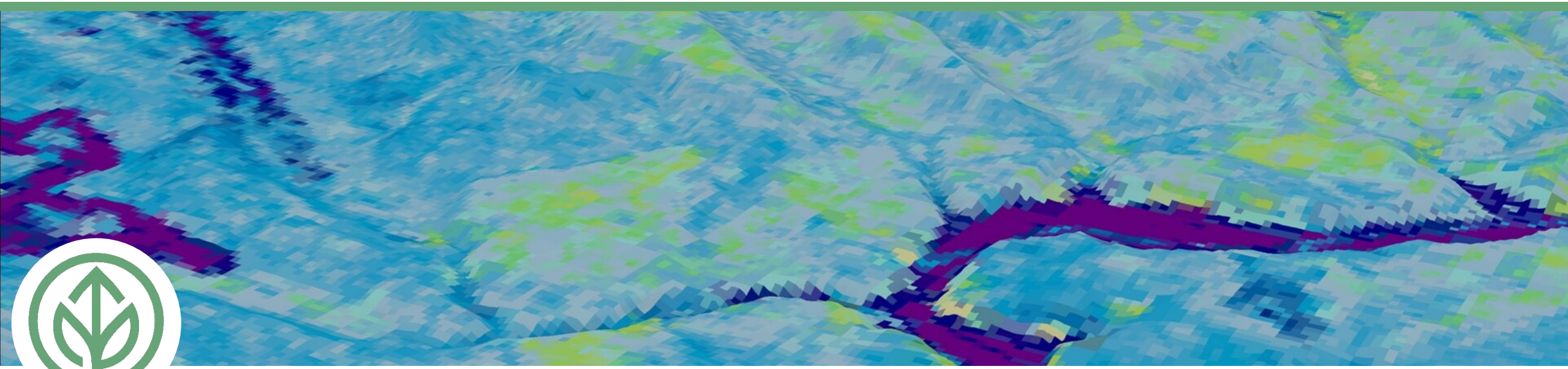
National Aeronautics and Space Administration



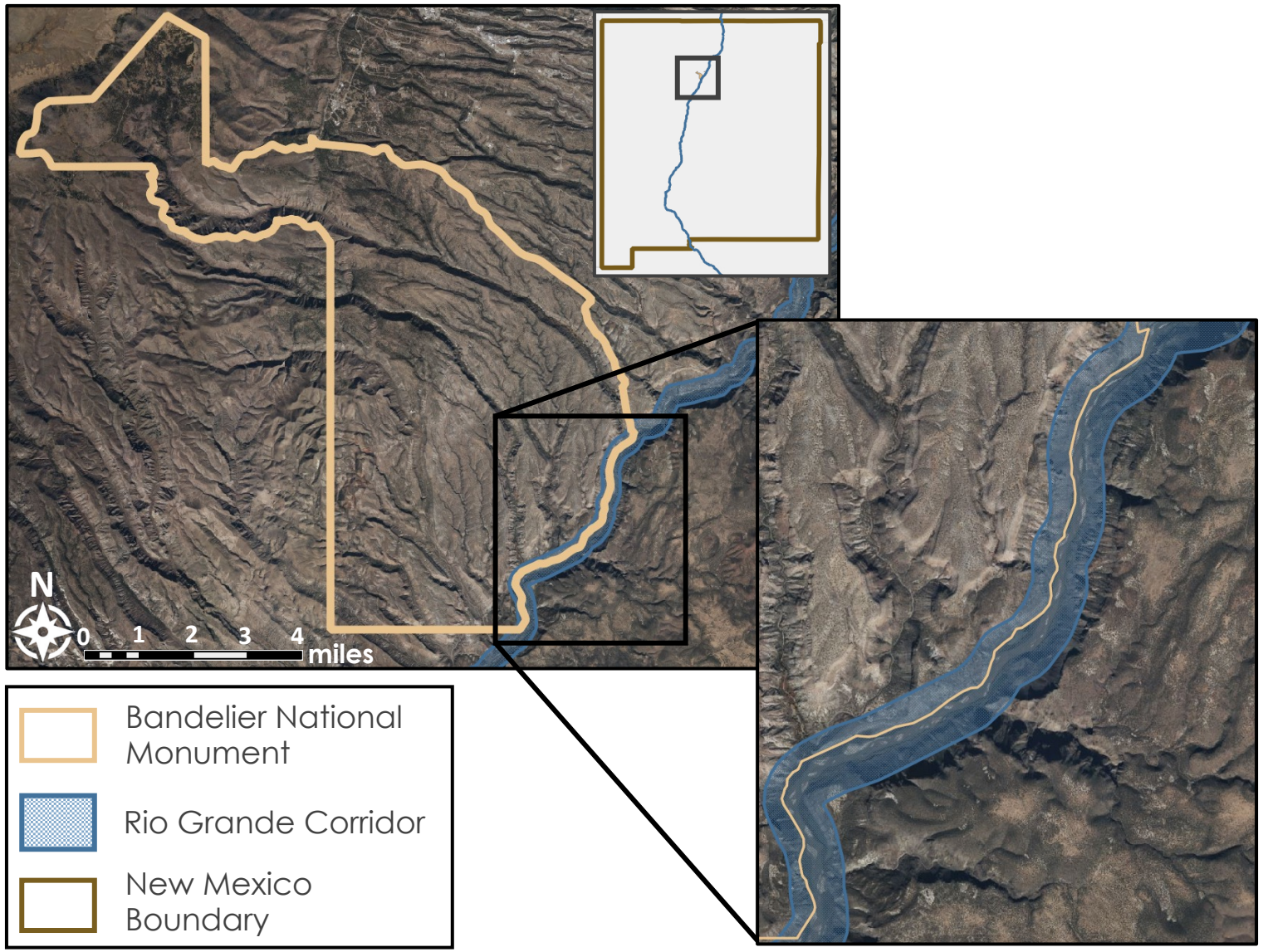
Bandelier Ecological Conservation

Mapping Invasive Species Along the Rio Grande Corridor in Bandelier National Monument

