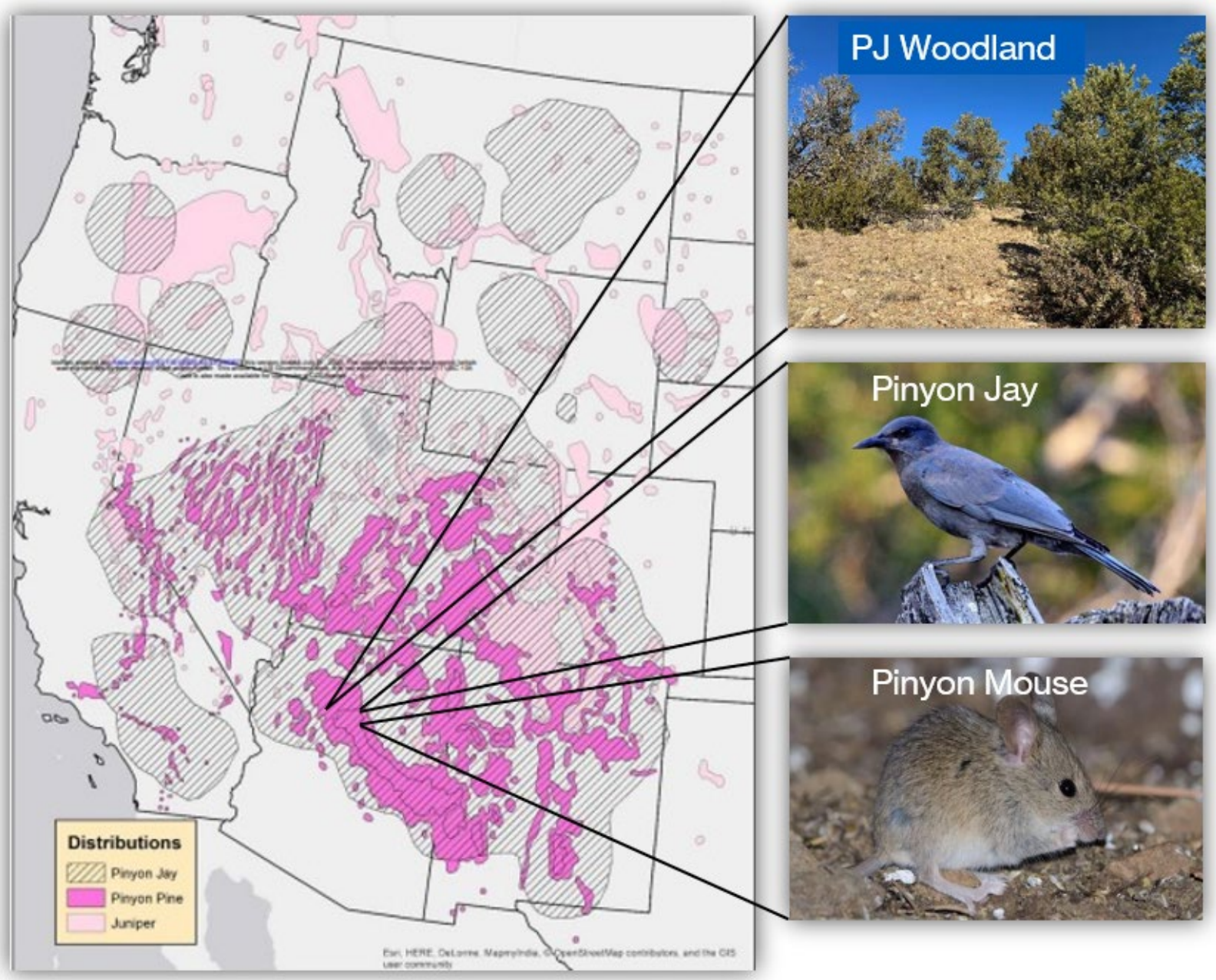
Modeling the Effects of Climate Change and Potential Management Interventions on Pinyon Juniper Woodland Distribution Using Aerial Imagery

Maria Teresa Hernandez, Amy V Whipple
Northern Arizona University
MS Project
NCER April 18, 2024

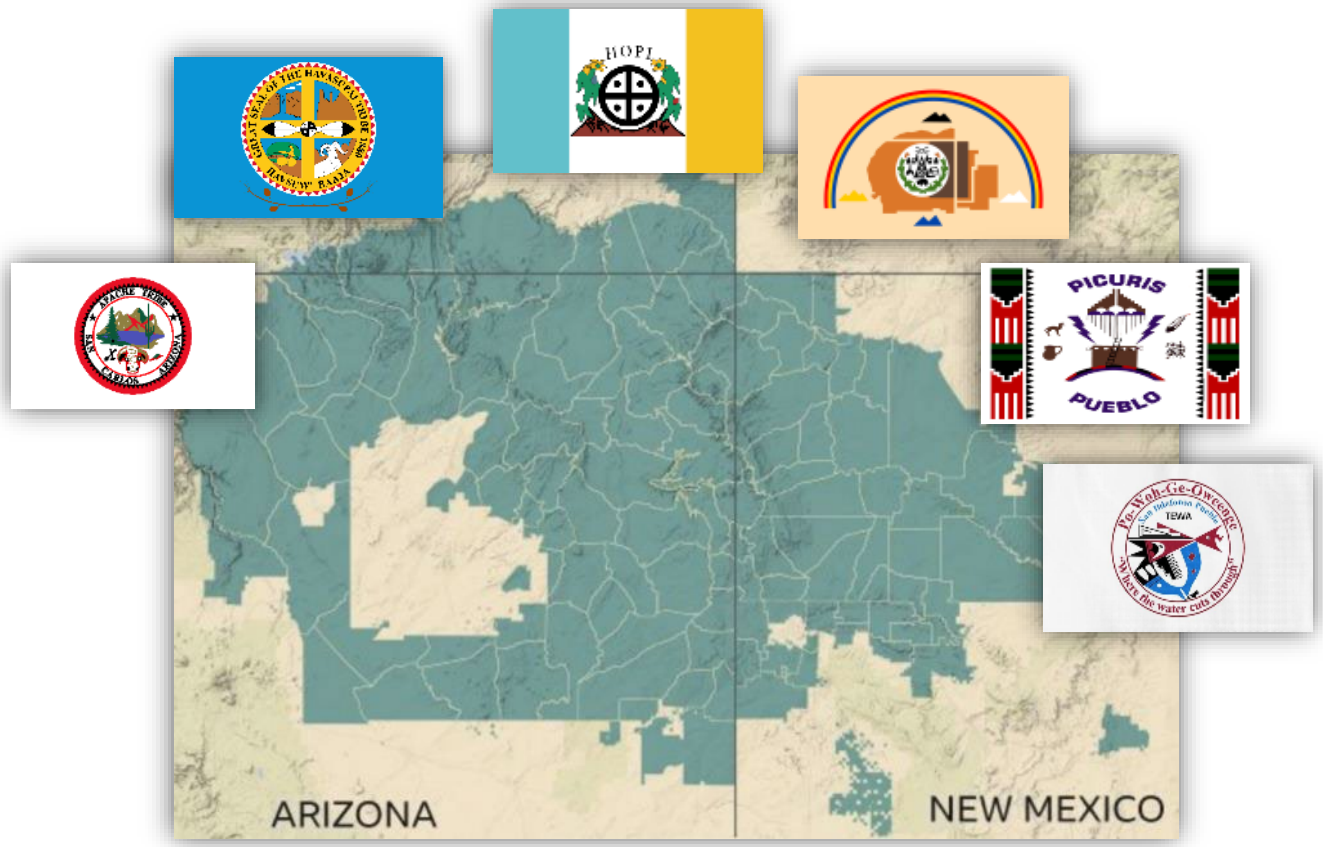
Talk Outline

- Pinyon Juniper Ecosystem Background
- Past REU NAU Projects
- MS Project – Pinyon Juniper & GIS
- Compiling the Data
- Final Steps

