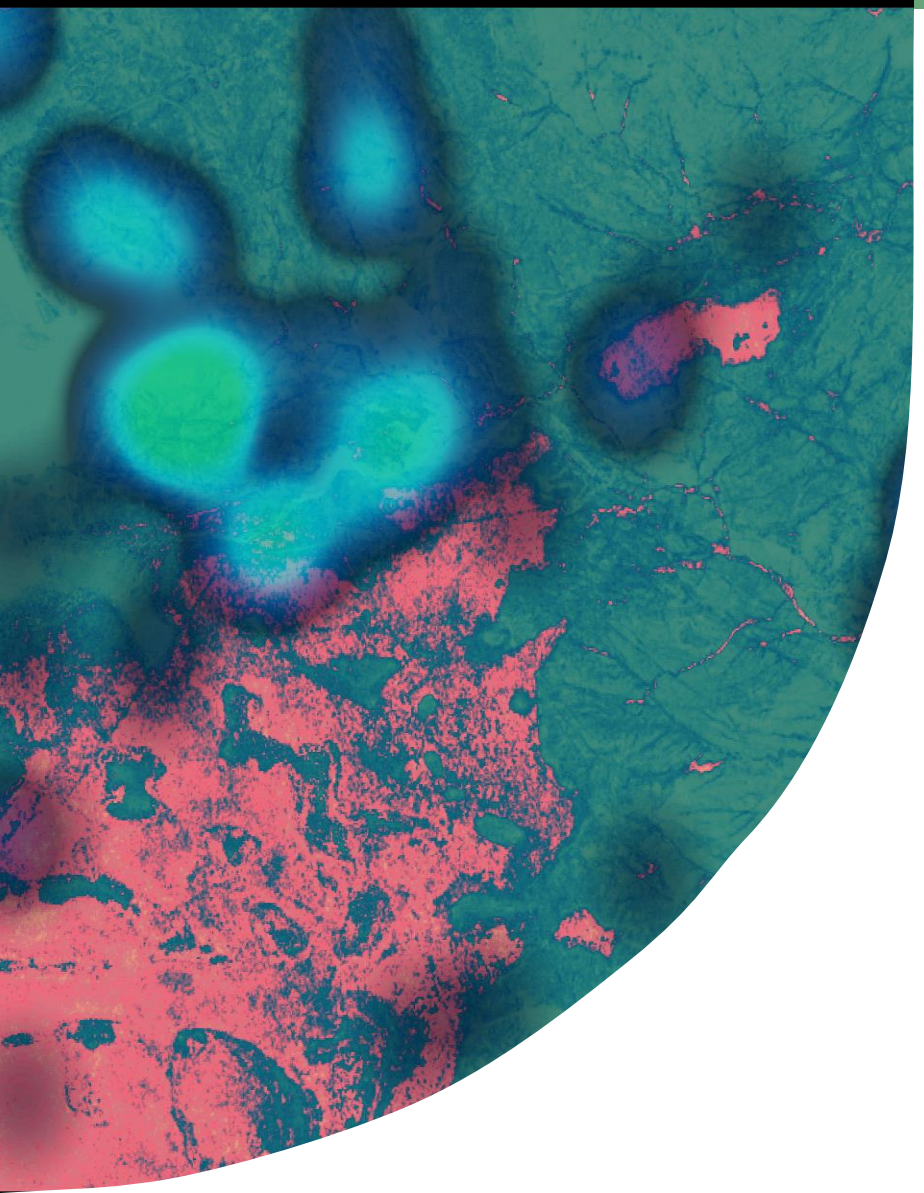
National Aeronautics and Space Administration



Zimbabwe Ecological Conservation

Assessing Effects of Urban Development and Drought on Tree Health to Protect White-Backed Vulture Nesting Sites in Zimbabwe