Evan Barrett • Megan Rich • Nusrat Zahan Jarin • Chloe Johnson

25TH DEVELOP ANNIVERSARY

Study Area



Study Period

June 2019 – June 2023

Community Concerns

Possible displacement of native species

Extreme events and soil degradation

Biodiversity loss and vegetation degradation

Photo credit: Sally King; Brian Jacobs; NPS

Partners

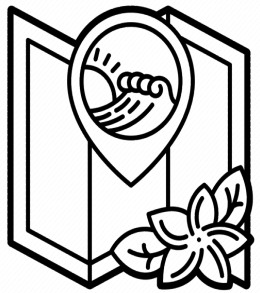
End User

National Park Service,
Bandelier National Monument

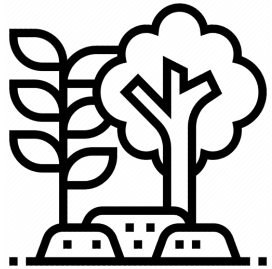
Objectives

Determine the extent of invasive species in the Rio Grande corridor over the past 5 years.

Produce vegetation classification maps



Visualize vegetation change using maps and timeseries analysis.



Assess the feasibility of using hyperspectral data to identify invasive species

Russian Olive

Siberian Elm

Saltcedar

Photo credit: Bandelier National Monument

Earth Observations

Multispectral Imagery

Landsat 8 OLI
30m, 11 bands

Sentinel-2 MSI
10m, 13 bands

Hyperspectral Imagery

ISS DESIS
