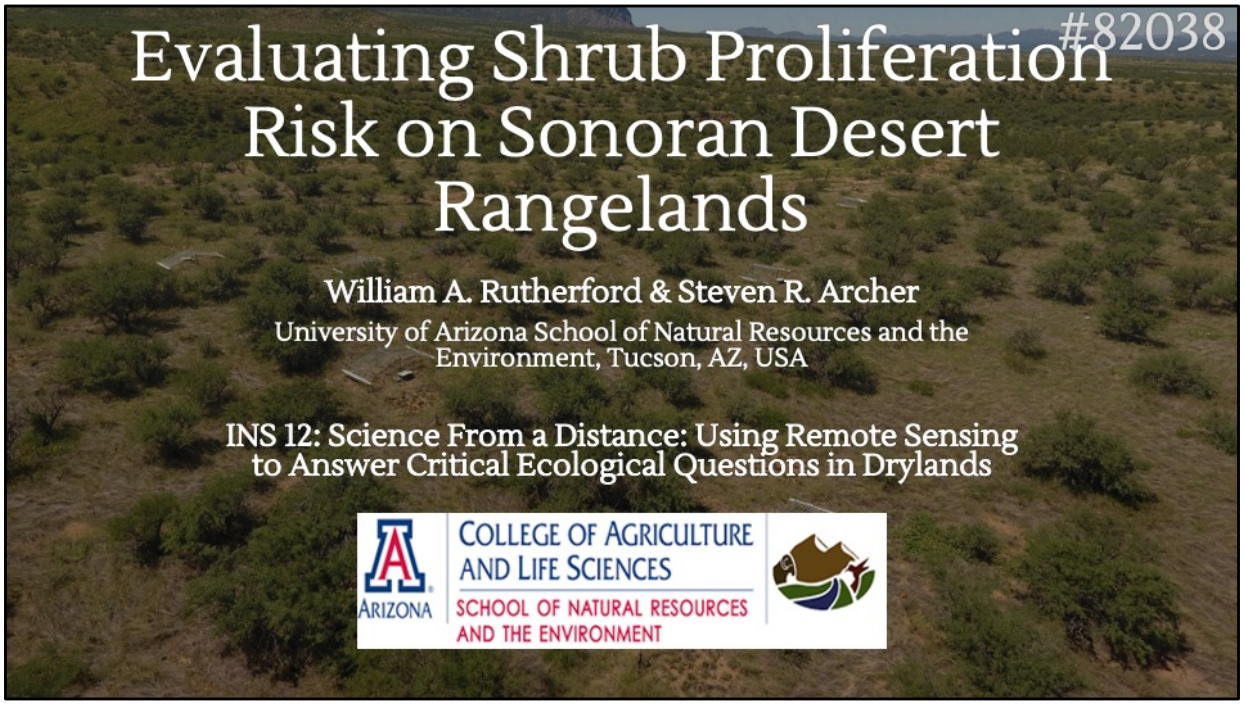
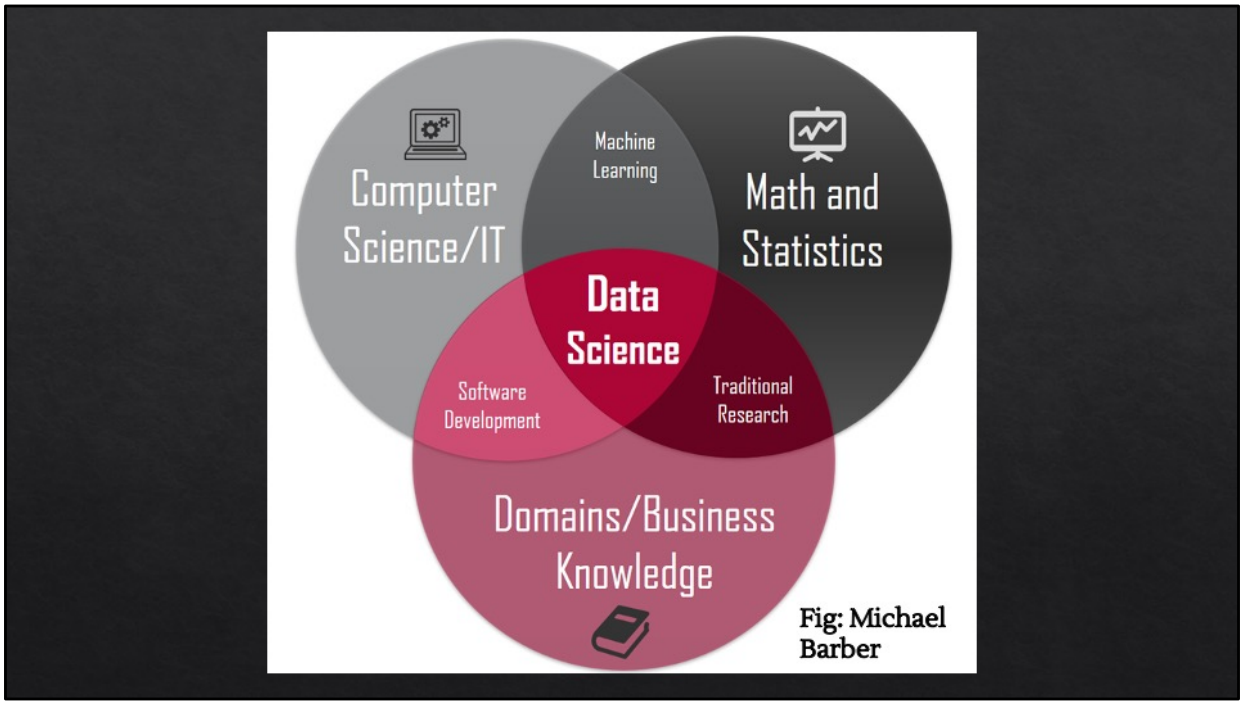
