Biodiversity and Ecosystem Function: Predicting resistance to wildfire from spectral diversity

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Problem Statement

We are facing a crisis of ecological function.

- Biological diversity maintains ecosystem function, especially for the ecosystem function of ecosystem stability
- We are limited in our ability to measure diversity and ecosystem function from the ground across large spatial scales
- However, large-scale data allows for analyses that yield generalizable results
- One way to characterize biological diversity at large scales is the spectral species concept, allowing us to explore BDEF relationships at ecosystem-relevant scales.
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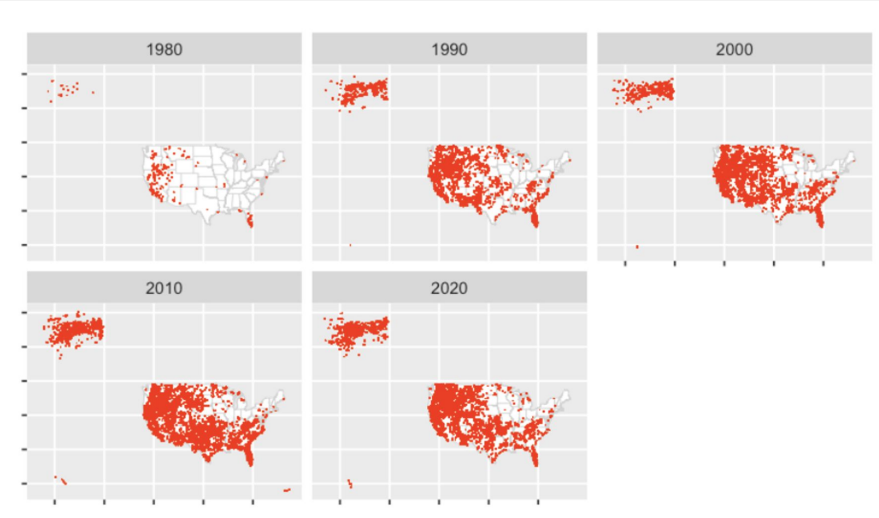
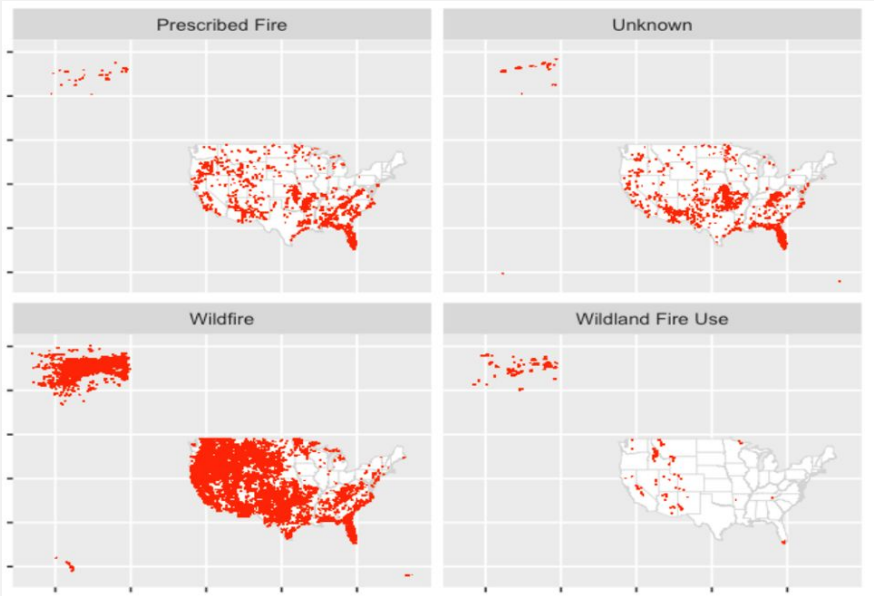
Rationale



Wildfire effects extend across the U.S.
Provides insights on the Wildfire Incident type



It would be of great societal benefit to understand how biological diversity affects resistance to fire

Scientific Question

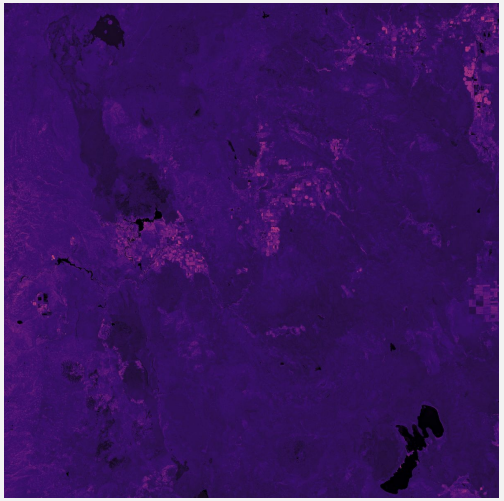
Objective: Explore Biodiversity-Ecosystem Function (BEF) relationships at large spatial scales using an environmental data cube

Question: How does biodiversity, characterized as spectral diversity from satellite remote sensing (Sentinel-2), confer resistance to wildfires?