30m, 235 bands

Image Credit: NASA, Rama, DLR, Pixabay

Methodology

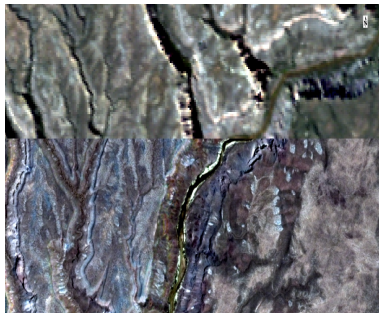
Data Processing

GEE
Landsat 8 OLI
Sentinel 2 MSI

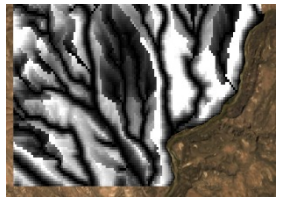
ENVI
ISS DESIS

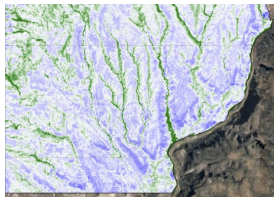
True Color Image

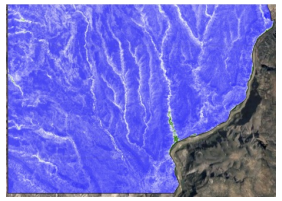
Pan Sharpening

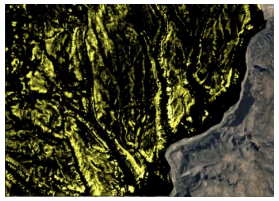


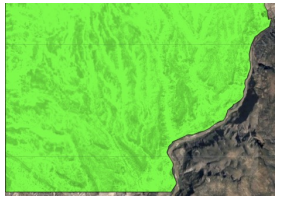
Index Calculation

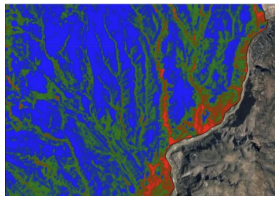

HAND

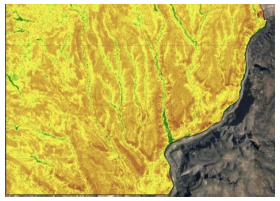

NDVI

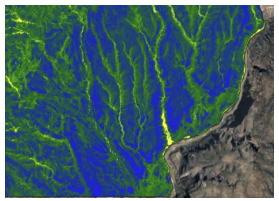

EVI

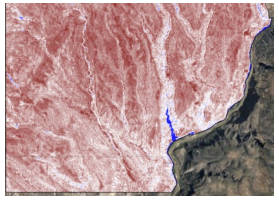

TCB


LAI

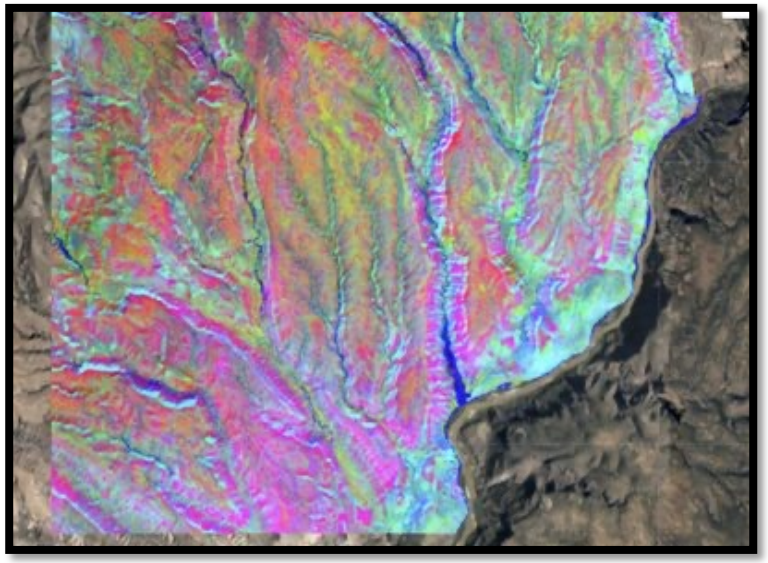

TCW


MSAVI

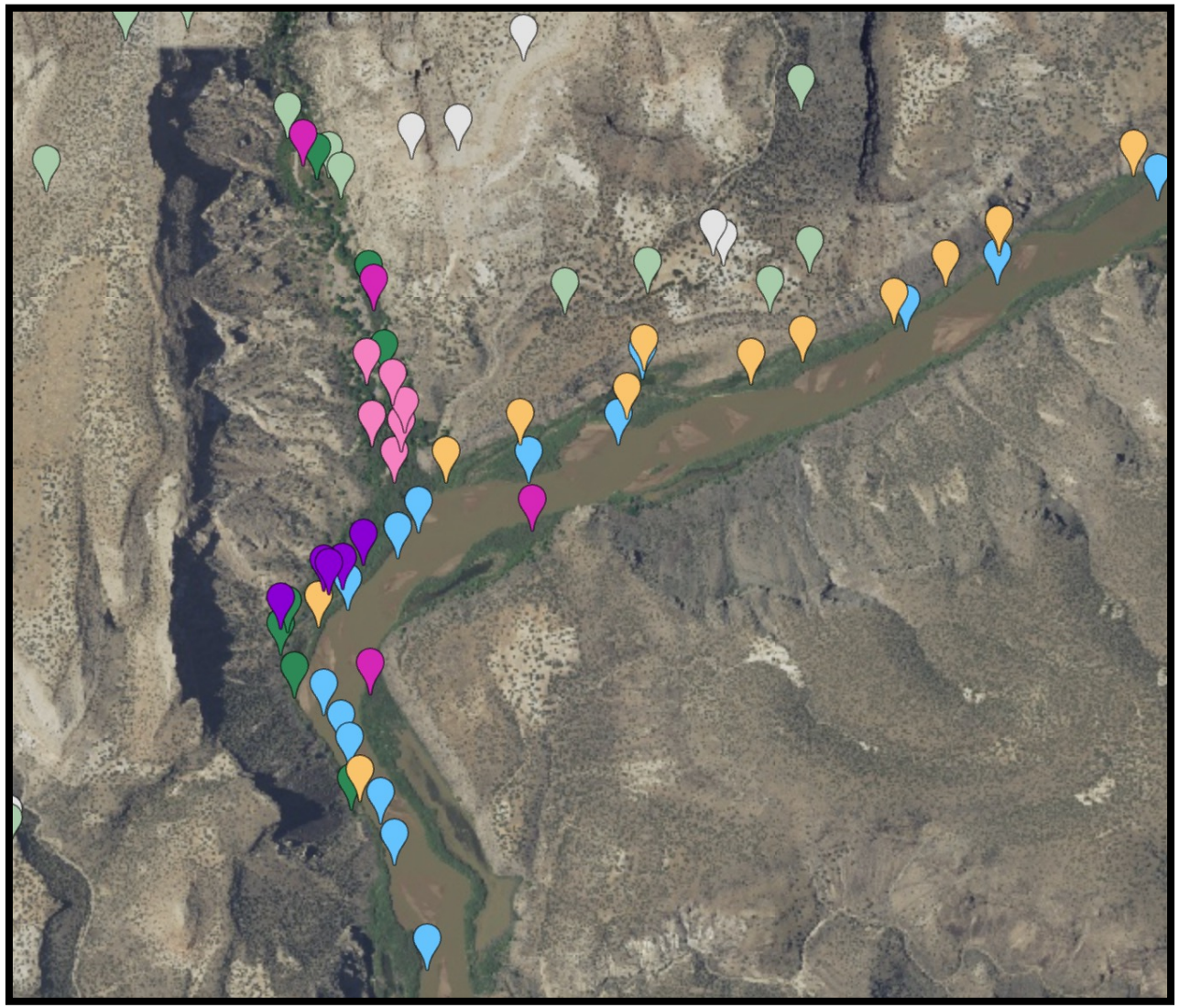

TCG


NDMI

Principal Component Analysis



Training Points



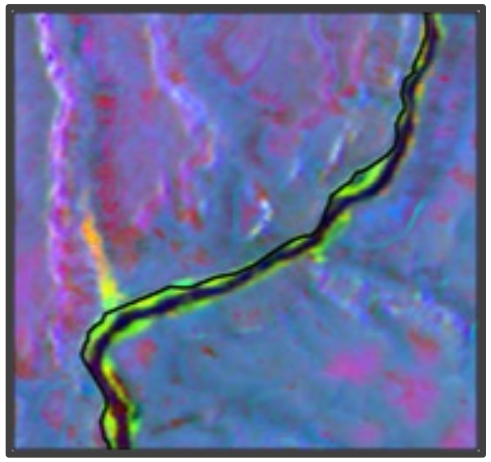
NAIP Imagery
475 training points
May 2022

- Bare Soil / Rock
- Water
- Riparian Vegetation
- Siberian Elm
- Russian Olive
- Grass and Shrubland
- Cottonwood
- Saltcedar