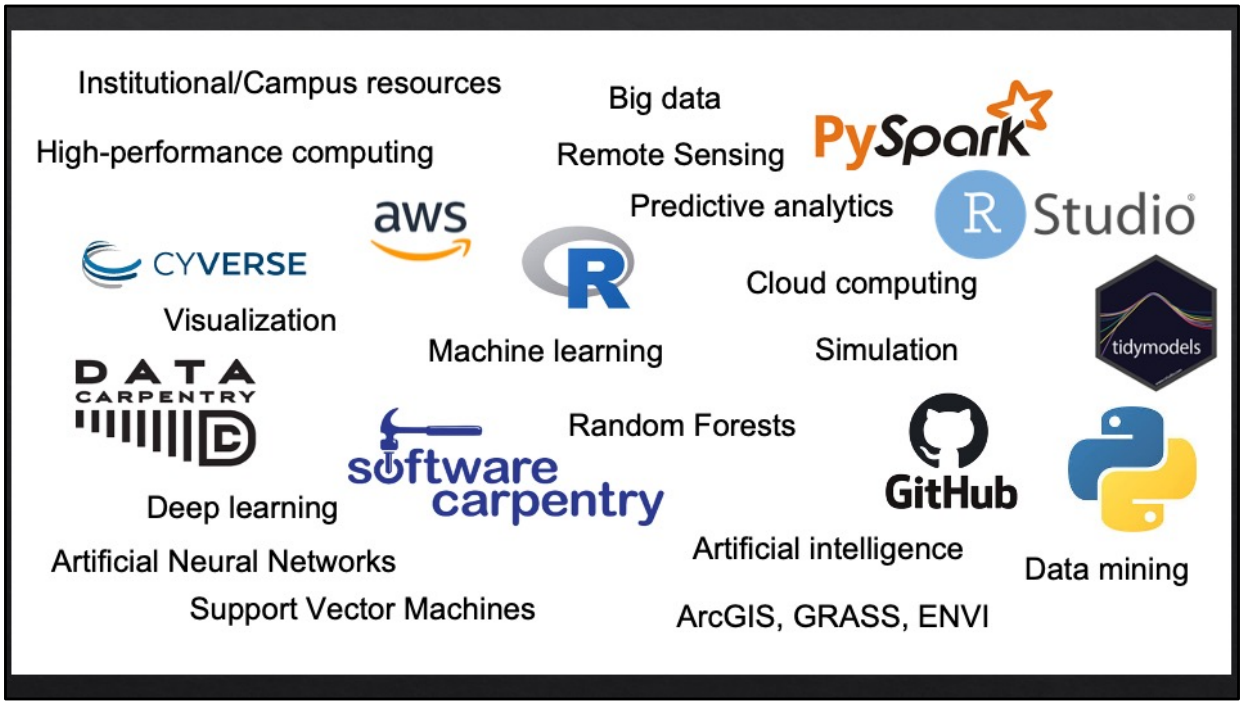


