Using NASA Earth Observations to Prioritize Locations for the Monitoring and Management of Cultural Resources in Glen Canyon National Recreation Area
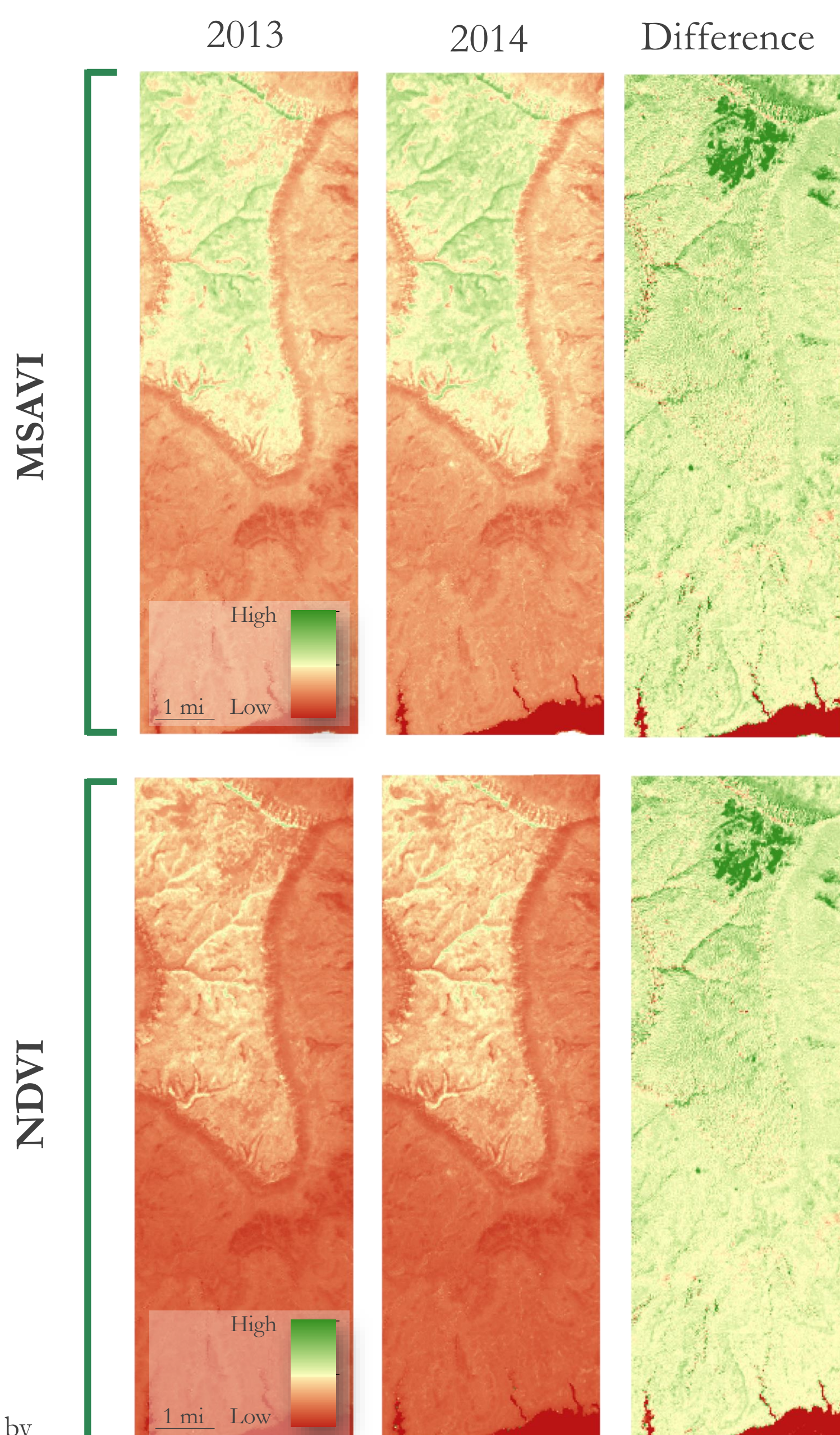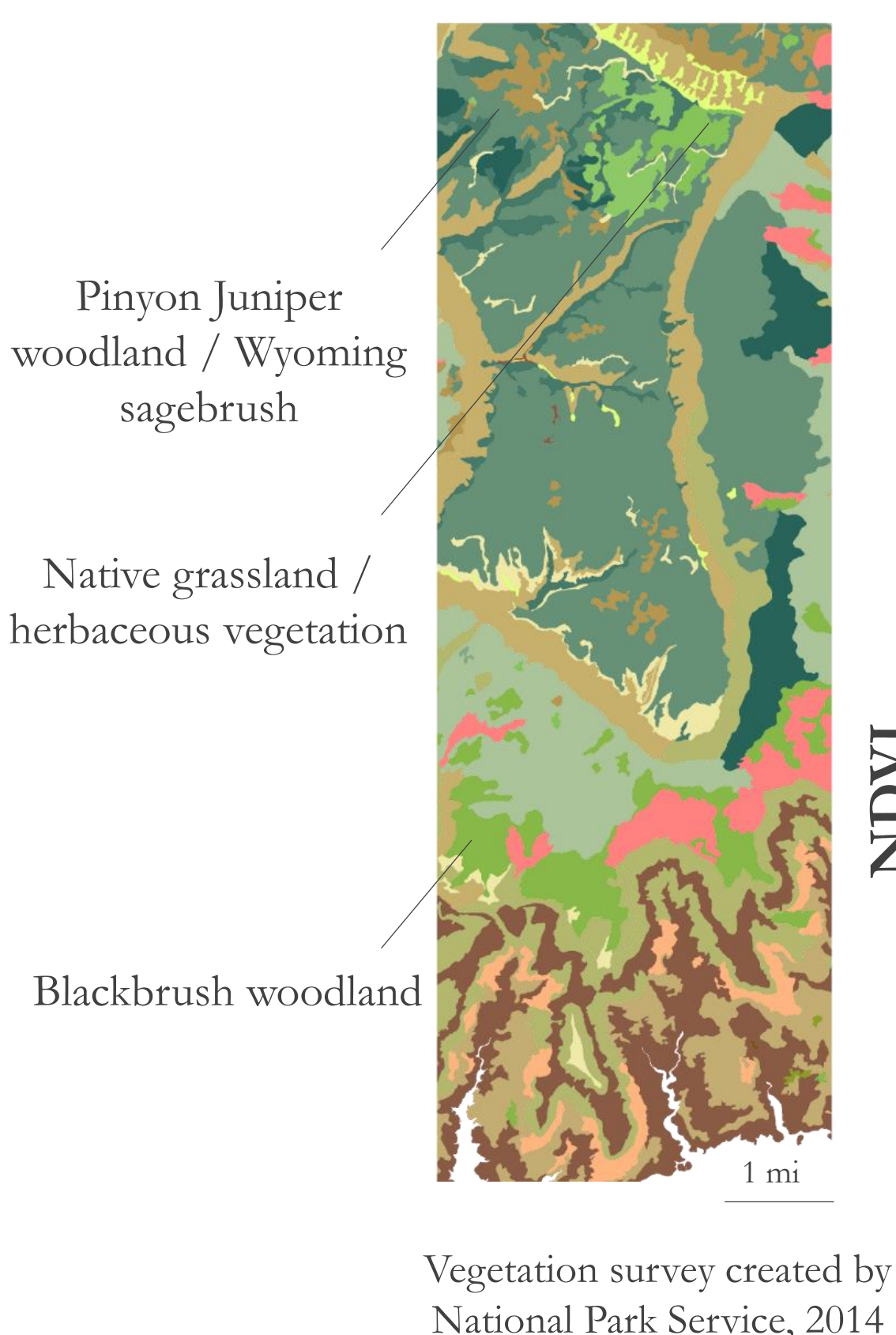
Abstract