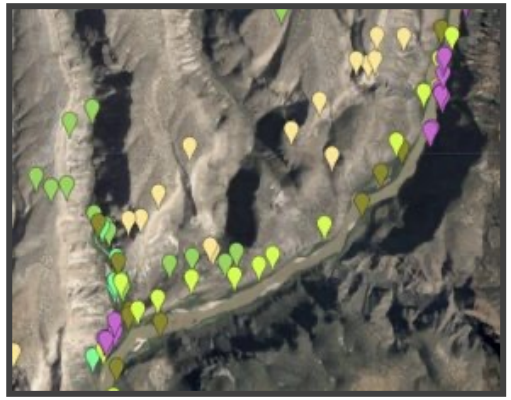
Methodology

Classification

Processed Image

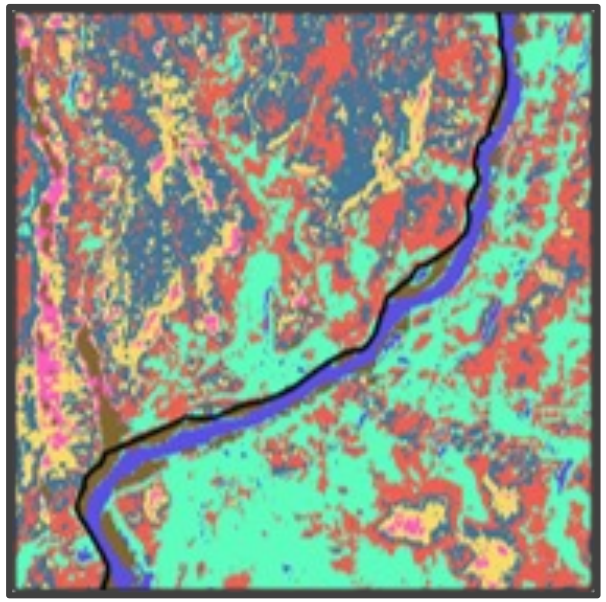


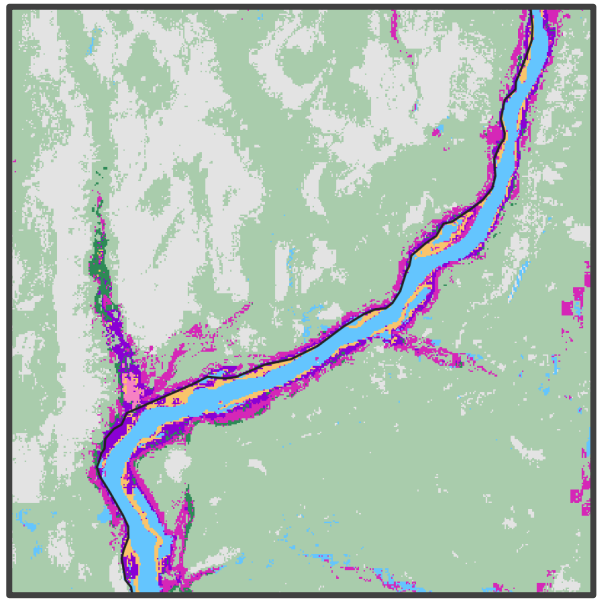
PCA Image



Training Points

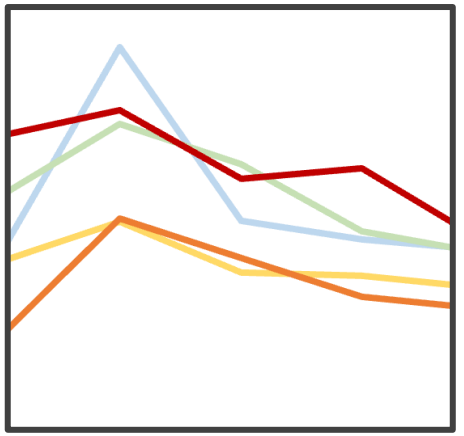
Unsupervised Classification

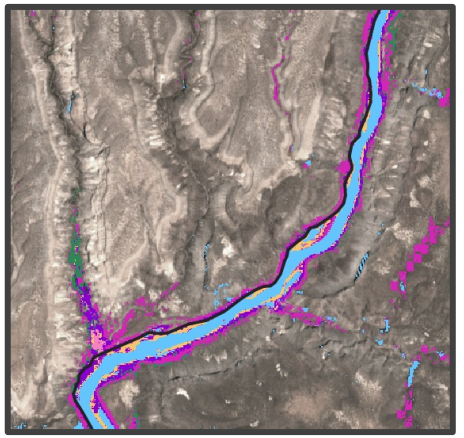




Supervised Classification

Time Series

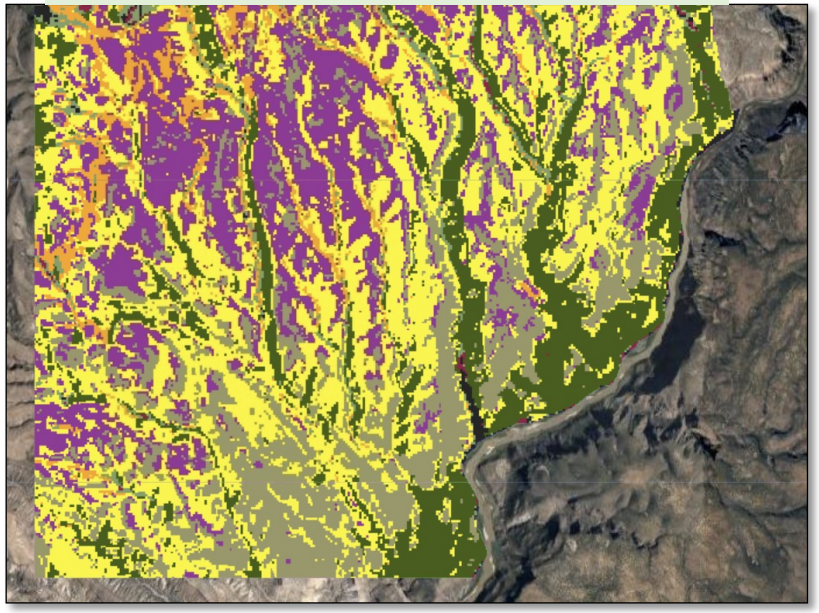




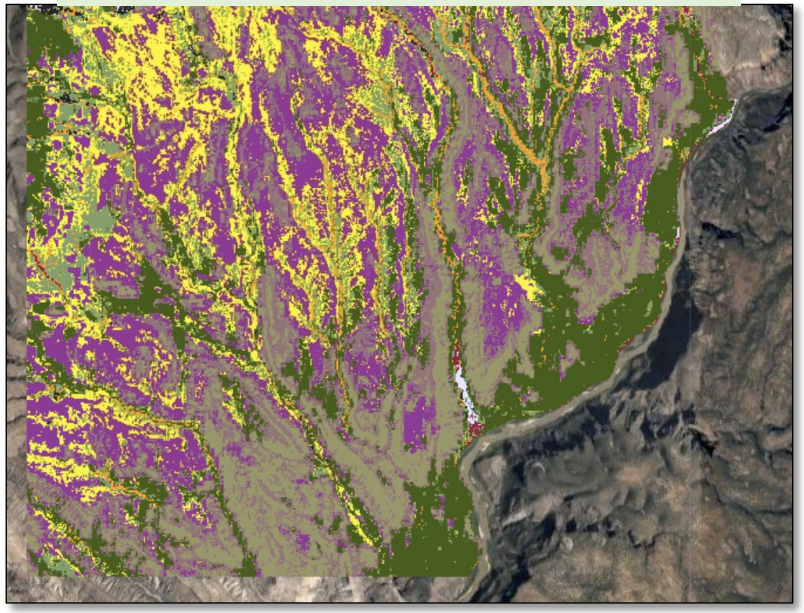
Accuracy Assessment

Results (Unsupervised K means)