Hello everyone. Thank you for viewing my Inspire presentation evaluating shrub proliferation risk on sonoran desert rangelands. I'm Austin Rutherford, a phd candidate at the university of Arizona. im applying geospatial and machine learning techniques to the restoration of native grassland ecosystems.

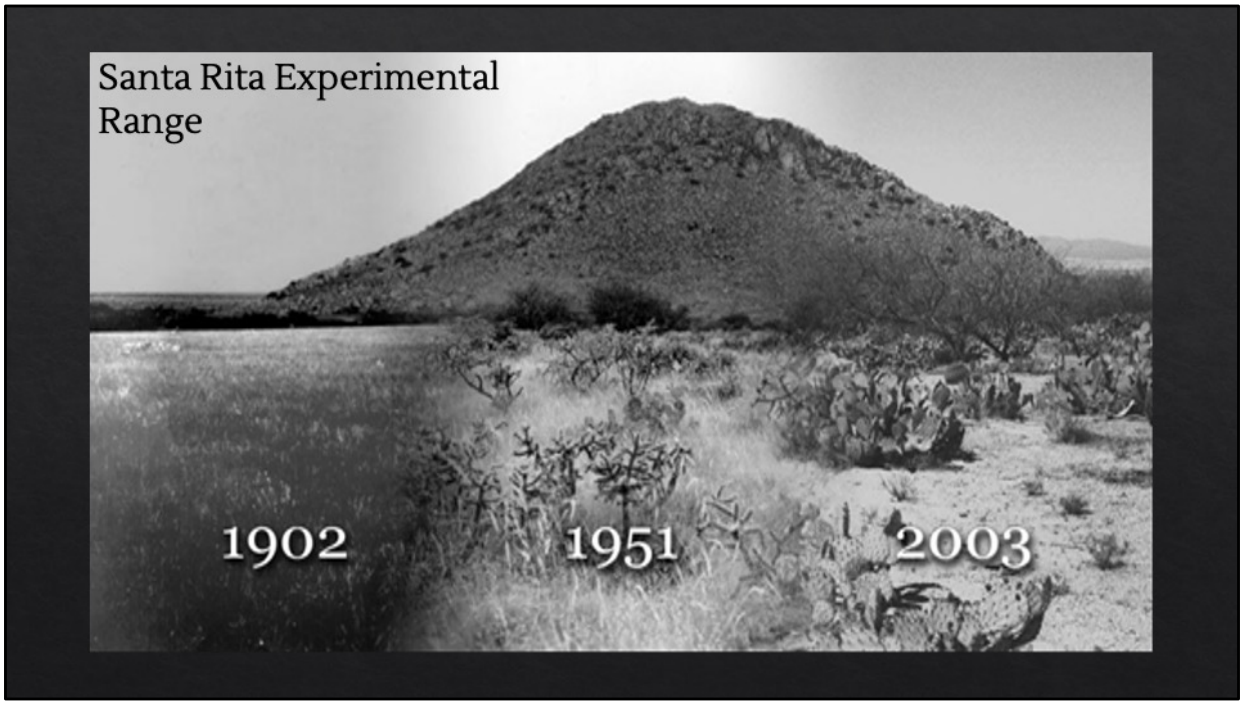


Data science is a promising field combining multiple domains in computer science, mathematics, and research. born from modern improvements in computing power, cloud hosting, and statistical methods for handling big and unwieldy datasets. relying heavily on open-sourced products, with great benefit to research in money savings.



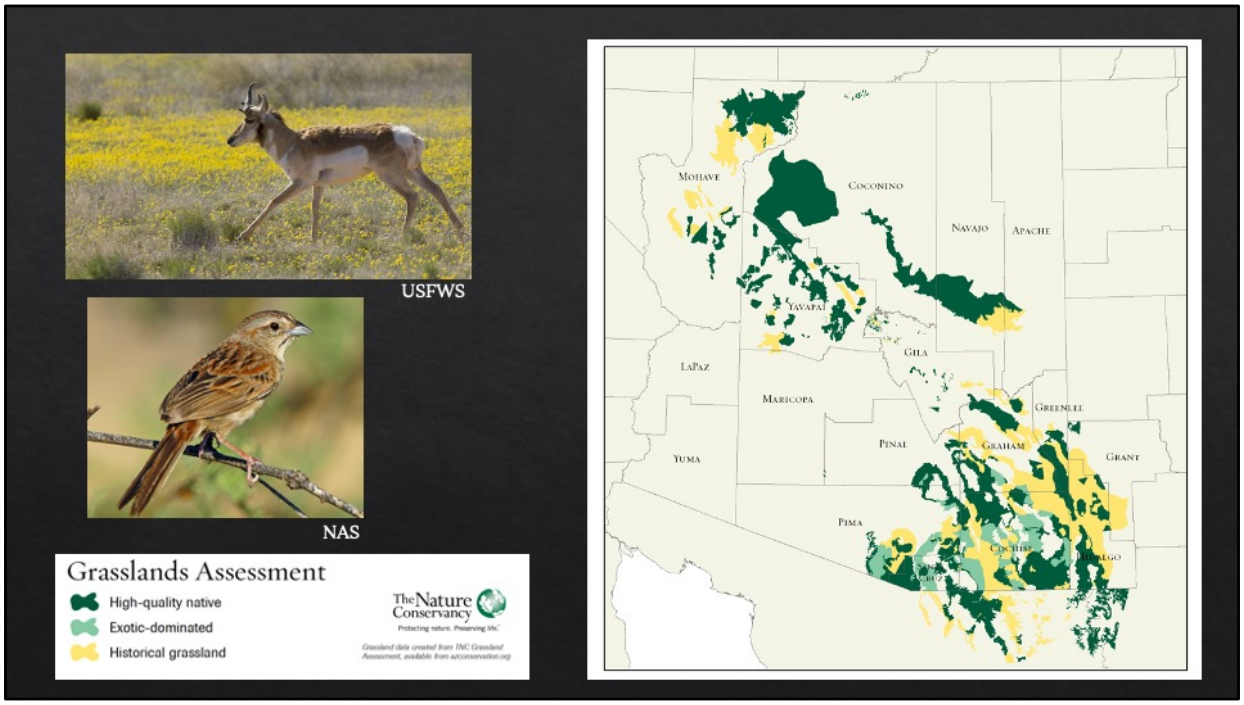
Difficulties with modern data science arise with the vast number of software applications, programming languages, and fast-evolving terminology and standards for use in research. It is our job as scientific researchers to uncomplicate the complicated, to ensure we are using the best methods.