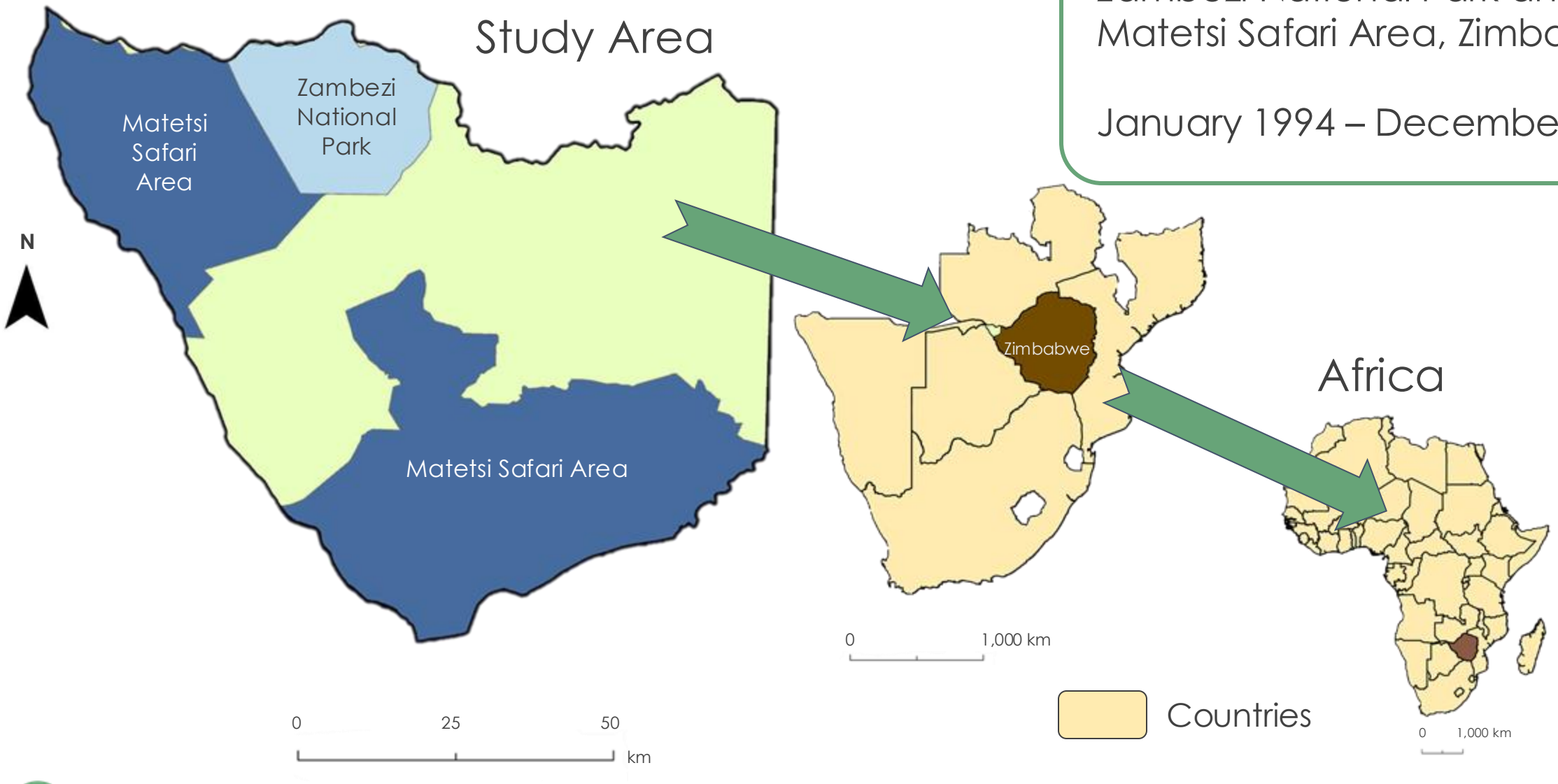
Brenna Bruffey, Sophie Michalski, Karim Shadid (Analytical Mechanics Associates)