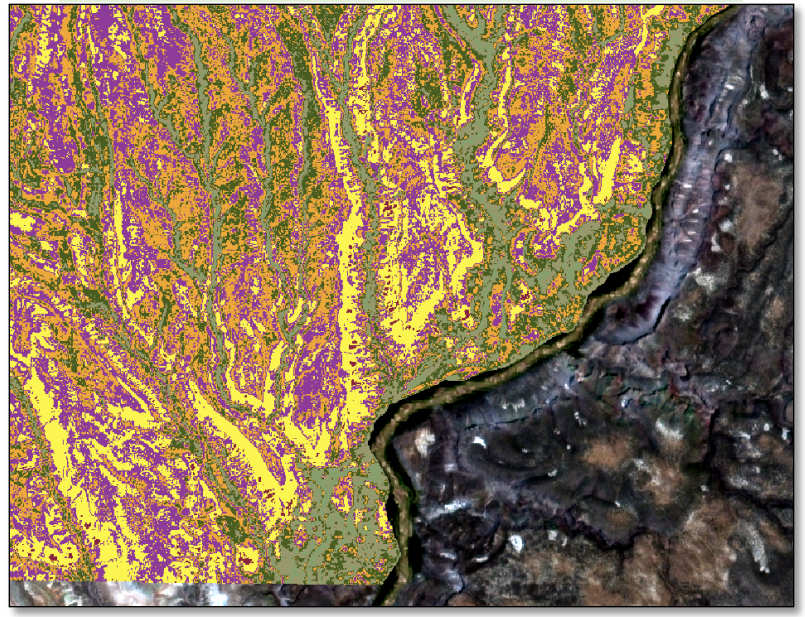
Landsat 8

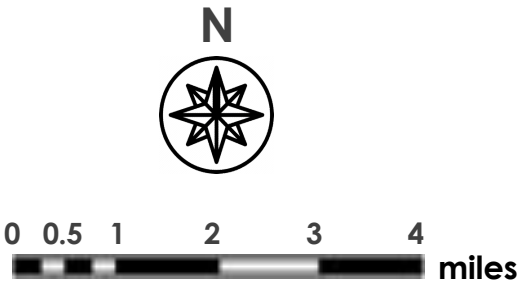


Sentinel-2



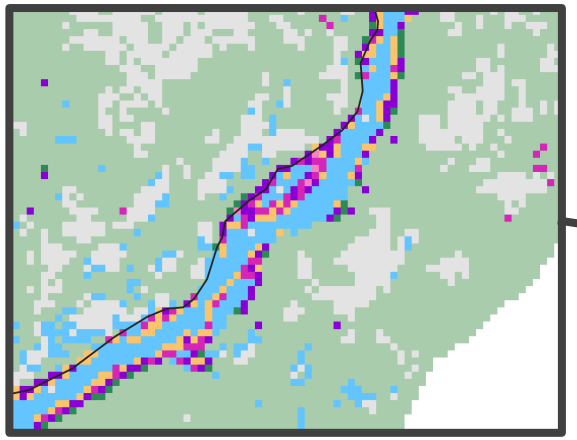
DESIS 2022



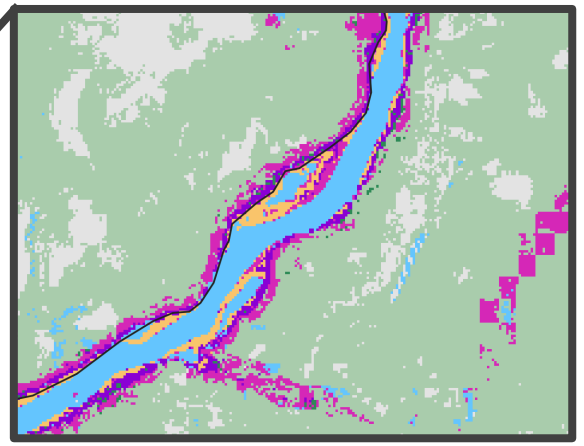


Supervised Classification (2022)