This is a common dryland scene on a beautiful spring day in southern Arizona. Looking deeper, we see a complex dry landscape with multiple plant types, complicated topography, land use disturbance, grass invasion, barriers through fencing. In this, we find research inspiration and can tackle tougher questions through data science.

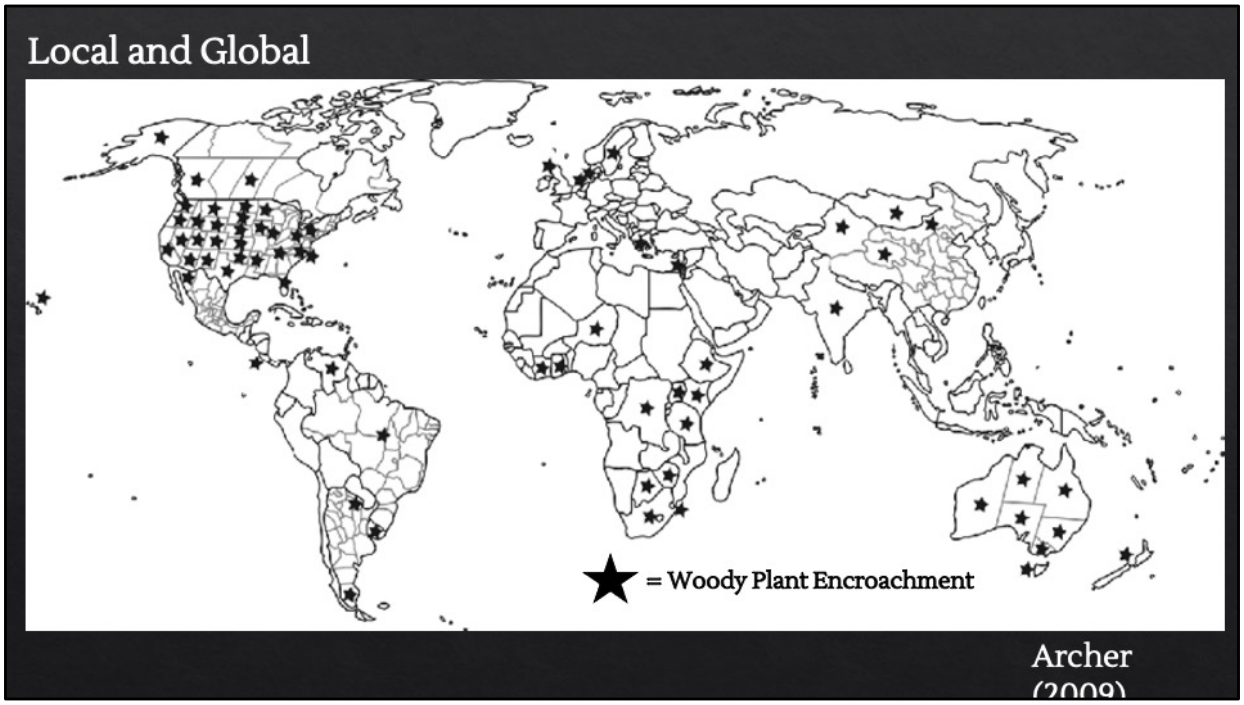


My focus is on the woody plant dynamics of the sonoran desert. This is a repeat photo from the santa rita experimental range south of Tucson, where grass dominance in the early 1900s has now transitioned to more bare ground, cactus, and shrubs in the uplands

Many land managers view woody plants like mesquite as a major current or potential problem. Not only as a competitor for resources that limits grass production for livestock, but also as a threat to a multitude of other ecosystem services as in habitat for grassland endemic wildlife.