Georgia – Athens | Spring 2025

Study Area and Period

Zambezi National Park and Matetsi Safari Area, Zimbabwe

January 1994 – December 2024




Victoria Falls

Image Credit: Diego Delso

Partners

Victoria Falls Wildlife Trust

Connected Conservation

Community Concerns

Wildlife tourism

Elephant aggression

Growing population

Vulture decline

Tree cover and vulture response

Vulture Threats & Elephant Aggression

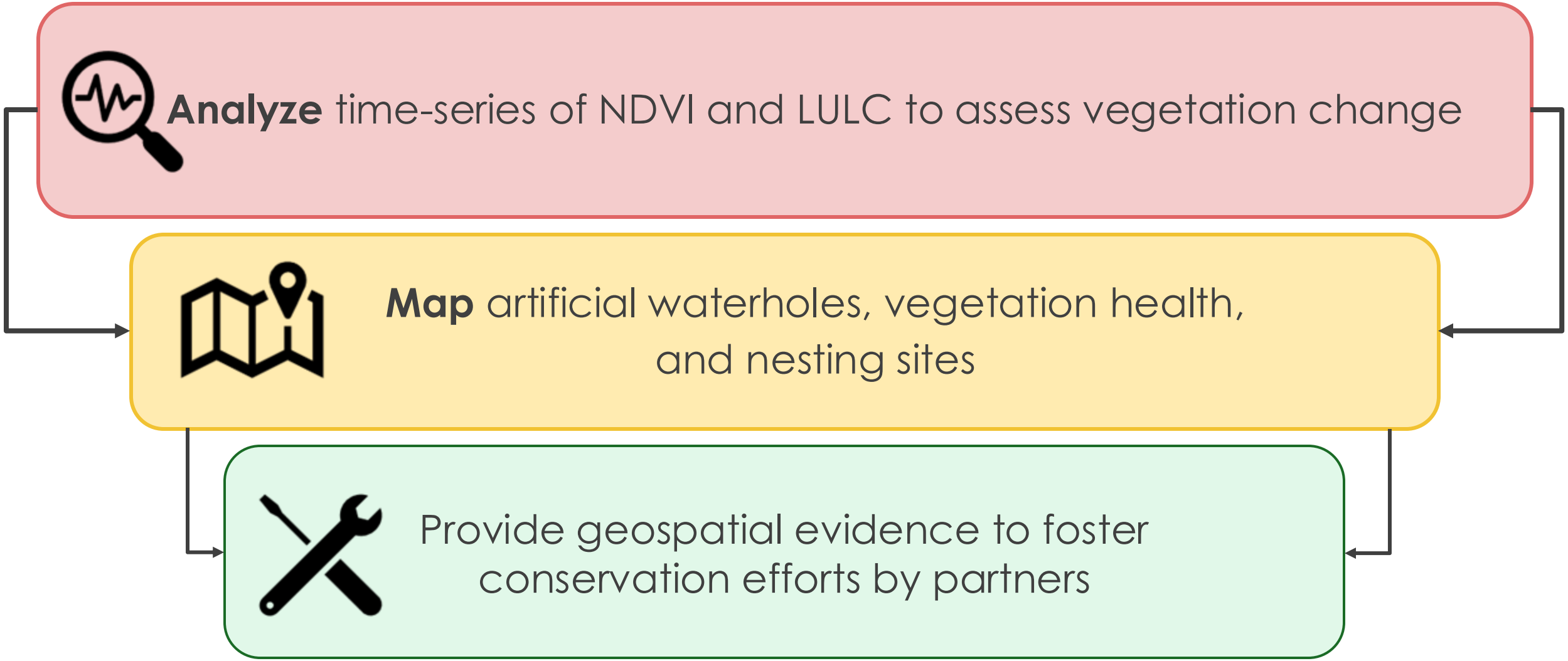

Image Credit: John Haslam

White-backed vultures (Gyps africanus) are **endangered** due to loss of nesting trees

Urban expansion, drought, and vegetation damage around waterholes present new environmental challenges