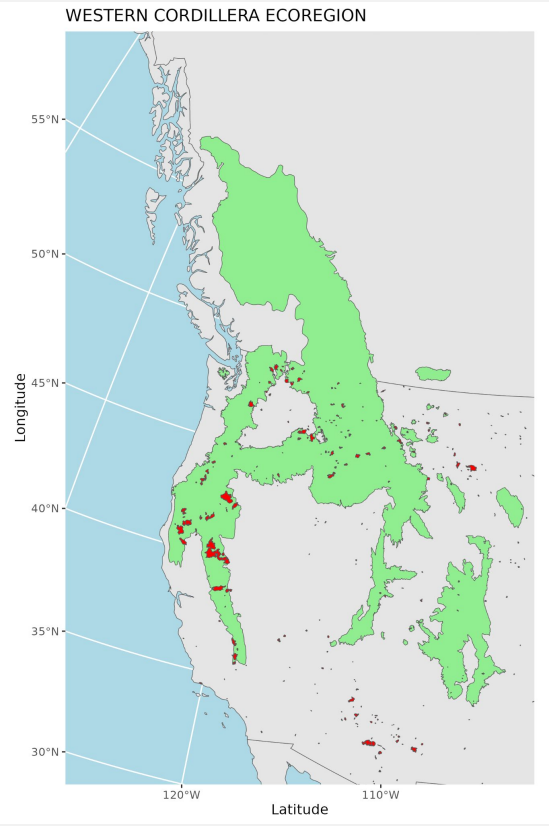
Hypothesis: Areas with higher spectral diversity of vegetation are more resistant to wildfires (i.e. reduced severity of wildfires)

Data

RGB
(Below)



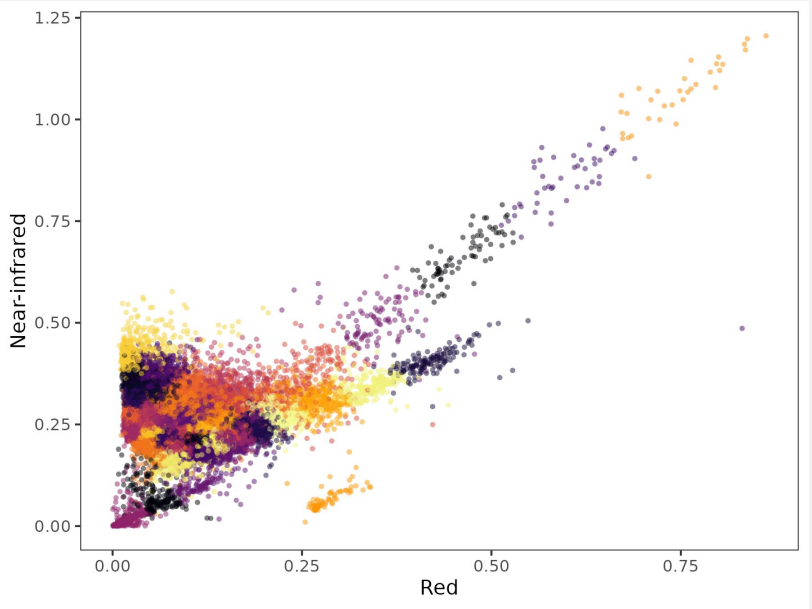
Multispectral Bands
(Above)



Western Cordillera
2021 Wildfires (Right)

Preliminary Analyses

- Use AI to generate spectral species via k-means unsupervised clustering
- Calculate spectral species diversity using a moving window



Forthcoming Analyses

Model the relationship between spectral diversity and fire severity

- Regression (supervised ML) with variable selection to identify the spatial scales at which biodiversity has the strongest influence on ecosystem function

- Leverage high-performance computing and data streams to improve predictions of the severity of future fires

Next Steps

Expand to different metrics of biodiversity and ecosystem function:

1. What is the relative influence of spectral and structural diversity in predicting ecosystem function?

2. For what types of ecosystem function is biodiversity most important (i.e., stock, flow, stability)?

Impact

Revolutionize our capacity to evaluate biodiversity variables at scale for near real-time forecasting and prediction of ecosystem function

- We present an open-source pipeline and data product with capacity to adapt to a high volume of new data

- Our results will allow for targeted interventions to manage biodiversity in areas with the most potential to impact ecosystem function

- For dissemination, we will take an iterative co-production approach with stakeholders to (1) identify priorities and (2) integrate into existing decision support tools for supporting healthy ecosystem functioning

Thank you for listening!

ACKNOWLEDGEMENTS:

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https://github.com/CU-ESIIL/hackathon2023_A