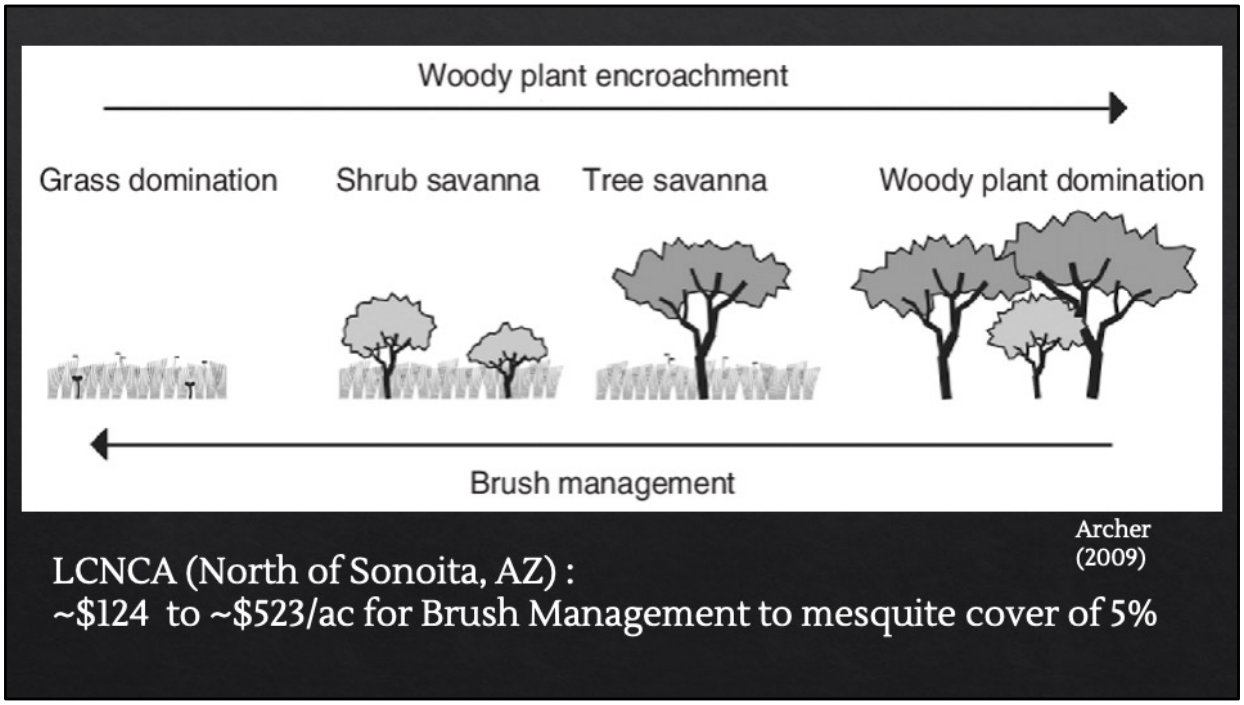
Grasslands are prized in Arizona for their unique habitat to species like the sonoran pronghorn antelope or the botteri's sparrow. Land managers strive to maintain grasslands for these species, and many others, and also preserve historical habitat conditions.



A surge in woody plant cover is not a condition unique to Arizona or the United States, but often a management concern in drylands around the globe. Grassland ecosystems are disappearing at alarming rates, and the pastoralists, whose livelihoods are often centered around these ecosystems, are at the most risk.

I return to this scene. Previously I mentioned some of the ecologically complex traits inherent in this photo. Now I'd like to pose the question, what are the specific drivers and processes that can lead to this scene and similar ones that can be dominated by a woody overstory

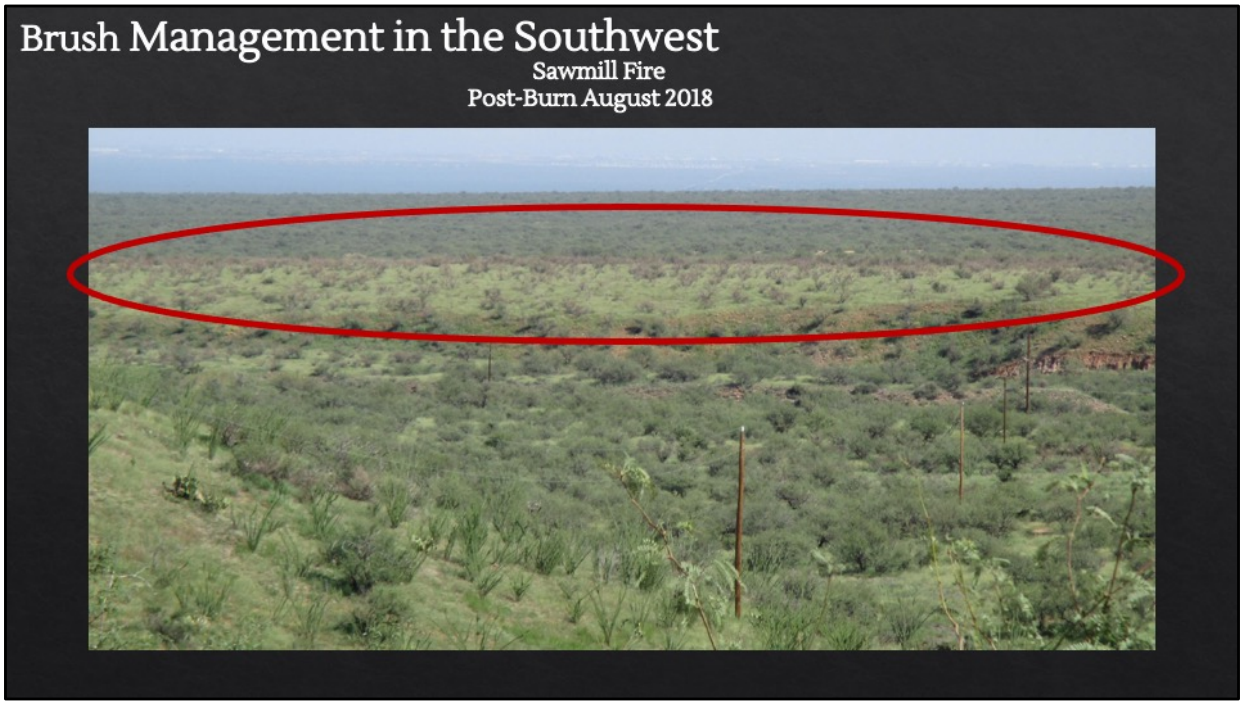
Primary drivers are climate change with shifts in precipitation regimes, increases in co2 ,and temperature; grazing disturbance by over use of grasses; but also alterations to historical fire regimes and fuel loads. All of which tend to favor woody plants in drylands.