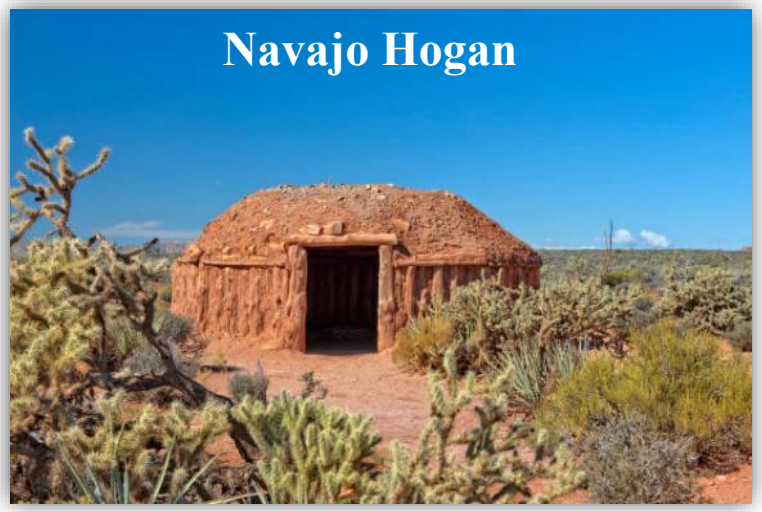
Pinyon - Juniper Ecosystem



Pinyon – Juniper Ecosystem



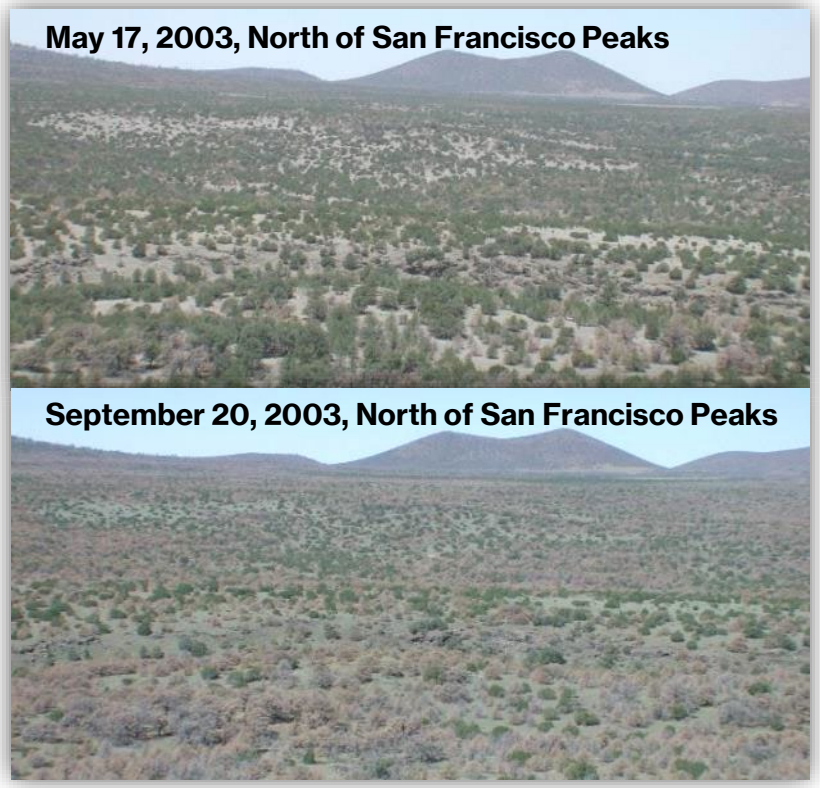
People of the Southwest



Juniper Branches for Culinary Ash

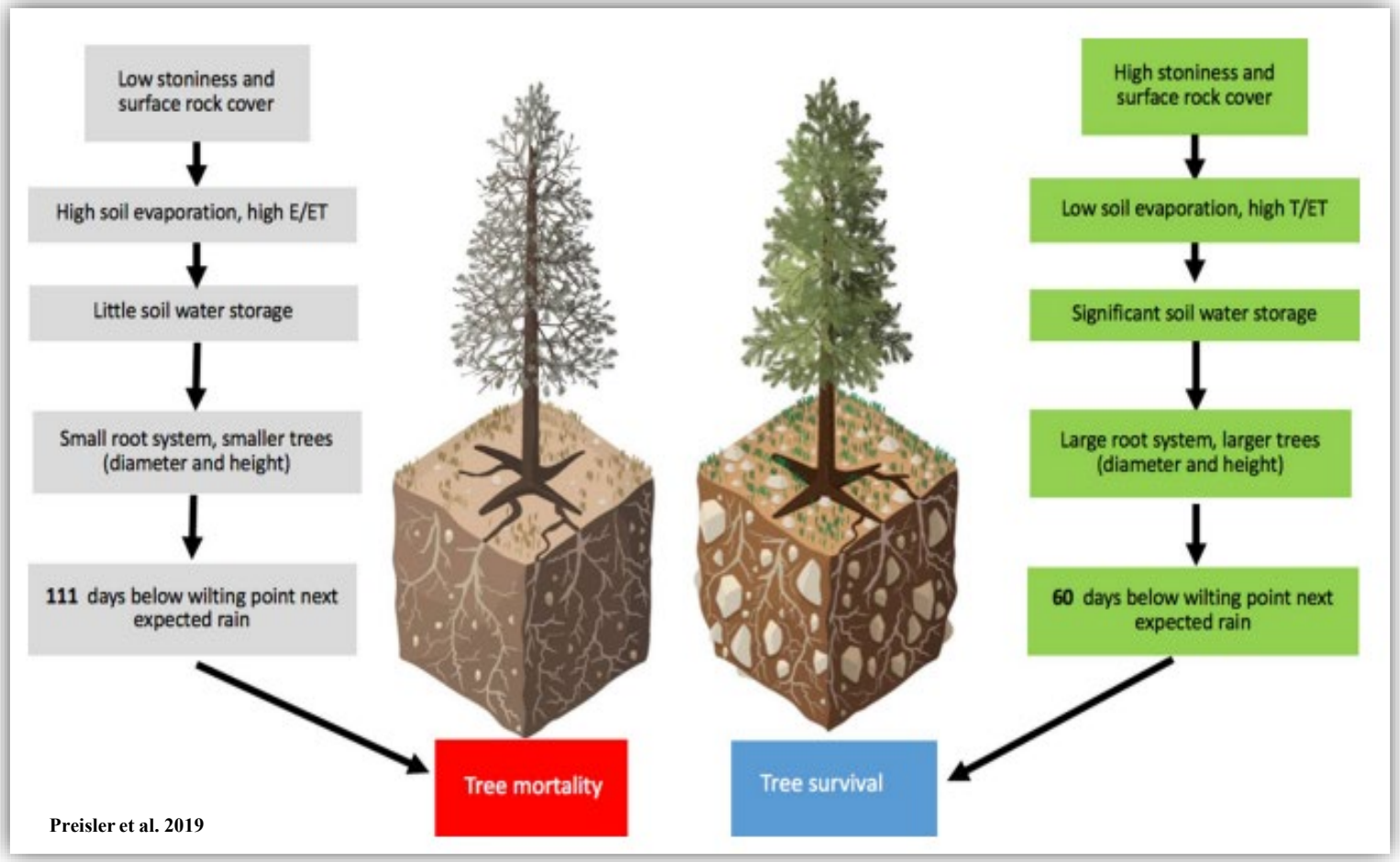
Pinyon Pine Seeds

Pinyon – Juniper Ecosystem & Mortality



- Regional mortality rose from 135,780 acres in 2021 to 355,900 acres in 2022.
- Majority of Mortality occurred in the Kaibab National Forest in AZ & The Navajo Nation.