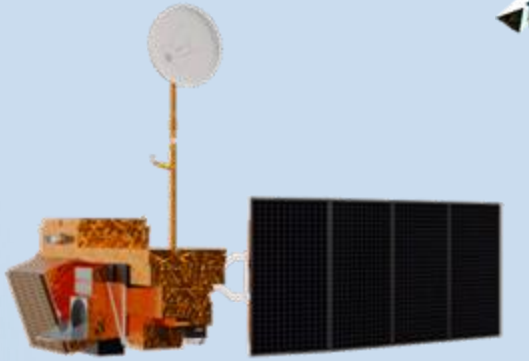
African elephants **impact nesting trees** by removing branches, stripping bark, and toppling trees

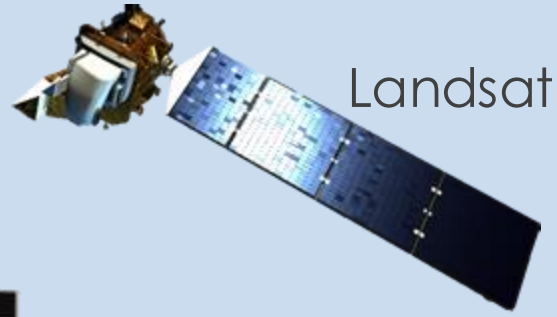
Project Objectives



Earth Observations

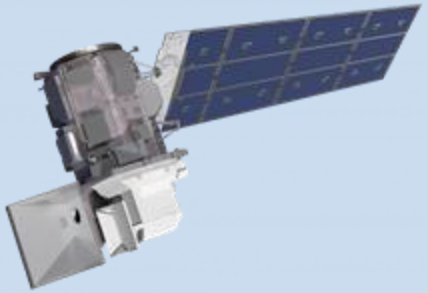
Landsat 5 TM

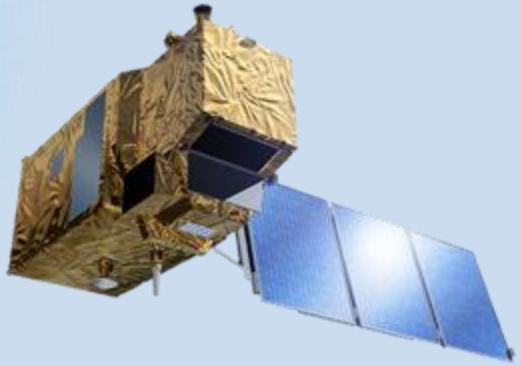




Landsat 8 OLI

Landsat 9 OLI-2





Sentinel-2 MSI

Landsat 7 ETM+

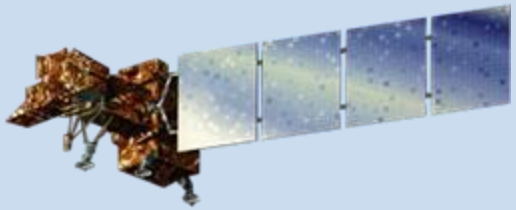
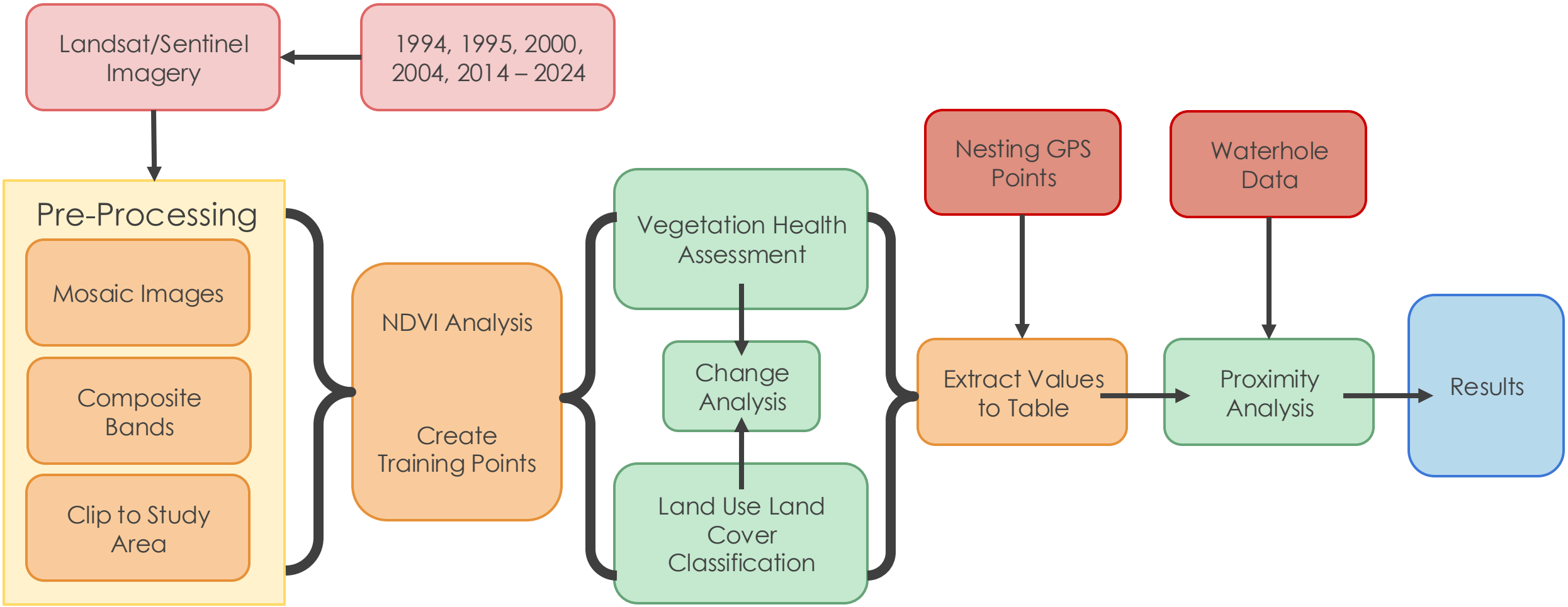