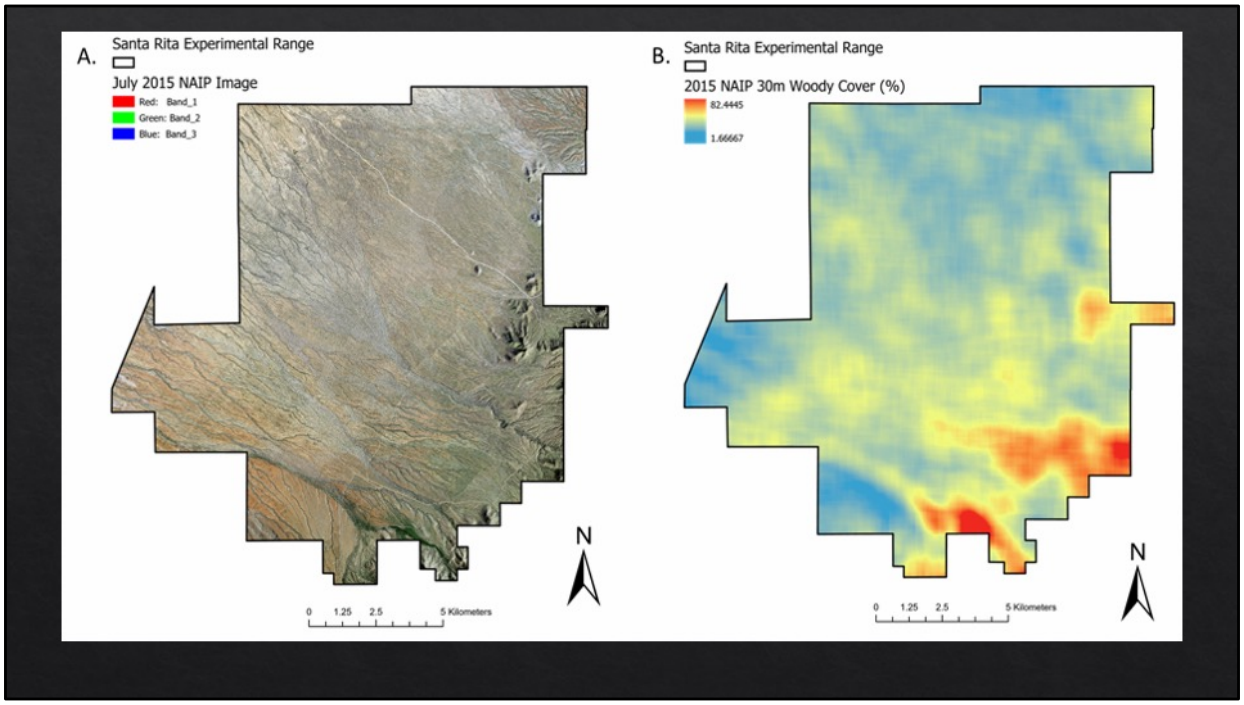
Thinking along a gradient of a grass dominated ecosystem to a woody dominated system, land managers in the Western US often employ techniques called brush management to restore a site back to it's previous condition. This can be costly in upwards of $500/ac.