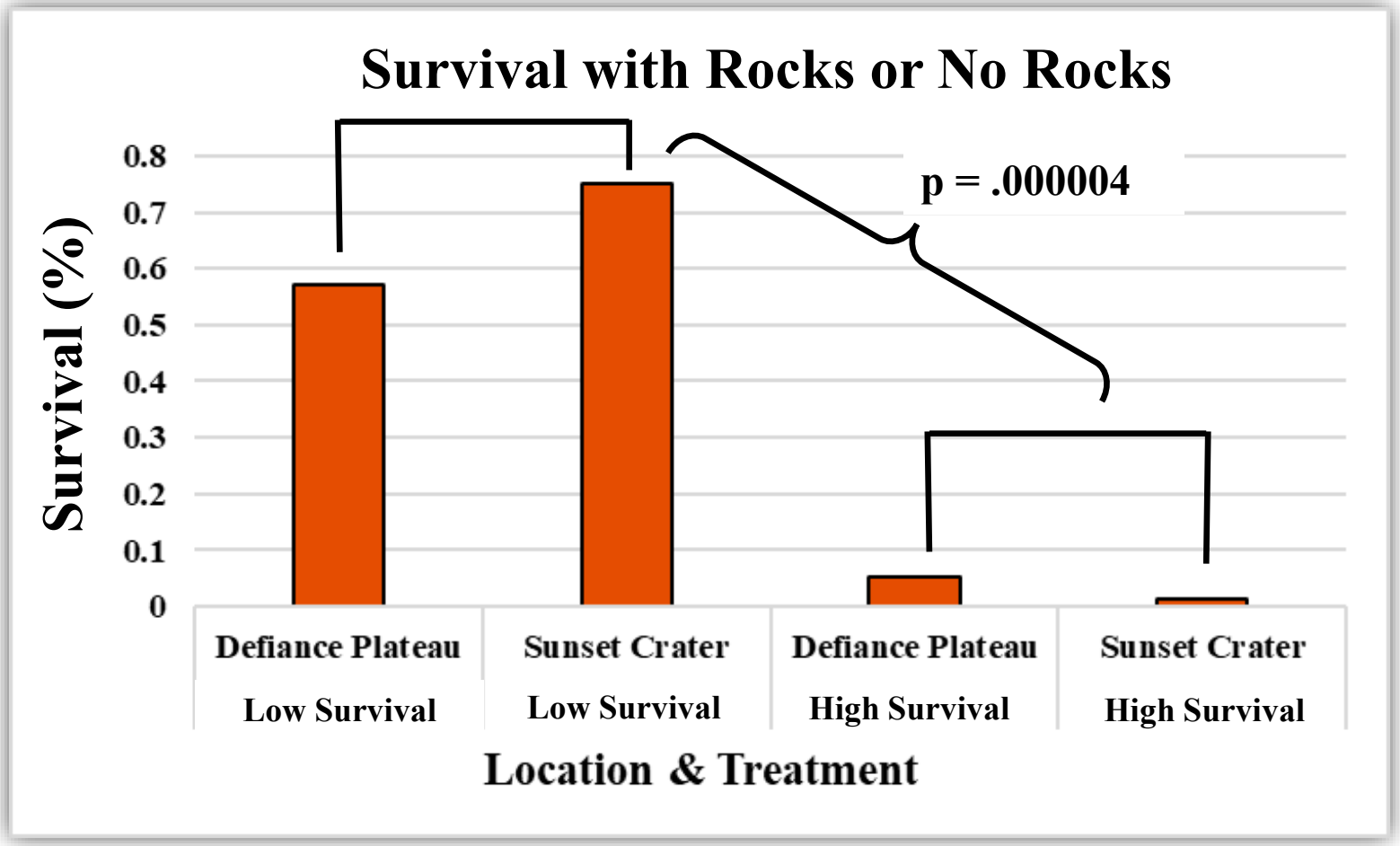
Drought Survival Strategy



2019 REU NAU Project

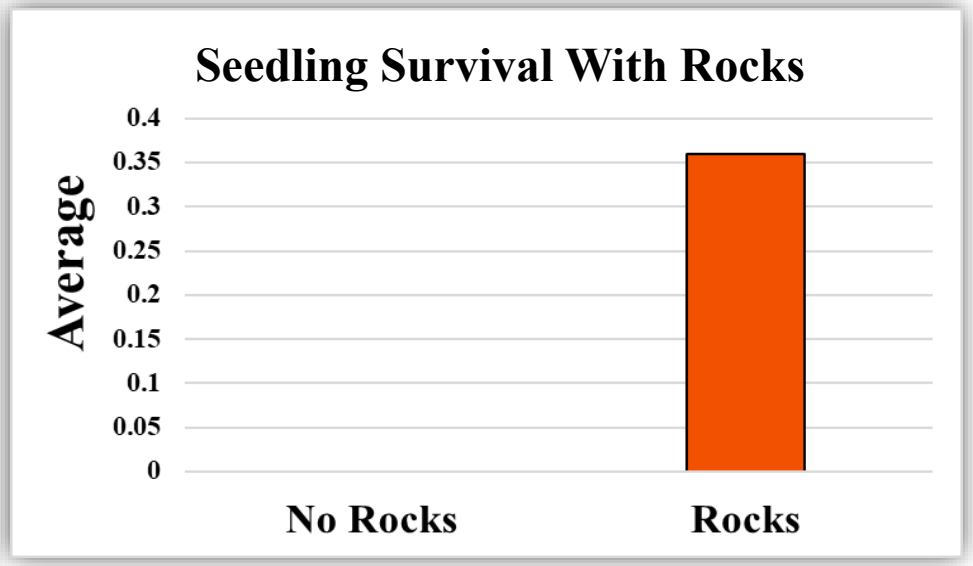
Photo by Nicole Pino

Photo by Nicole Pino



NAVAJO TECHNICAL UNIVERSITY
EST. 1979
NITSÁHÁKEES NÁHATÁ IINÁ SIIH HASIIN

2022 REU NAU Project



NAVAJO TECHNICAL UNIVERSITY

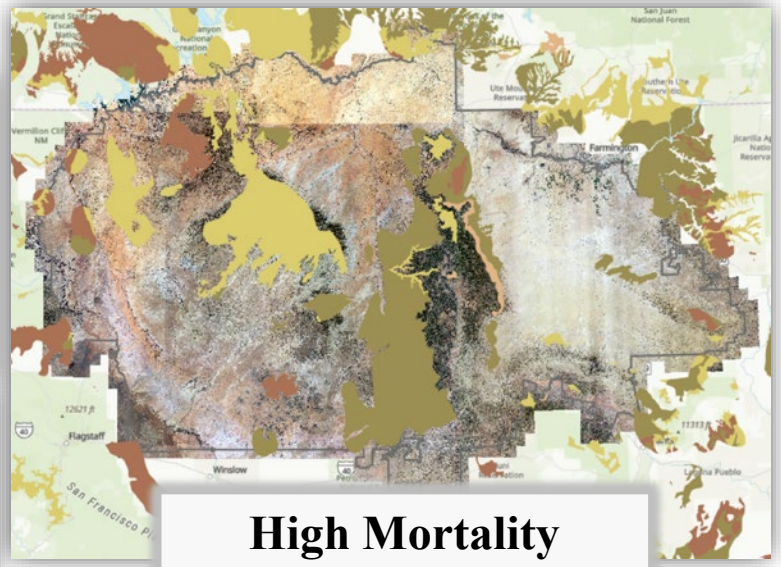
Is there a landscape level pattern of higher survival where there are more rocks?

- Where are the trees surviving and where are they not?
- What soil, geological, & climatic factors are contributing to the issue?
- Where are good areas to plant seedlings that will have high survival rates for restoration?

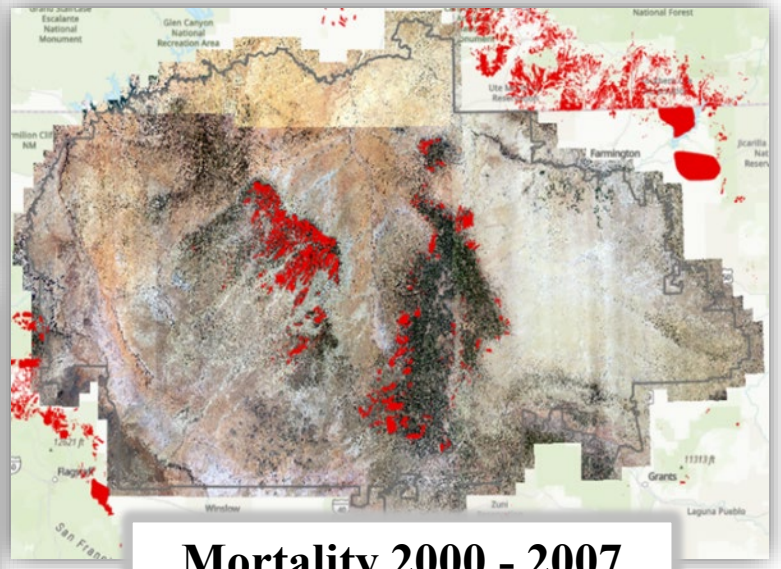
- **Hypothesis** – Mortality will be lower where tress are growing in or around boulders, shallow rocks, and bedrocks.