Glen Canyon National Recreation Area (NRA) contains a diverse suite of culturally and historically significant archeological sites that are threatened by erosion and changing land cover dynamics. The National Park Service (NPS) is tasked with monitoring, studying, and preserving these archeological sites, many of which reside in extremely remote locations. At Glen Canyon NRA, perennial vegetation helps stabilize soils and mitigate erosion. The loss of such soil stabilizers is indicative of high erosion potential. This project calculated vegetation indices and generated a time series of vegetation maps across the entire extent of Glen Canyon NRA using Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 Operational Land Imager (OLI) data for the years 1995 to 2017. The project team then used multiple vegetation analyses from across the study period to provide an assessment of year-to-year change in the abundance and distribution of soil-stabilizing vegetation. This approach allowed for a comprehensive assessment of vegetation and soil stabilization across a broad region that could not be assessed by traditional ground-based means. Finally, the team used these vegetation analyses to assess the rate of change of vegetation cover and to predict future vegetation distribution. Land managers and archeologists at the NPS can use the results of this work to prioritize the monitoring and management of important archeological sites that could otherwise be lost to erosion.
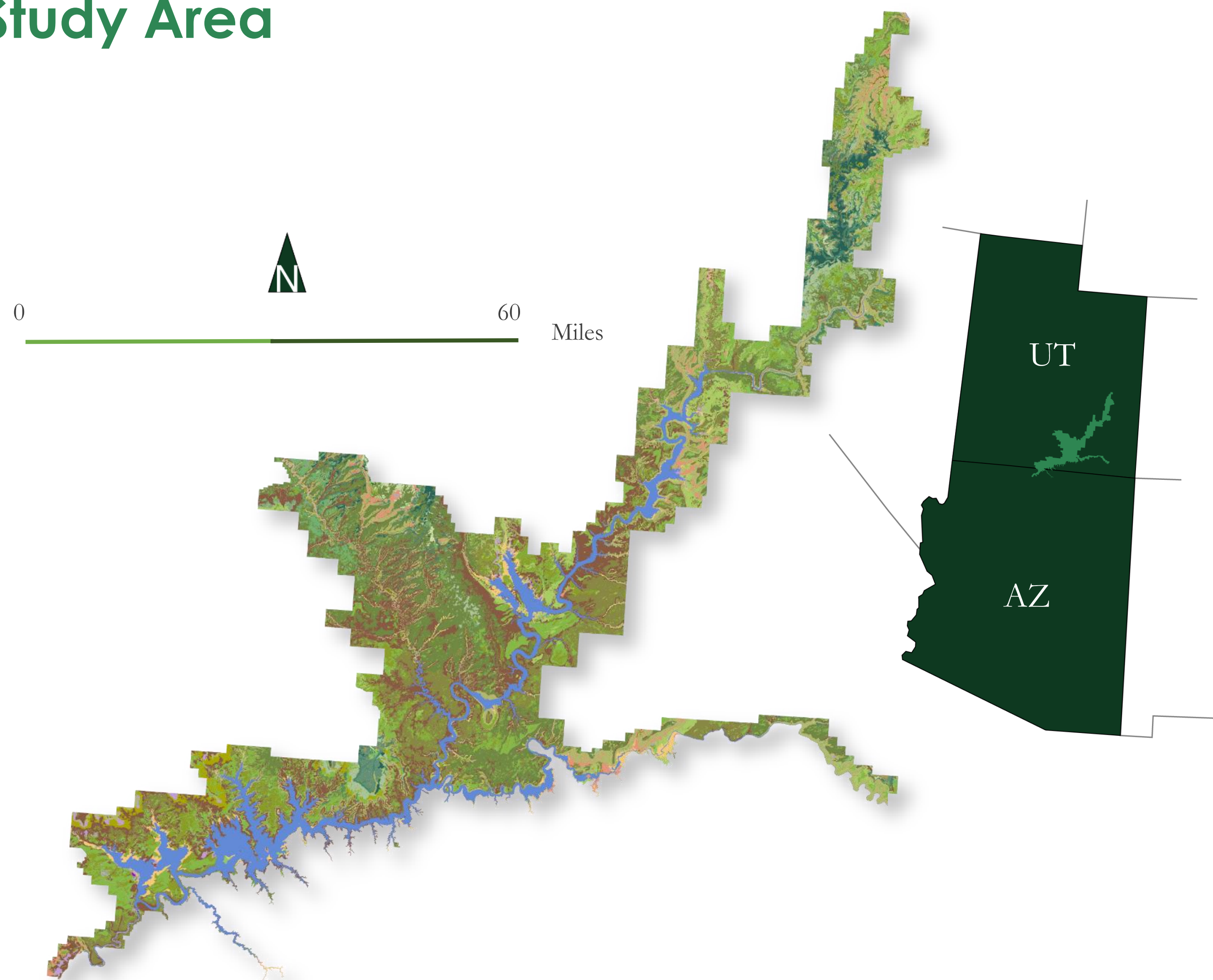
Objectives