Brush Management in the Southwest

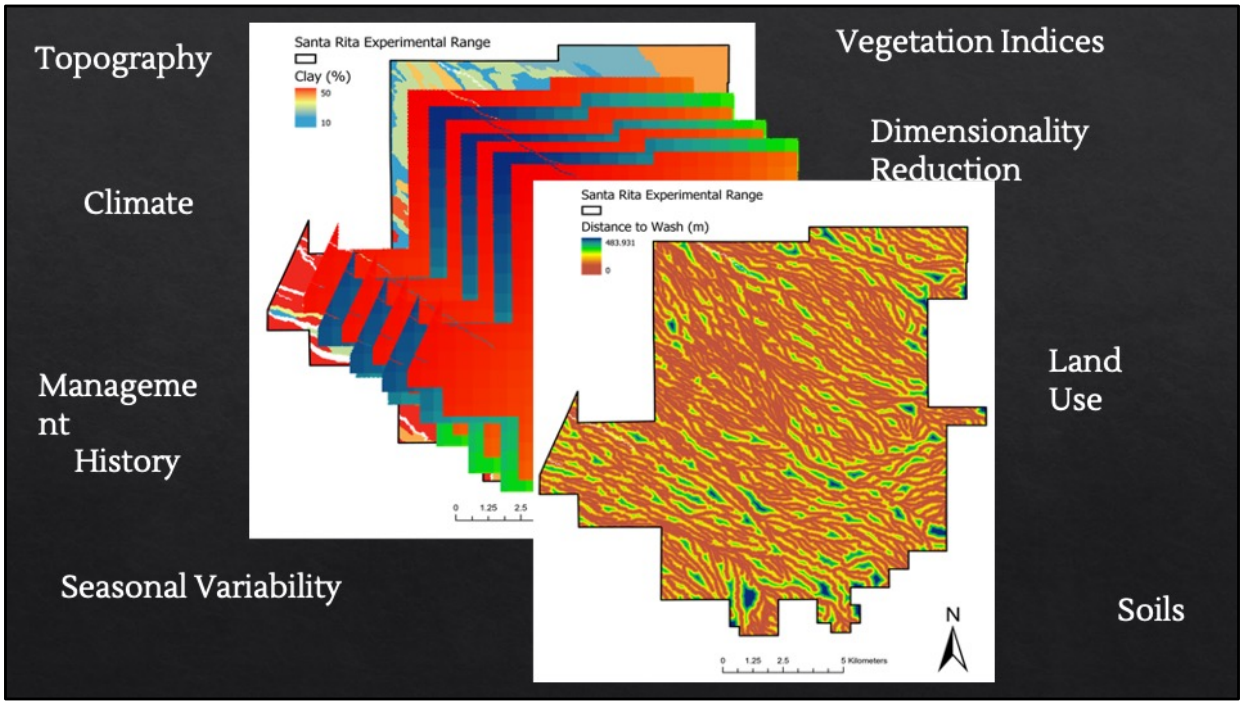
One common technique is herbicide application, either aerially as seen here or on the ground. Not only do herbicides have other serious environmental concerns but woody plants like mesquite can re-grow quickly following a treatment, not restoring the grasslands as intended.



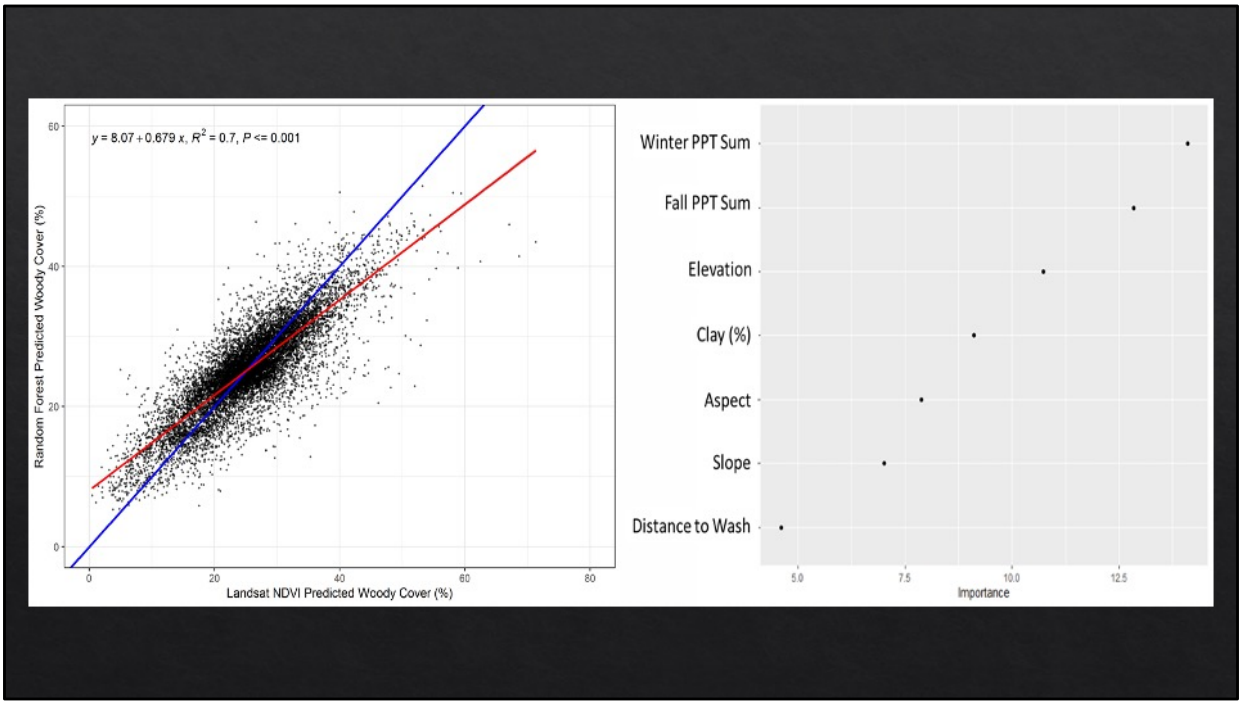
Also there's prescribed burning, or a fortuitous wildfire, which can damage shrubs, reducing resource competition, allowing for perennial grasses to thrive. Cost, agency approval, and close by infrastructure adds complications as well, despite a fire's potential ecosystem benefit.