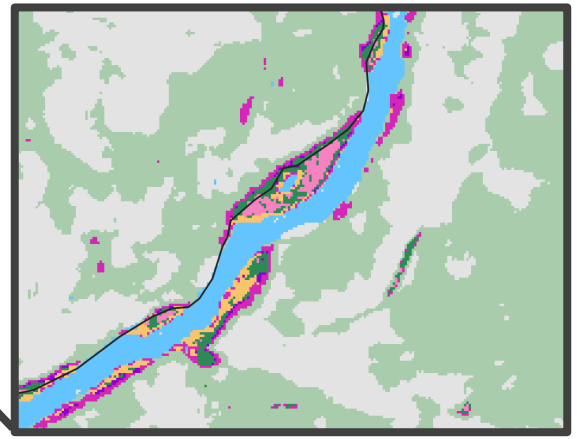
Landsat 8

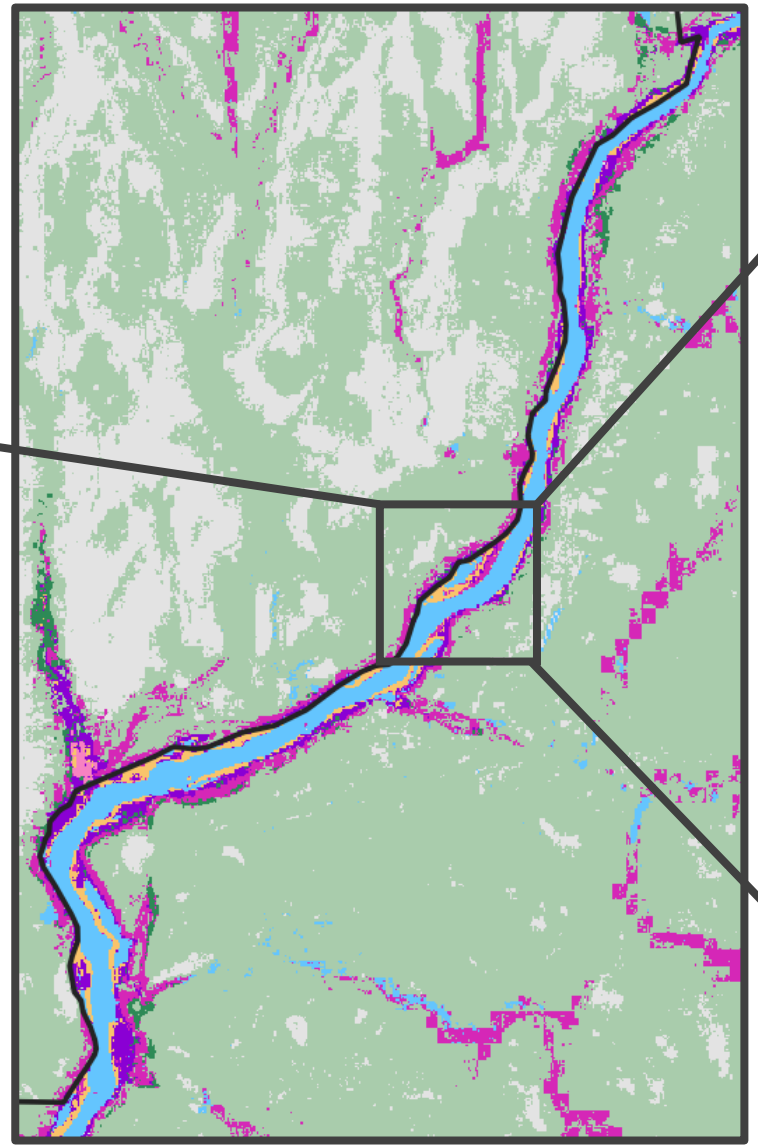


Sentinel-2



DESIS



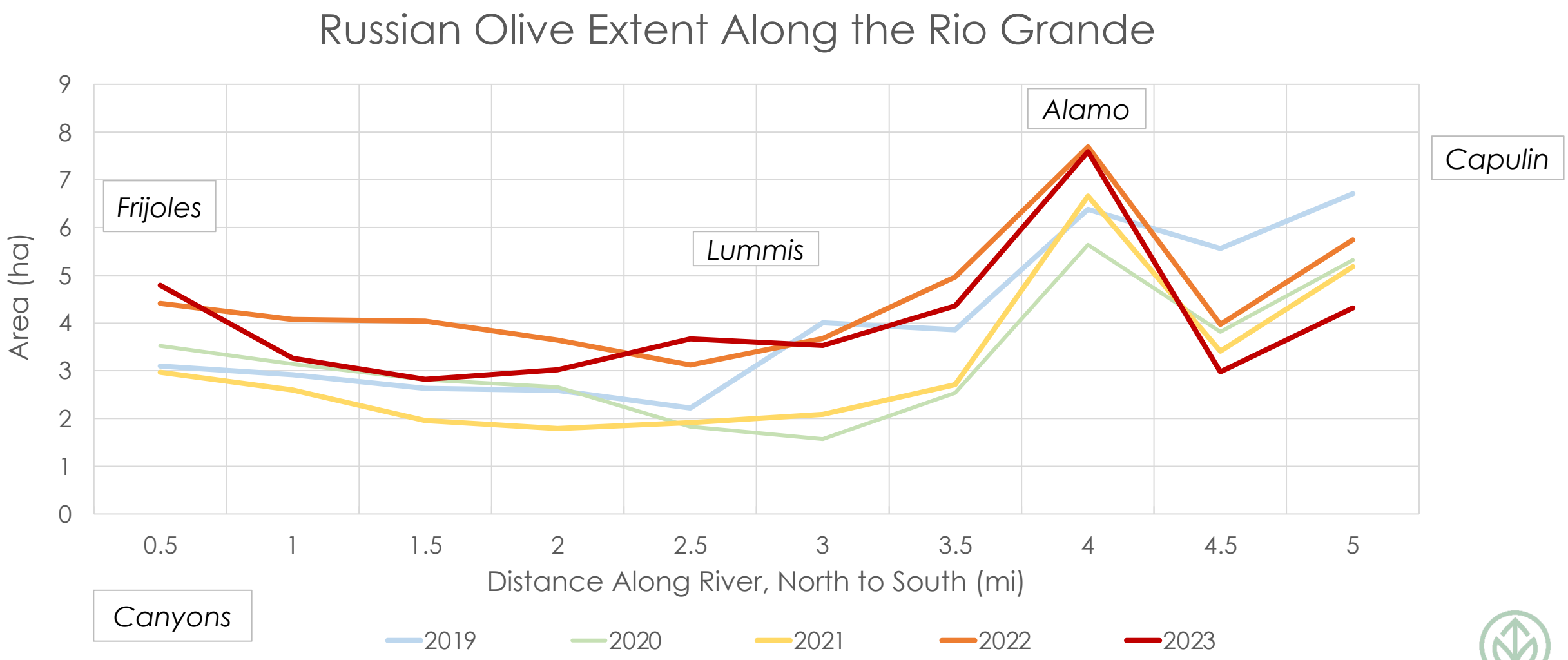


Land Classes

- Siberian Elm
- Bare Soil and Rock
- Native Riparian Vegetation
- Russian Olive
- Cottonwood
- Water
- Saltcedar
- Grasses and Shrubs