▶ **Create** vegetation distribution maps of Glen Canyon National Recreation Area for 1995 – 2018

▶ **Analyze** spatial trends in gains and losses of vegetation over the study period

▶ **Provide** a reproducible means by which such analysis can be conducted by park officials in the future

▶ **Evaluate** locations within the park at high risk for erosion

▶ **Apply** vegetation loss information to cultural resource assessment
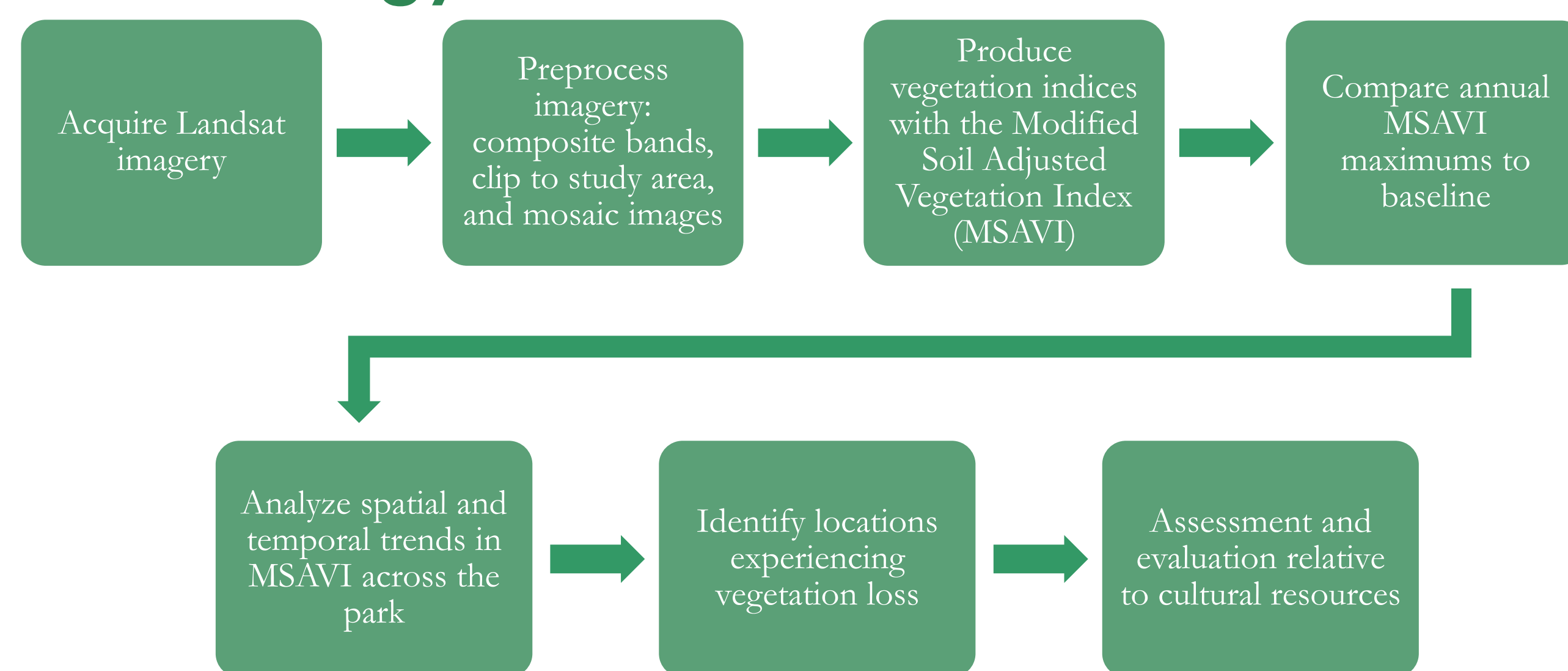
Study Area