Rocks

No Rocks



High Mortality Vulnerability Soils

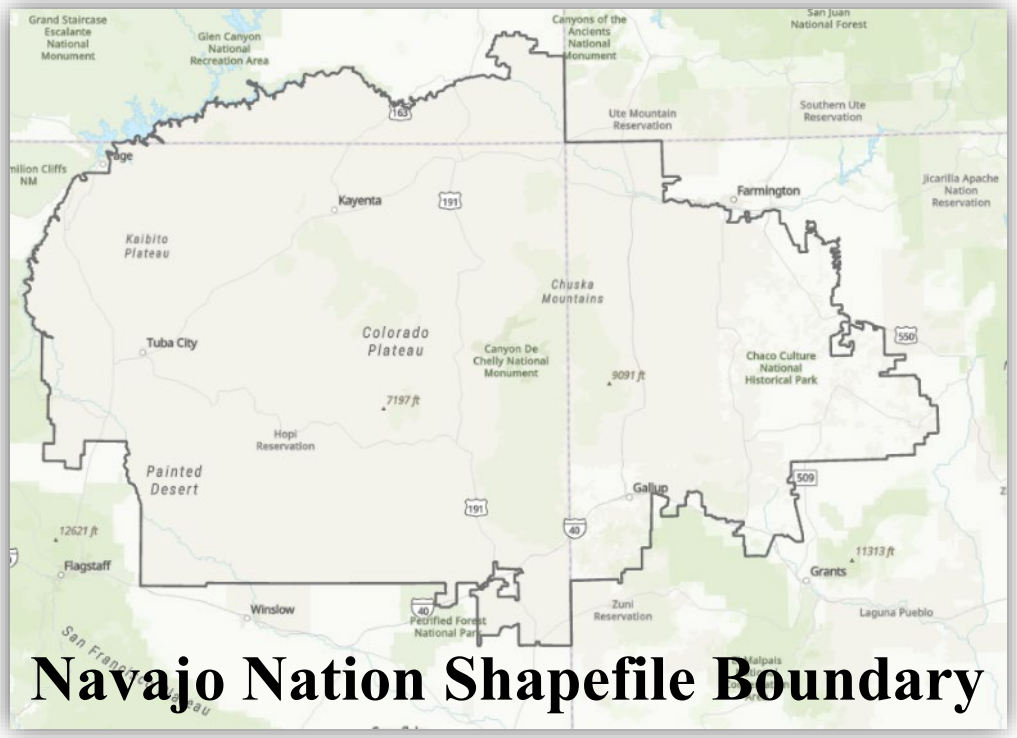


Mortality 2000 - 2007

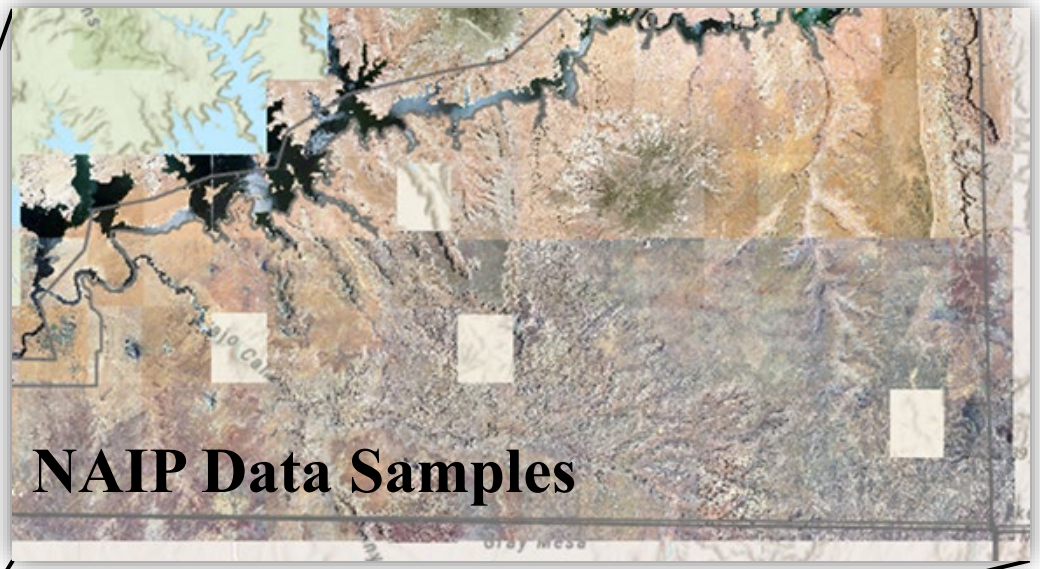
Study Site - Navajo Nation

National Agricultural Imagery Program

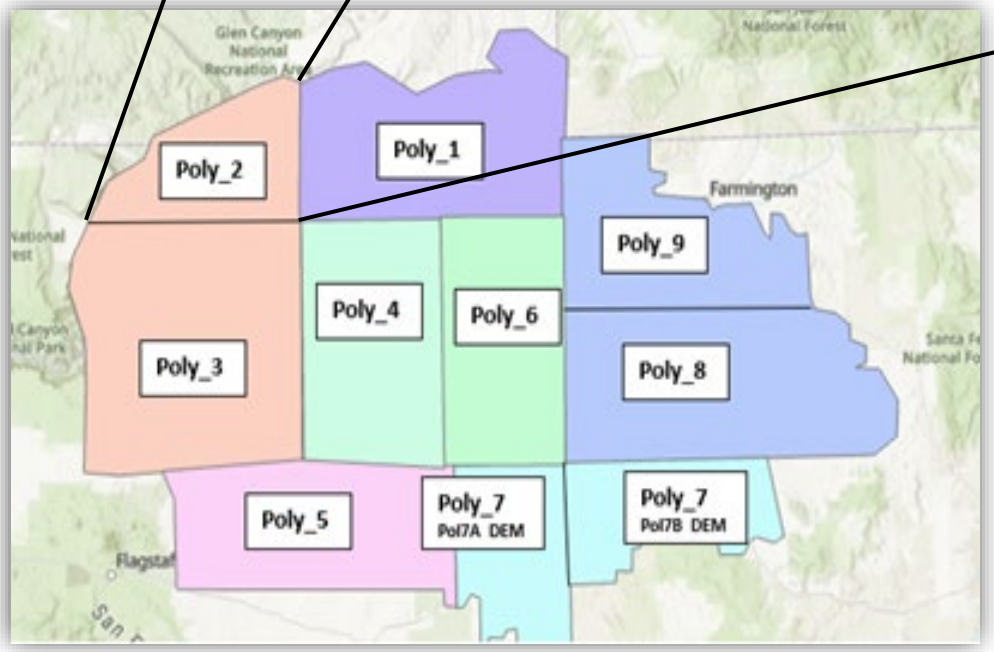
NAIP



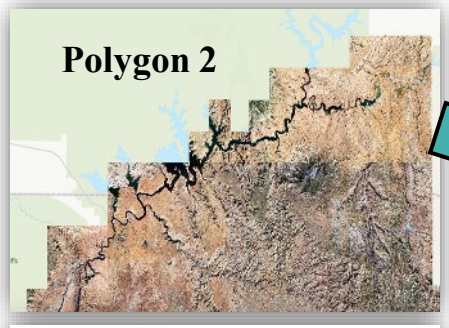
Navajo Nation Shapefile Boundary

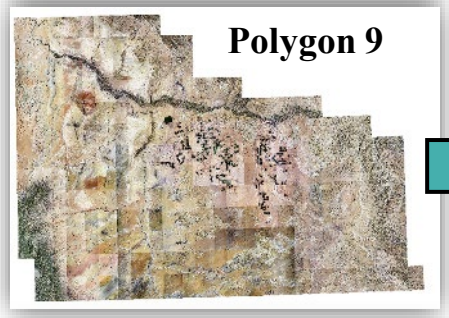


