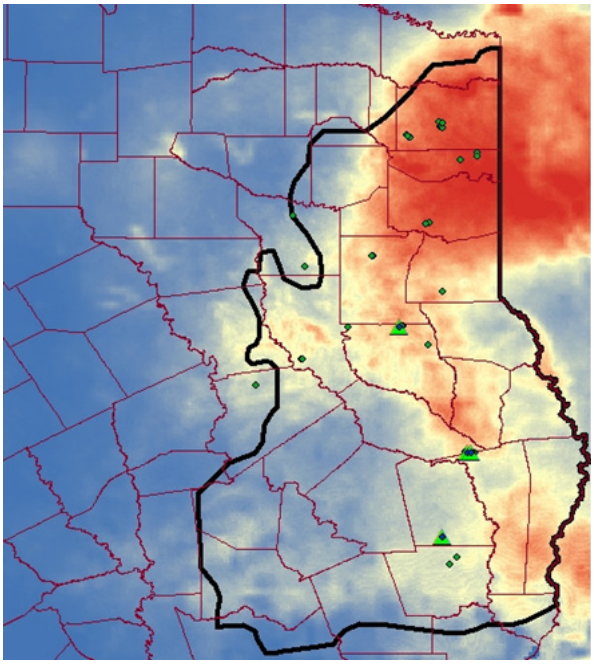

Figure 2. Trillium texanum Distribution Map (Green triangles indicate presence locations from field survey).

We used the independent field data collected by BRIT to validate the models for the aforementioned four species. For all other species, including these four, we evaluated models using threshold-independent measures such as Area Under Curve (AUC) and a threshold-dependent True Skill Statistics (TSS). For internal model evaluation, we partitioned the presence location data into training locations (75% of locations), for training the model, and test locations (25%), for testing the model. We ran models with 500 iterations and 10 replications.

What They Found

Our preliminary models served as a useful tool in selecting focus areas for field surveys. Field surveys confirmed that the classification of a location as having "high suitability values" predicted the presence of the individual species (Figure 2). Consistently, Maxent produced valid distribution models for all species at varying scales: rectangular area encompassing Texas boundary, within Texas state boundary, and within the ecoregion where the species were found. Overall, all models were successful in discriminating between sites of potential species presence and random background locations. For each species, the models had AUC > 0.90 and TSS > 0.8, indicating strong model performance. However, we found that the model covering the largest extent consistently had the best discrimination ability. Using independent field survey data, we successfully validated our models despite a low sample of detections of the species. We conclude that a low number of occurrence data should not preclude investigators from developing useful models of species distribution.

What This Means

Presence-only species distribution models, such as those developed in this project, can be used in the future to determine areas of most concern for imperiled or likely to become imperiled species. Models can be used to guide the field surveys necessary for listing processes or the management of presently listed species. Models can serve as useful tools when developing new transportation-related projects so that potential habitat can be avoided in compliance with existing legislation requiring protection of plant species. Species distribution models will be useful in detecting and managing known roadside right-of-way populations of rare or listed species. These models may also inform future conservation measures relating to rare plants.

For More Information

Project Manager:
Martin Dassi, TxDOT, (512) 416-4738

Research Supervisor:
Dr. Hemanta Kafley, Tarleton State University, (254) 968-1740

Technical reports when published are available at **https://library.ctr.utexas.edu.**

Research and Technology Implementation Division
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
Keyword: Research