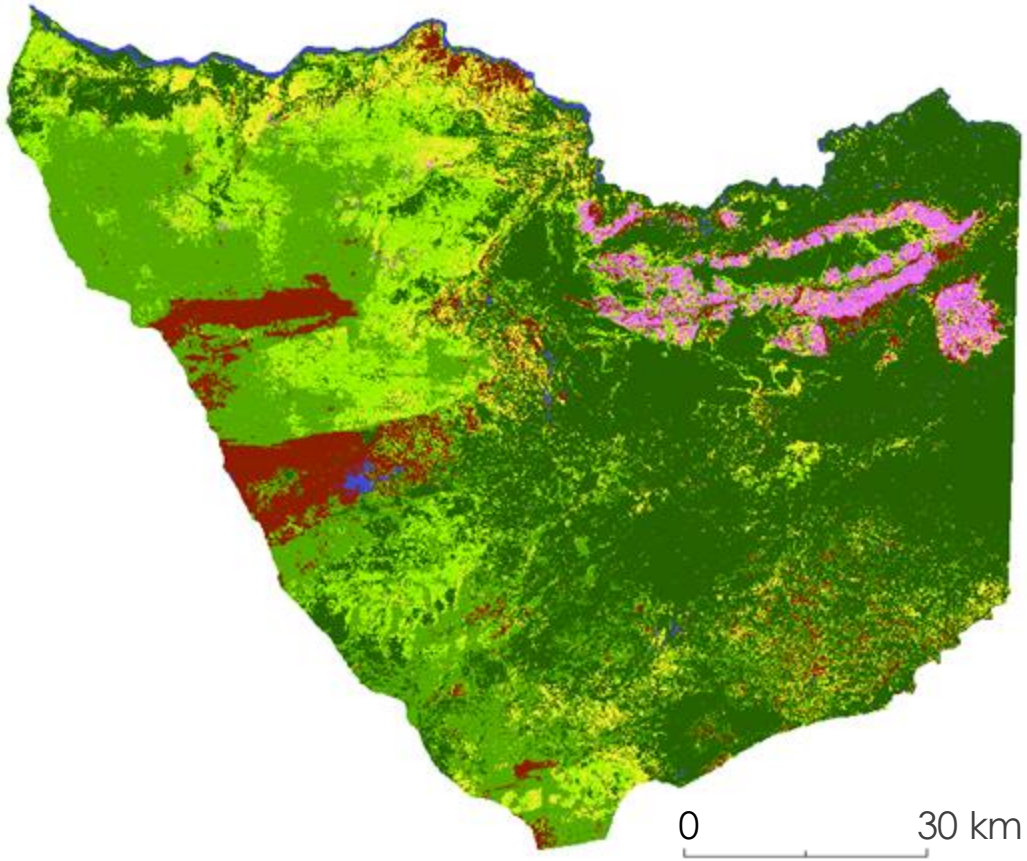
Image Credits: Andrew Colvin, NASA, ESA

Methods

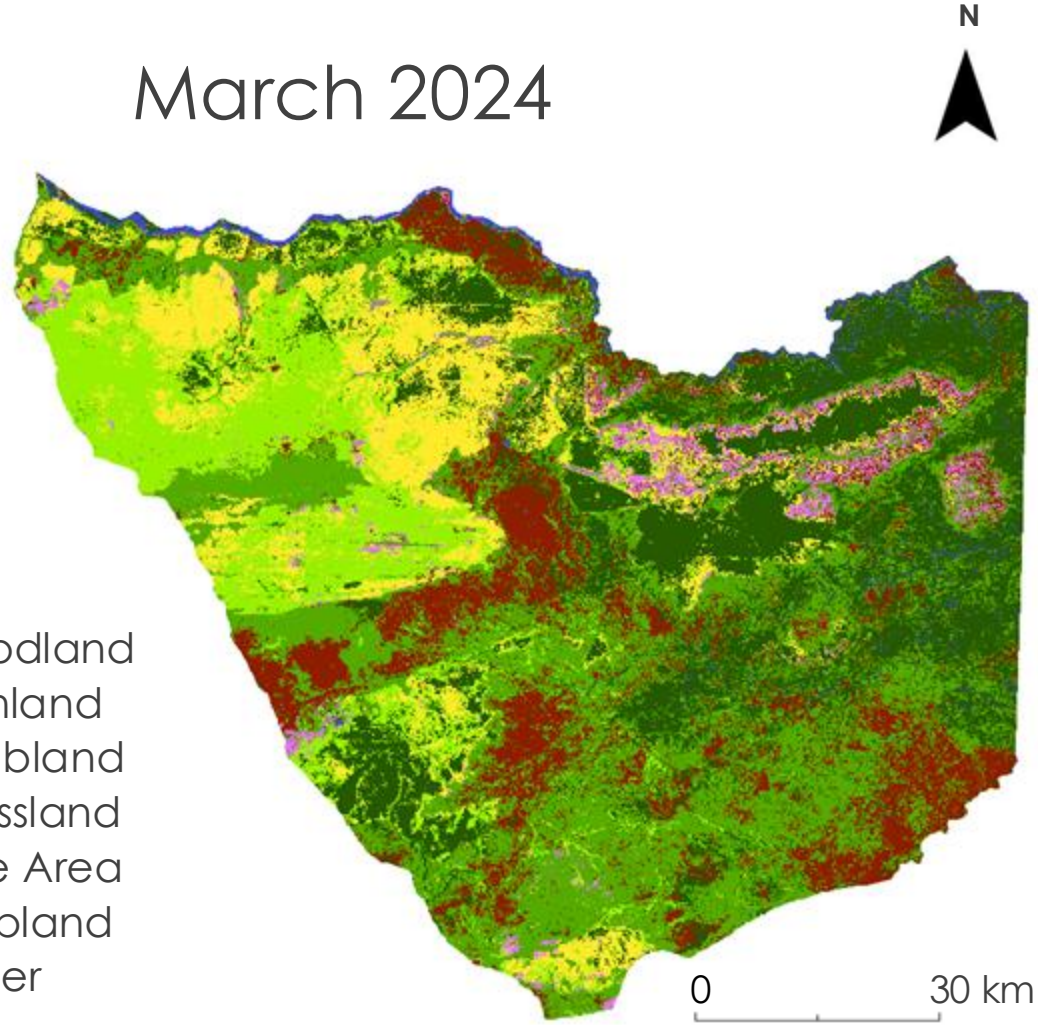

Landsat/Sentinel Imagery
1994, 1995, 2000, 2004, 2014 – 2024
Pre-Processing
Mosaic Images
Composite Bands
Clip to Study Area
NDVI Analysis
Create Training Points
Vegetation Health Assessment
Change Analysis
Land Use Land Cover Classification
Nesting GPS Points
Waterhole Data
Extract Values to Table
Proximity Analysis
Results