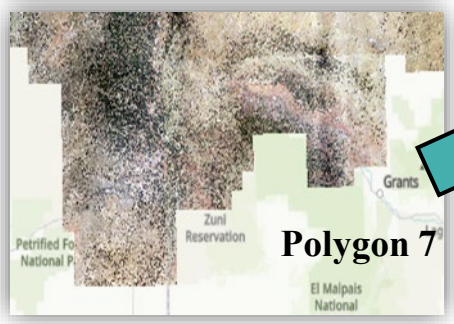
NAIP Data Samples



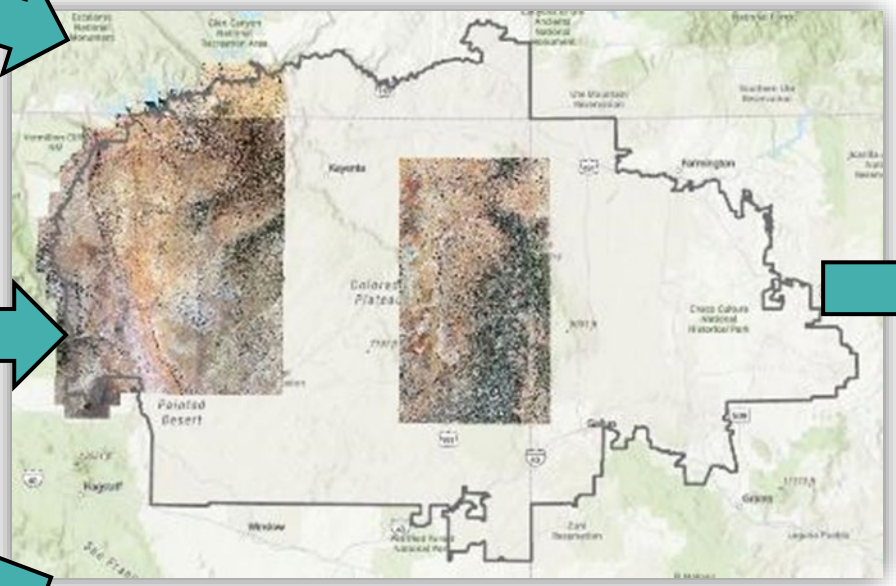
Compiling the Data



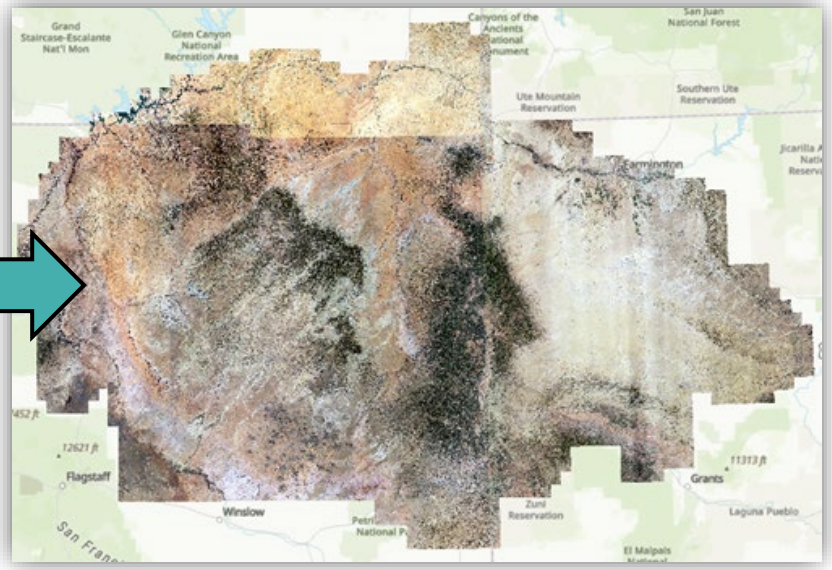




Individually Mosaicked Polygons

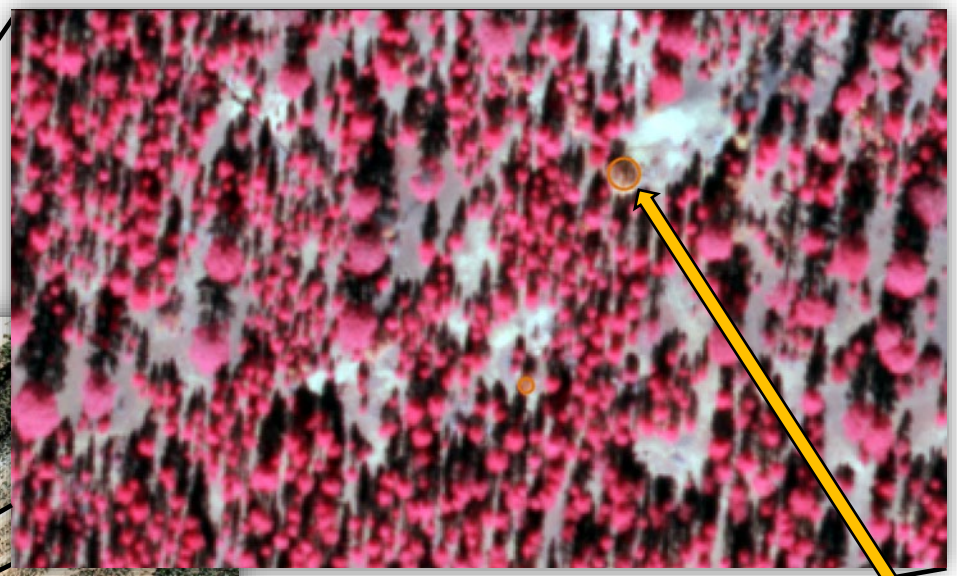


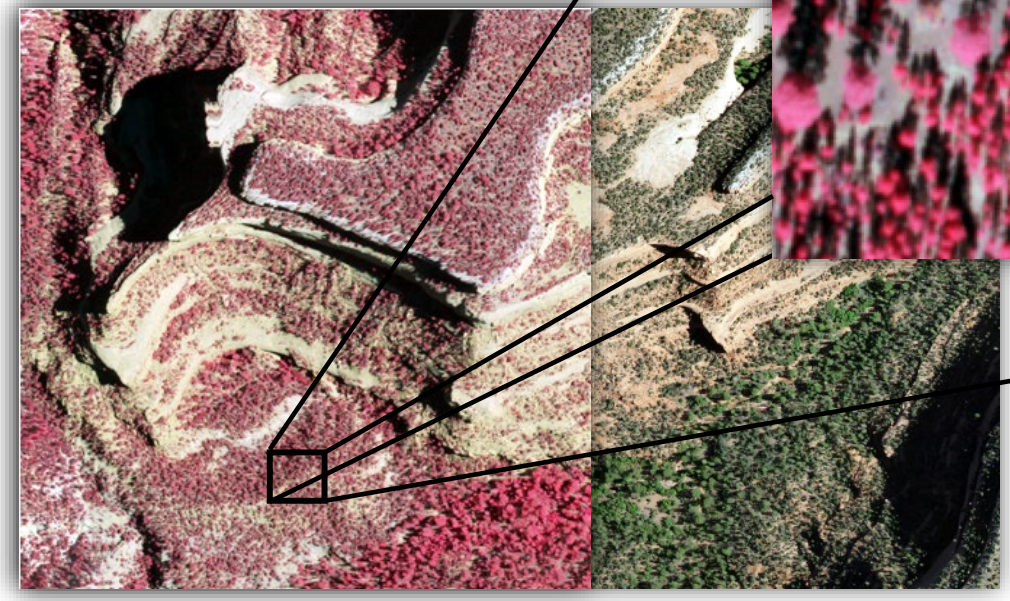
Individual Polygons mosaicked to create one complete area of the Navajo Nation