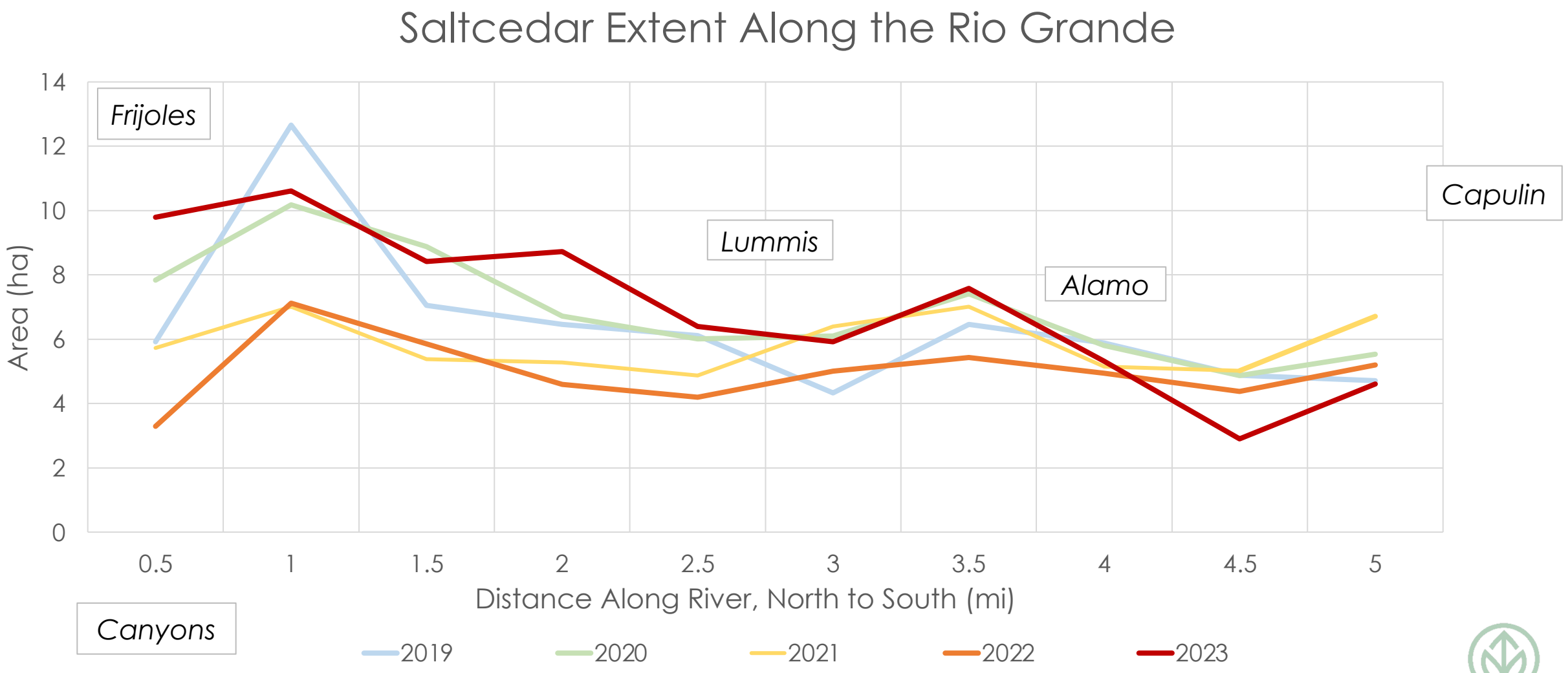
Results

River transect graph and time series



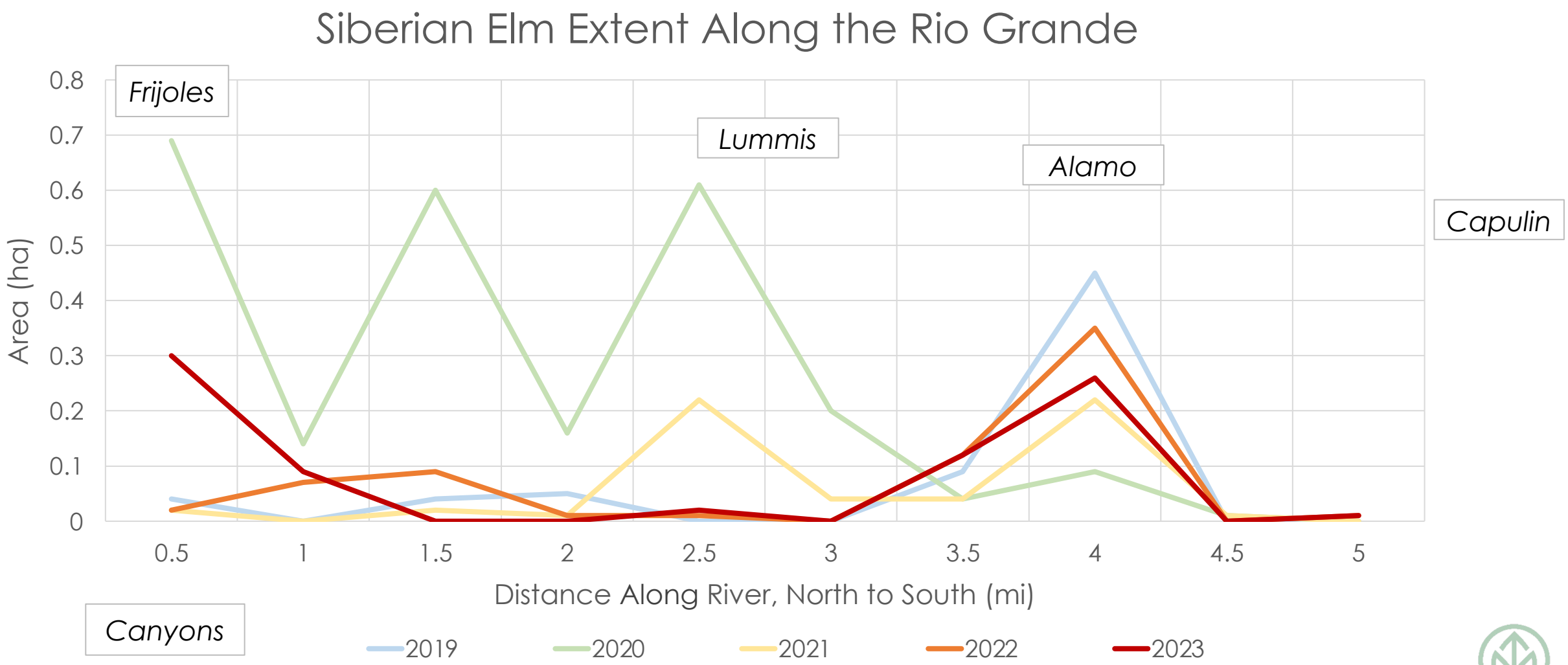
Results

River transect graph and time series



Results

River transect graph and time series



Conclusions

- **Principal Component Analysis** effectively reduces inputs for classification of vegetation
- **Supervised classifications** using remotely collected training data can identify distinct species of vegetation with **greater than 50% validation accuracy**
- The time series analysis shows that the extent of invasive riparian species in BAND has **increased** by **5.7%** between 2019 and 2023
- Based on vegetation classifications, the abundance of invasive species **peaks** in areas where canyons meet the Rio Grande corridor