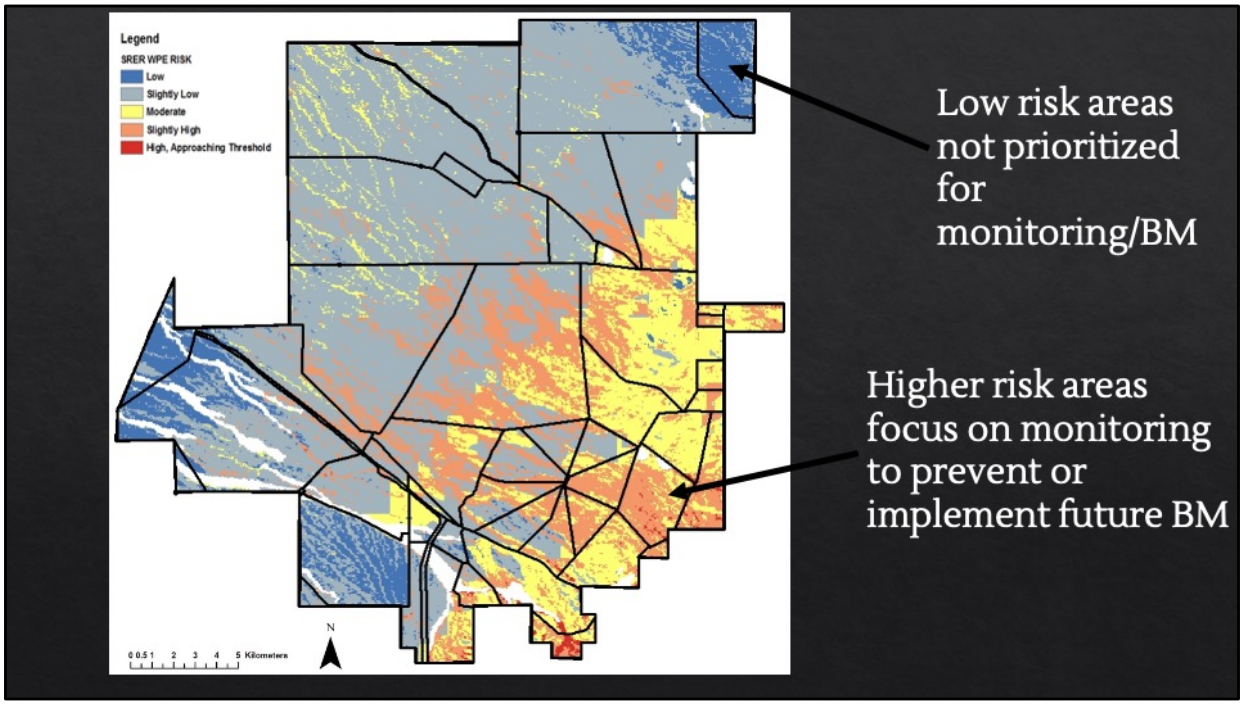
Based on site conditions, one of my goals is to be able to predict site woody cover and brush treatment potential using remote sensing products and its extracted woody cover values. We hypothesize why and how cover varies across this landscape, maybe due the soils, climate, management history, topography



We can spend many days and months measuring these variables on the ground, but when time and money is short, can we extract the same or comparable information from existing geospatial and remote sensing data sets and employ them in our ecological research?



Yes, where modern machine learning methods like Random Forests or Support Vector Machines provide promising predictions of a site's woody cover, much more so than standard regression models, while offering the most important biophysical and ecologically relevant variables to determine this woody cover.



Automating these computations, allows for expansion of our findings and apply them directly to management, where we can estimate a grassland's specific risk for additional woody plant cover across space and time, then target treatments and provide cost per area estimations to restore dry grasslands.

Highlight

- Climate change, heavy livestock grazing, and altered fire regimes can lead to a rise in shrub cover in the SW
- Land managers have tools to manage and restore Sonoran Desert grasslands, but with steep investments
- Site-level shrub cover controls and drivers elucidated via regional geospatial information
- Machine Learning can be a helpful technique to tackle common management and research objectives

To recap, climate change, grazing, and altered fire regimes can lead to a rise in shrub cover; land managers often employ costly tools to restore grasslands, geospatial data can provide valuable ecological insights; and machine learning can be an useful method to combine management and research goals

I return to this vista a final time. we love our dryland ecosystems, and field data is of course a premium. Now, doing “science from a distance” is not a compromise in time and money, it’s a promising option to expand our eye, tackle bigger ecological questions, and hopefully aid managers in preserving these landscapes.

If you have questions, feel free to email, provided here. I would like to thank my advisor, steve archer, my dissertation committee, the UA R community, and funders: USDA NIFA, Western SARE, and the Global Change Summer Research Award. Thank you for watching.