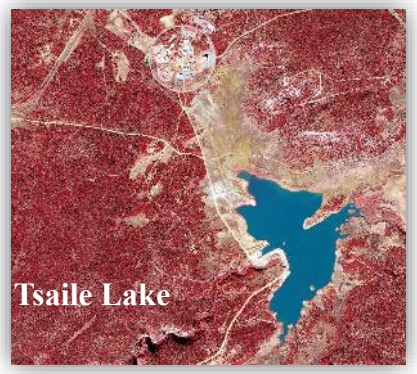
Final Mosaic NN21_DEM Entire Navajo Nation

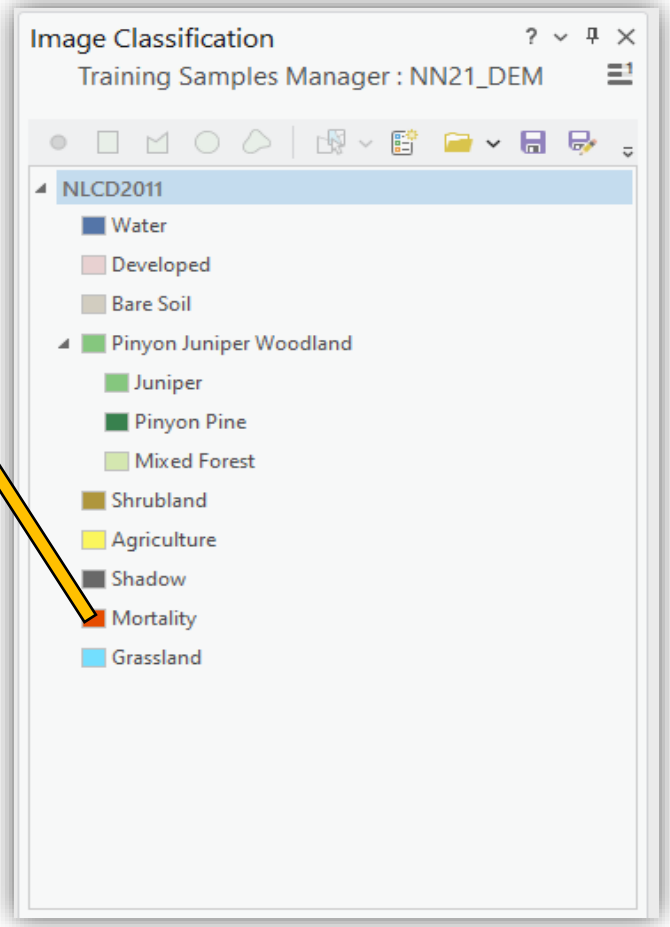
Classification of the Landscape





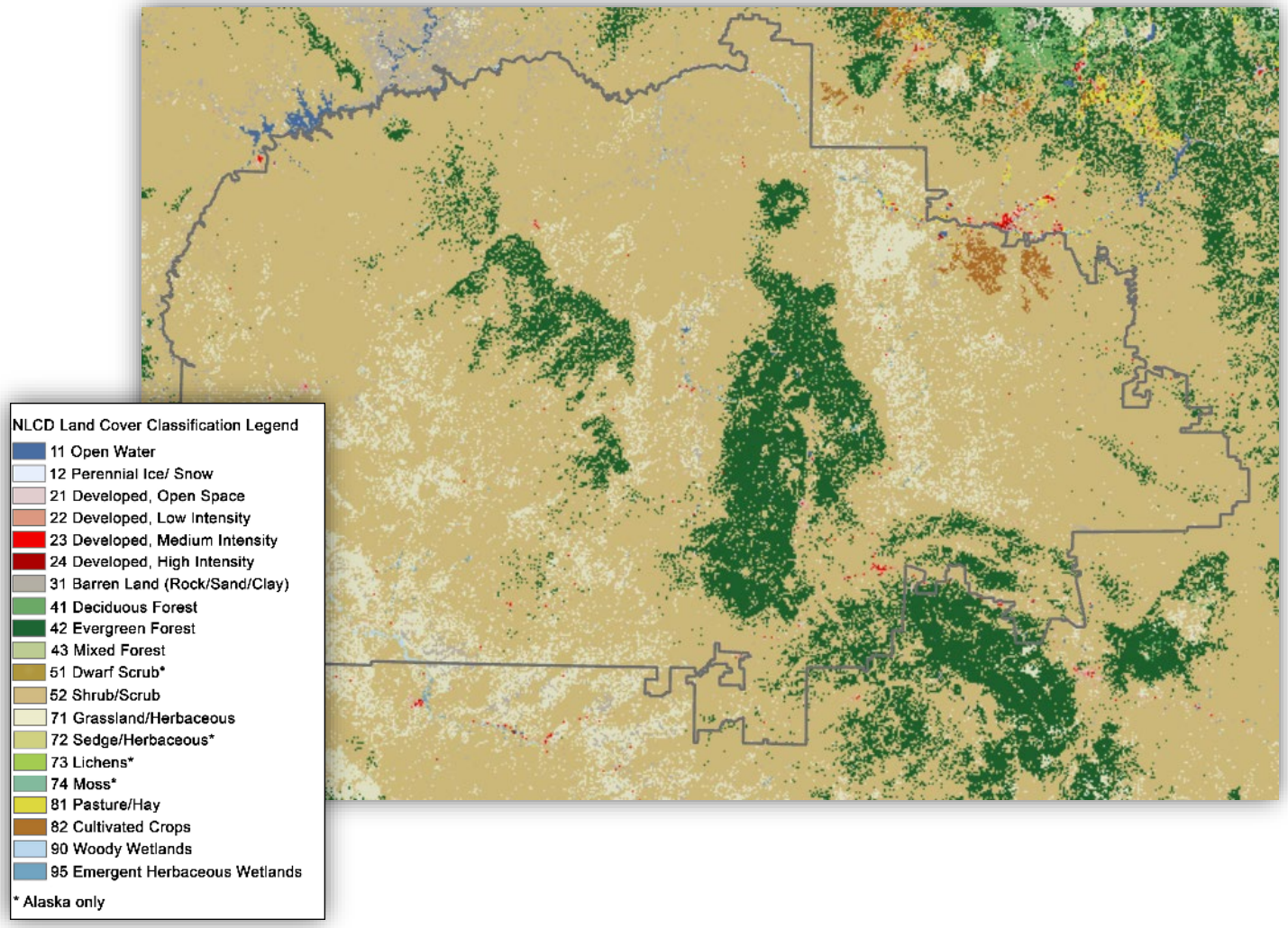
Infrared VS Natural Color

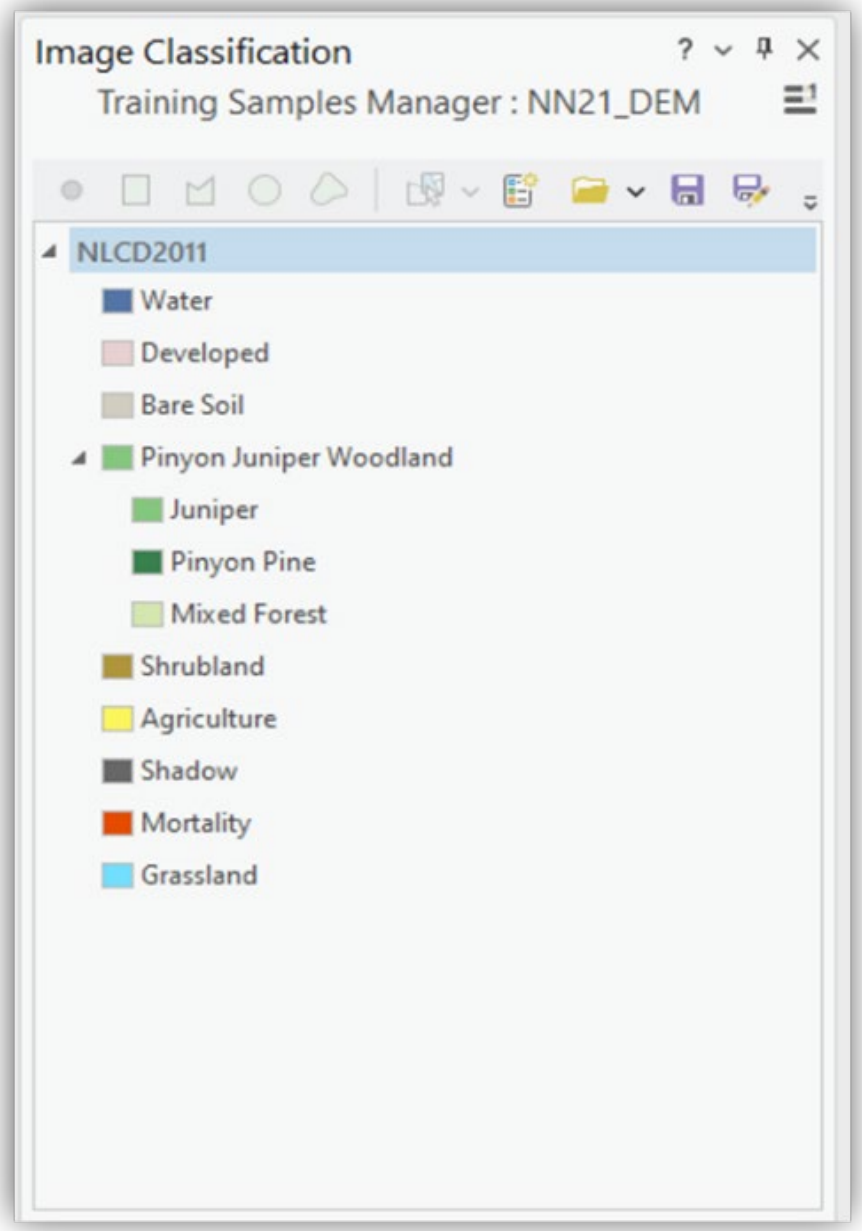




Example of Resulting Classification Map

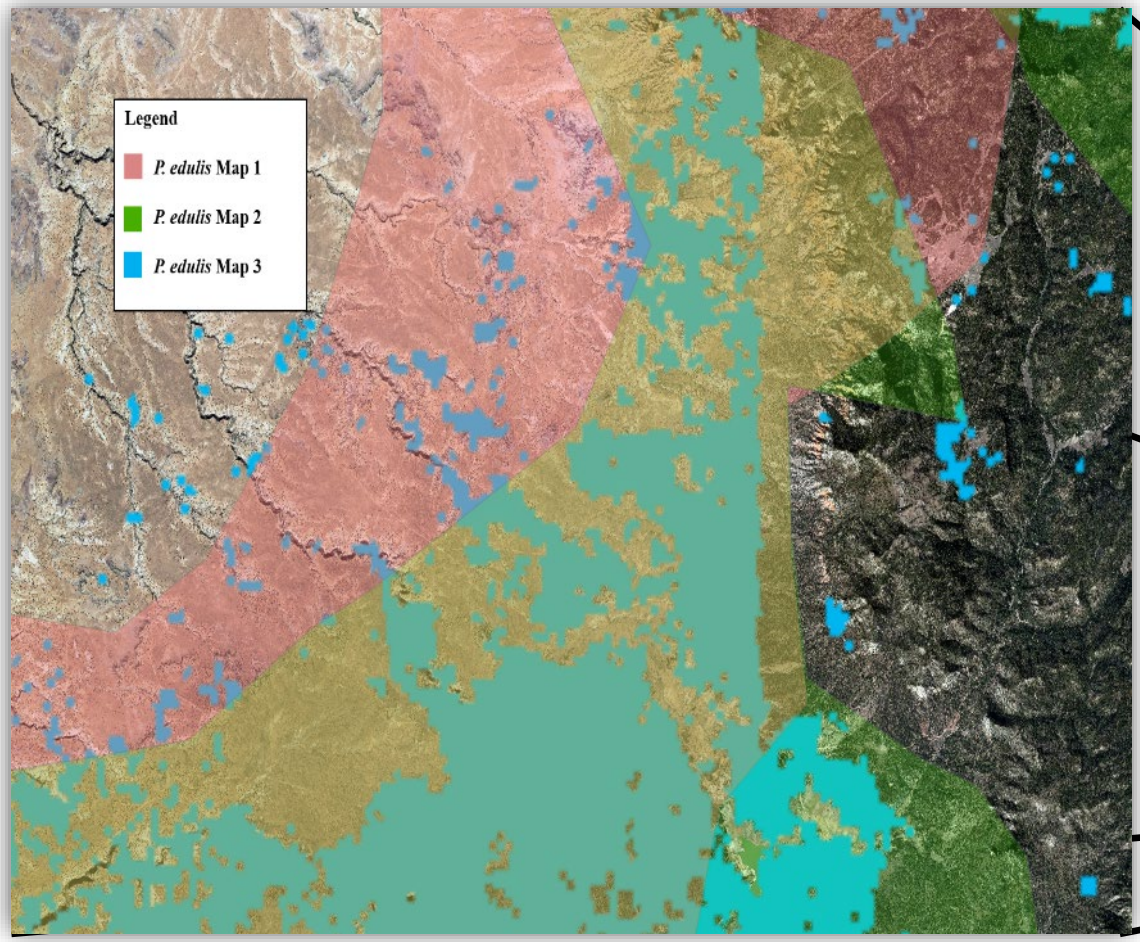
National Land Cover Database 2019

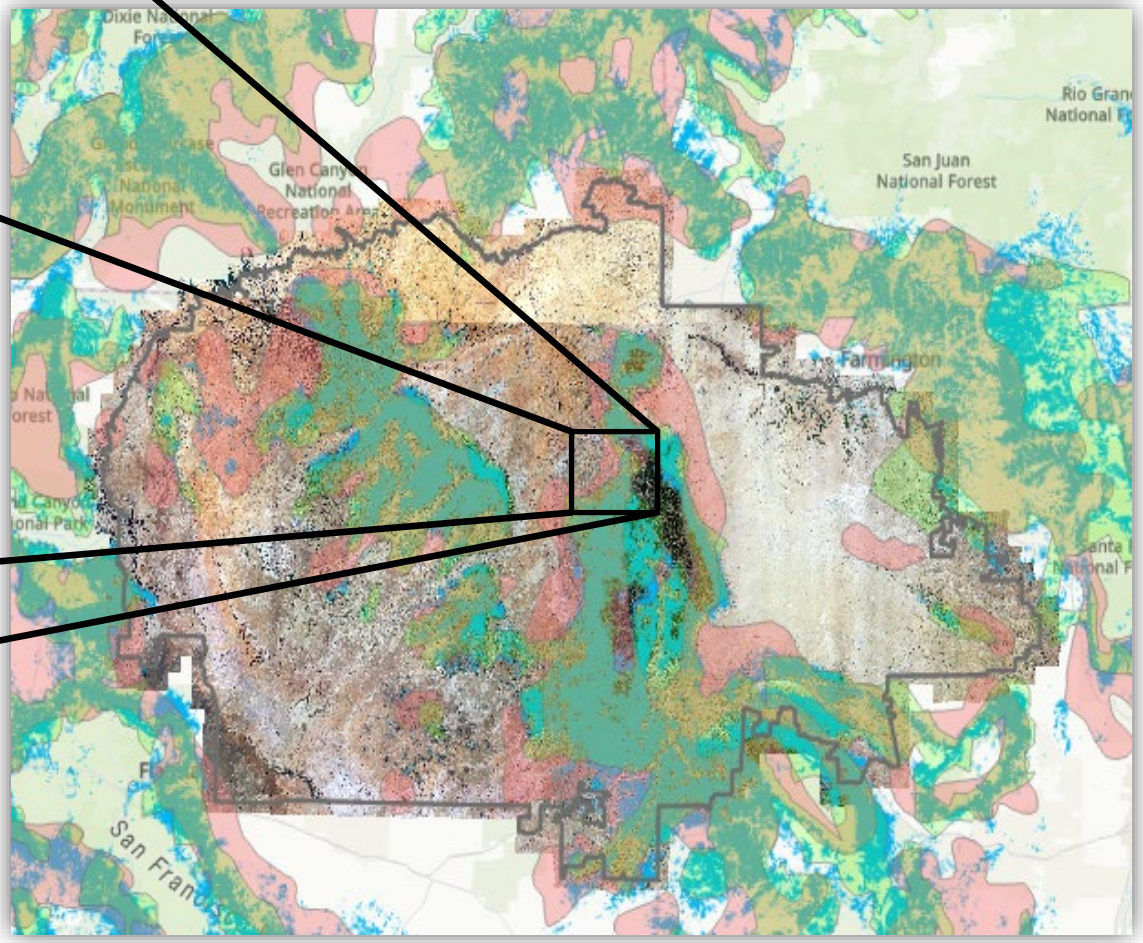




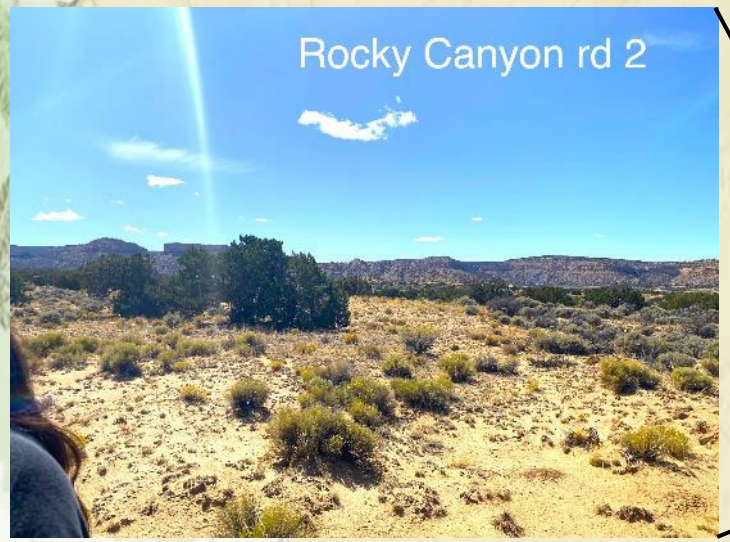
My Classification Schema

Post – Classification Accuracy Assessment





Ground Truthing



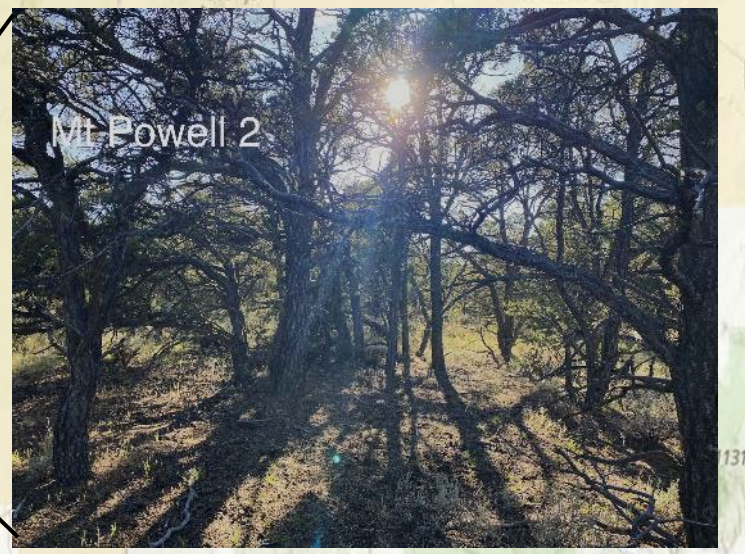


Image Classification

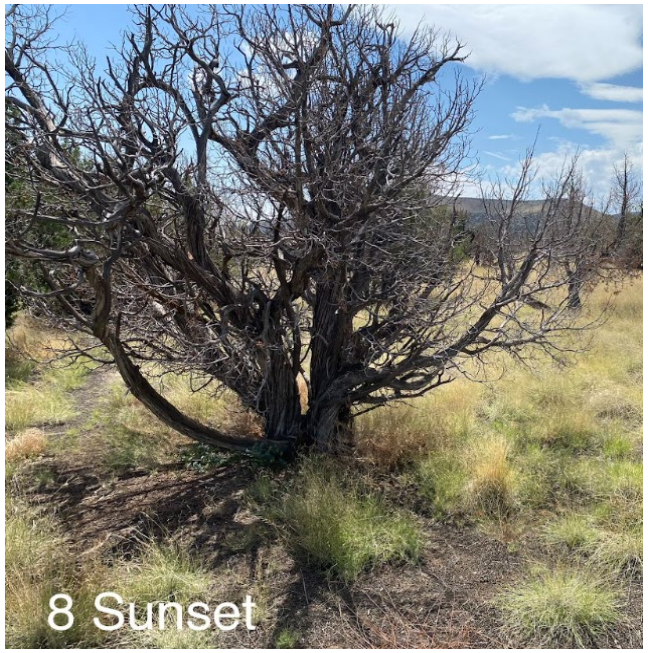