Landcover Output Results

April 1995

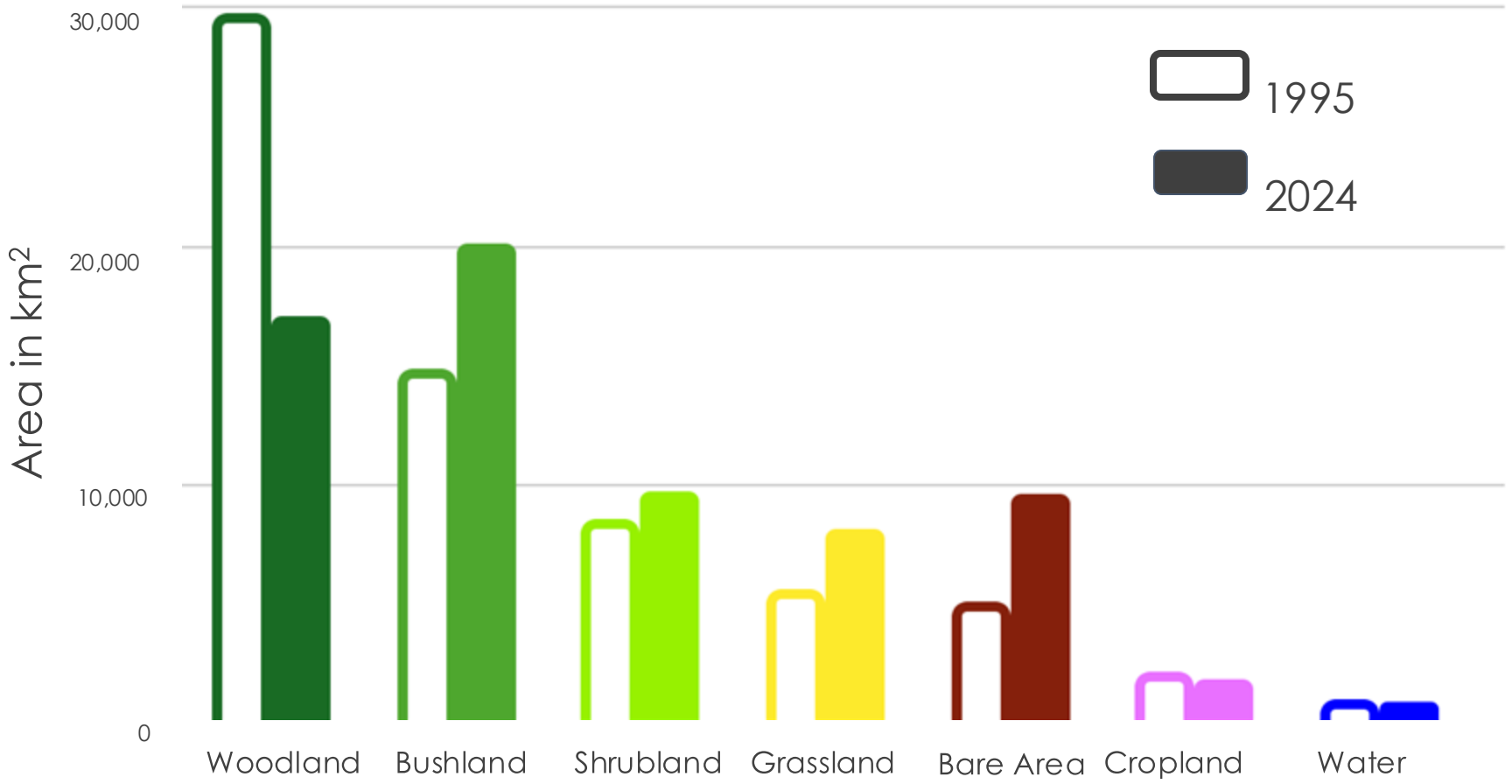


March 2024



Woodland
Bushland
Shrubland
