**Assessing the Ability of Open Access Remote Sensing Data and Machine learning to find Spatial and Temporal Patterns of Woody Plant Encroachment in Savanna Ecosystems**

Woody plant encroachment (WPE) is a global phenomenon that is affecting grasslands, savannas, and rangelands at an accelerating rate. WPE refers to a shift in the dominant vegetation of an ecosystem from grasses to woody species and yields mixed effects on ecosystem services and local economic activities. Many of these effects vary based on the physiology and relative abundance of a particular woody species associated with the encroachment. Given the scale of WPE in the United States, there is a pressing need to improve the methods used to quantify the extent of WPE. The rise of open access data and machine learning methodologies provide new opportunities to study WPE at the scales necessary to define the spatial and temporal trends of WPE. We seek to identify the specific advantages offered by different remote sensors coupled with machine learning to guide future research about WPE. We will use a UAV to collect our multispectral and LiDAR data, and a small aircraft to collect the hyperspectral data. Our open access imagery will be downloaded from Sentinel-2. Our overall aim is to generate a map of the distribution of our two study species at the Martin Ranch in Menard, Texas – ashe juniper (*Juniperus* *ashei*) and honey mesquite (*Prosopis glandulosa*). The data will be classified using a pixel-based approach with Random Forest in R using the *caret* package. Our models will be trained on 70% of our pixel data, which will be selected based on the unique phenology of our two study species. Model performance will be validated using the remaining 30% of the training pixels and is expected to yield at least 80% accuracy or a 0.61 kappa value at the pasture scale. The final models will be subject to a pairwise comparison to assess differences in performance for each sensor type. Our findings will guide future efforts in identifying remotely sensed data with the highest cost-utility for use in machine learning applications. In addition, the results will identify the local extent and magnitude of WPE, as this phenomenon affects numerous ecosystem processes such as carbon storage, water quality, and support for biodiversity. The improvement of species-specific mapping will be beneficial for understanding changes brought forth by WPE, and future work will build upon these methods to better quantify carbon in non-forest ecosystems to assess progress in meeting sustainability goals.