Training Samples Manager : NN21_DEM

- NLCD2011
  - Water
  - Developed
  - Bare Soil
  - Pinyon Juniper Woodland
    - Juniper
    - Pinyon Pine
    - Mixed Forest
  - Shrubland
  - Agriculture
  - Shadow
  - Mortality
  - Grassland

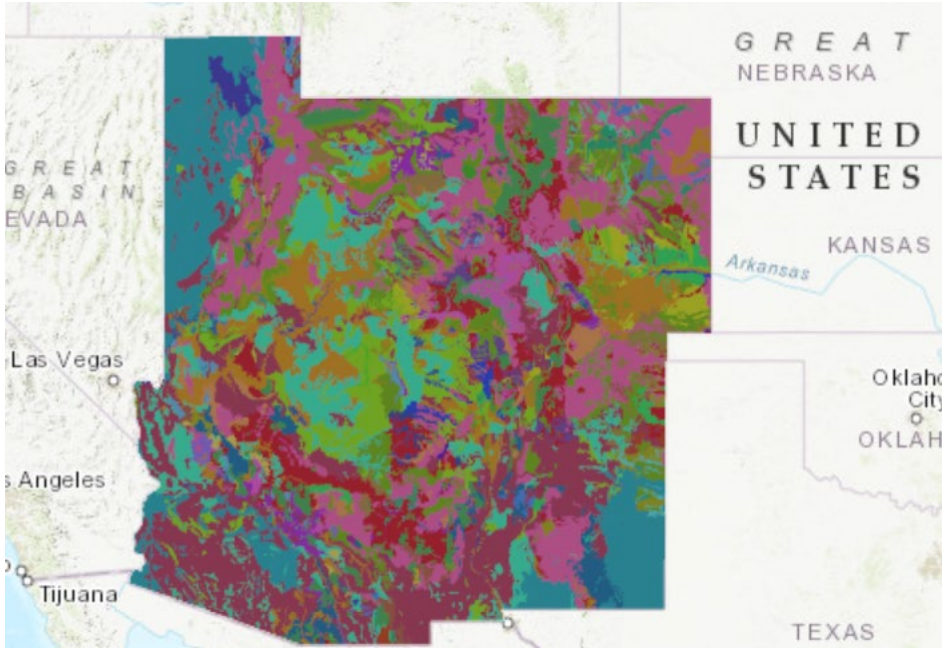
Reservation
Page
Vermilion Cliffs NM
Kayenta
Kaibab National Forest
Kaibito Plateau
Chuska Mountains
Havasupai Reservation
Grand Canyon National Park
Colorado Plateau
Canyon De Chelly National Monument
9091 ft
Historical Park
7197 ft
Coconino Plateau
Painted Desert
12621 ft
Flagstaff
Zuni
Laguna Pueblo
Jemez Pueb
Zia Pue
11313 ft

Analysis & Hypothesis Testing

Question – How does the presence of rocks align with Pinyon – Juniper mortality patterns?



Hypothesis – The percentage of PJ tree mortality is lower where tress are growing in or around boulders, shallow rocks, and bedrocks.



Acknowledgments

Funding by the USDA & NSF
Permits permitted Navajo Nation
Tribal Consultation:
Tribal Agencies
Navajo Technical University

To Steven Chischilly and NTU for your collaboration and passionate REU interns. Thank you to Brandee Keyonnie for your help with ground truthing and driving 4 x 4 vehicles and giant vans. Thank you to the Research and Mentoring for Post Baccalaureates program (RaMP) for your help in the field and to all the mentors for your dedication and time spent on a very needed program.


Thank You