Results

▶ The spatial distribution of vegetation loss is unevenly concentrated based on topographic features (i.e. mesa tops).

▶ The spatial distribution of vegetation loss coincides with the apparent distribution of different plant/ecological communities → exposed grasses vs. riparian vegetation.
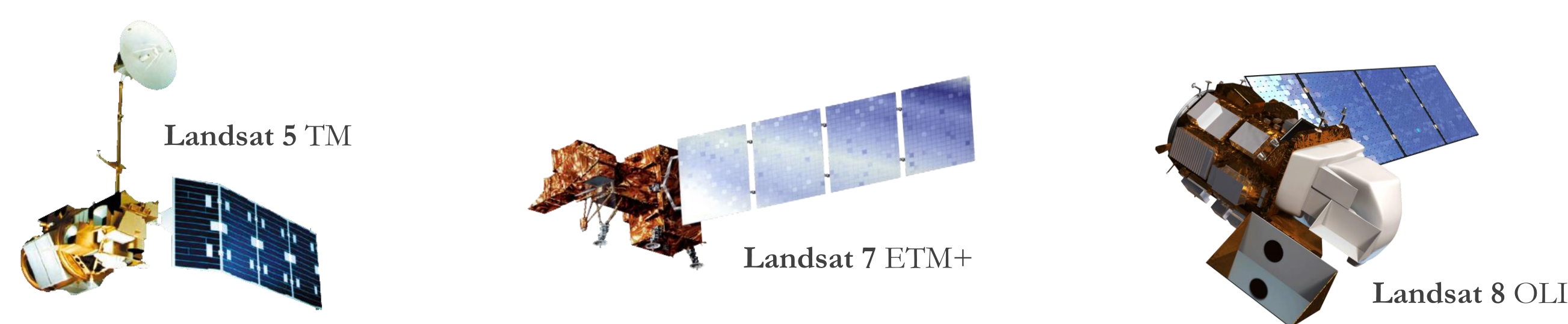

Pinyon Juniper woodland / Wyoming sagebrush

Native grassland / herbaceous vegetation

Blackbrush woodland

1 mi

Vegetation survey created by National Park Service, 2014

2013   2014   Difference

MSAVI

NDVI

High — Low   1 mi

Methodology

Acquire Landsat imagery → Preprocess imagery: composite bands, clip to study area, and mosaic images → Produce vegetation indices with the Modified Soil Adjusted Vegetation Index (MSAVI) → Compare annual MSAVI maximums to baseline

Analyze spatial and temporal trends in MSAVI across the park → Identify locations experiencing vegetation loss → Assessment and evaluation relative to cultural resources

Earth Observations

Landsat 5 TM   **Landsat 7** ETM+   **Landsat 8** OLI

Conclusions

▶ Archeological sites on mesa tops may be at a higher risk of erosion than other regions of the park due to concentrated vegetation loss in those areas.

▶ Certain plant communities are more susceptible to vegetation loss than others (grasses vs. shrubs and trees); Archeological sites in these areas could be at higher risk of vegetation than others.

▶ Moisture sensitivity and susceptibility to vegetation loss of different plant communities could be incorporated into park management of archeological resources.

▶ The methods outlined herein provide a reproducible method for vegetation monitoring.

Acknowledgements

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Glen Canyon National Recreation Area