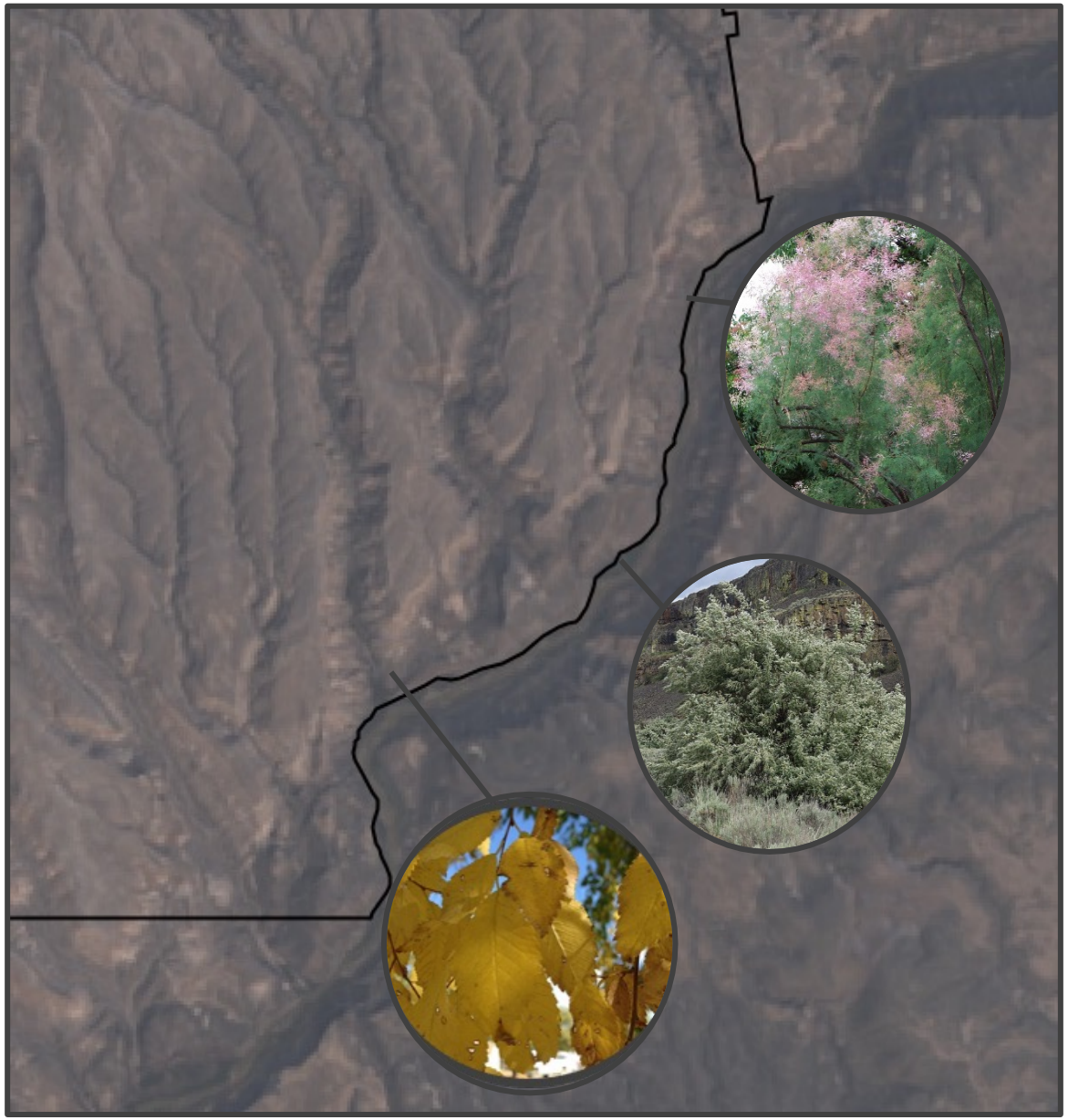
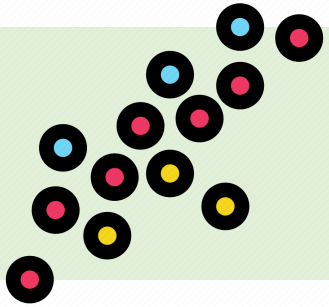


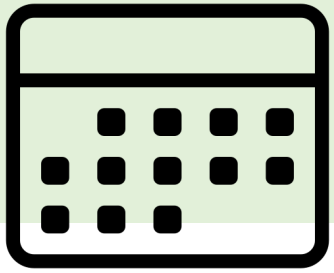
Image Credit: Walter Siegmund, Jerzy Opiota, Famartin

Errors and Uncertainties



Limited field training points to train the random forest classifier

Limited ground truthing data for historical classification



Temporal inconsistency among multispectral and hyperspectral datasets

Future Work

- Collecting and incorporating **field data**
- Utilizing **high-resolution imagery** to increase spatial precision
- Implementing additional **phenological characteristics** of the invasives

Image Credit: U.S. Fish and Wildlife Service

Acknowledgments

Fellow

- **Sarah Payne** (University of Georgia)

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Partners

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- **Anna Wheeler** (NPS, Southwest Invasive Plant Management Team, New Mexico Project Lead)
- **Kay Beeley** (NPS, BAND Ecologist)
- **Priscilla Hare** (NPS, BAND Biological Technician)
- **Laura Trader** (NPS, BAND Fire Ecologist)
- **Cassandra Suddath** (NPS, BAND Interpretation Staff)

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