Grassland
Bare Area
Cropland
Water

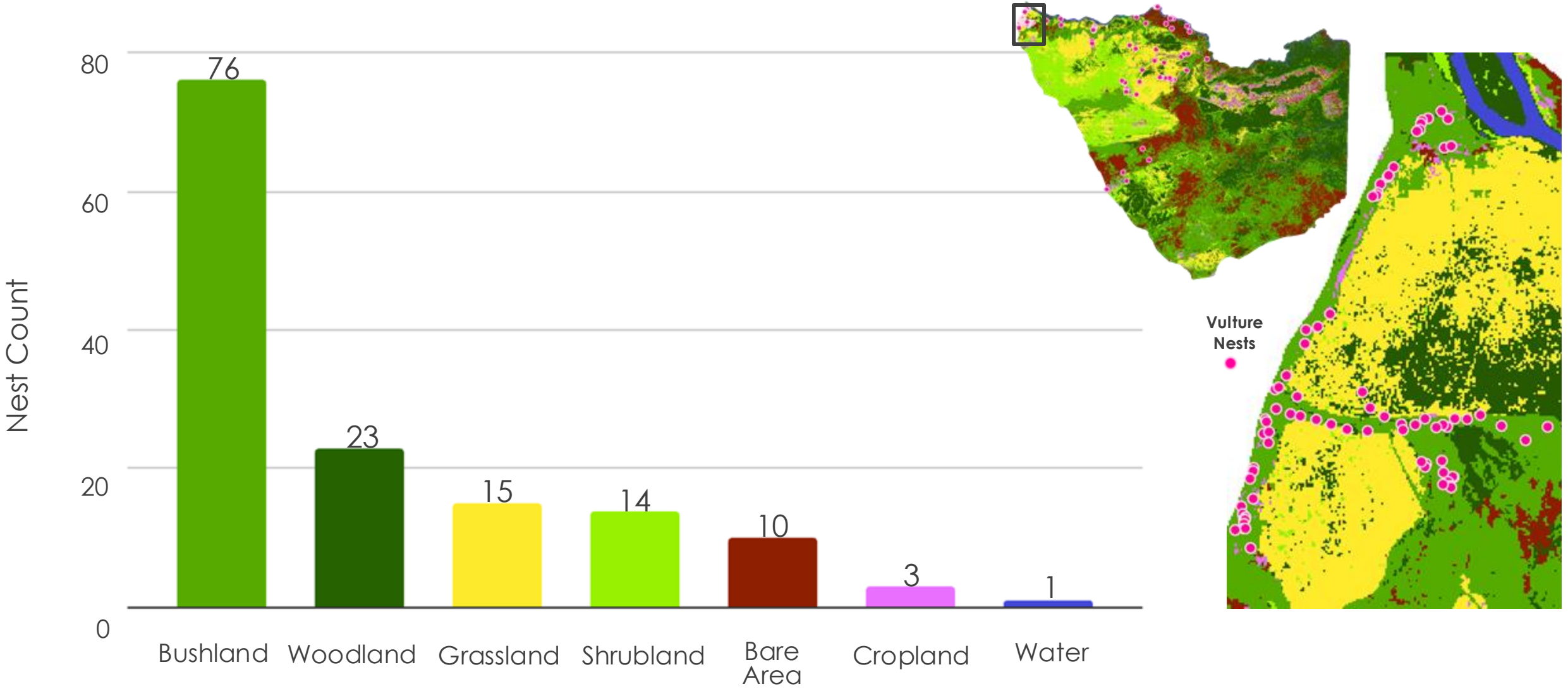
Landcover Change from 1995 to 2024



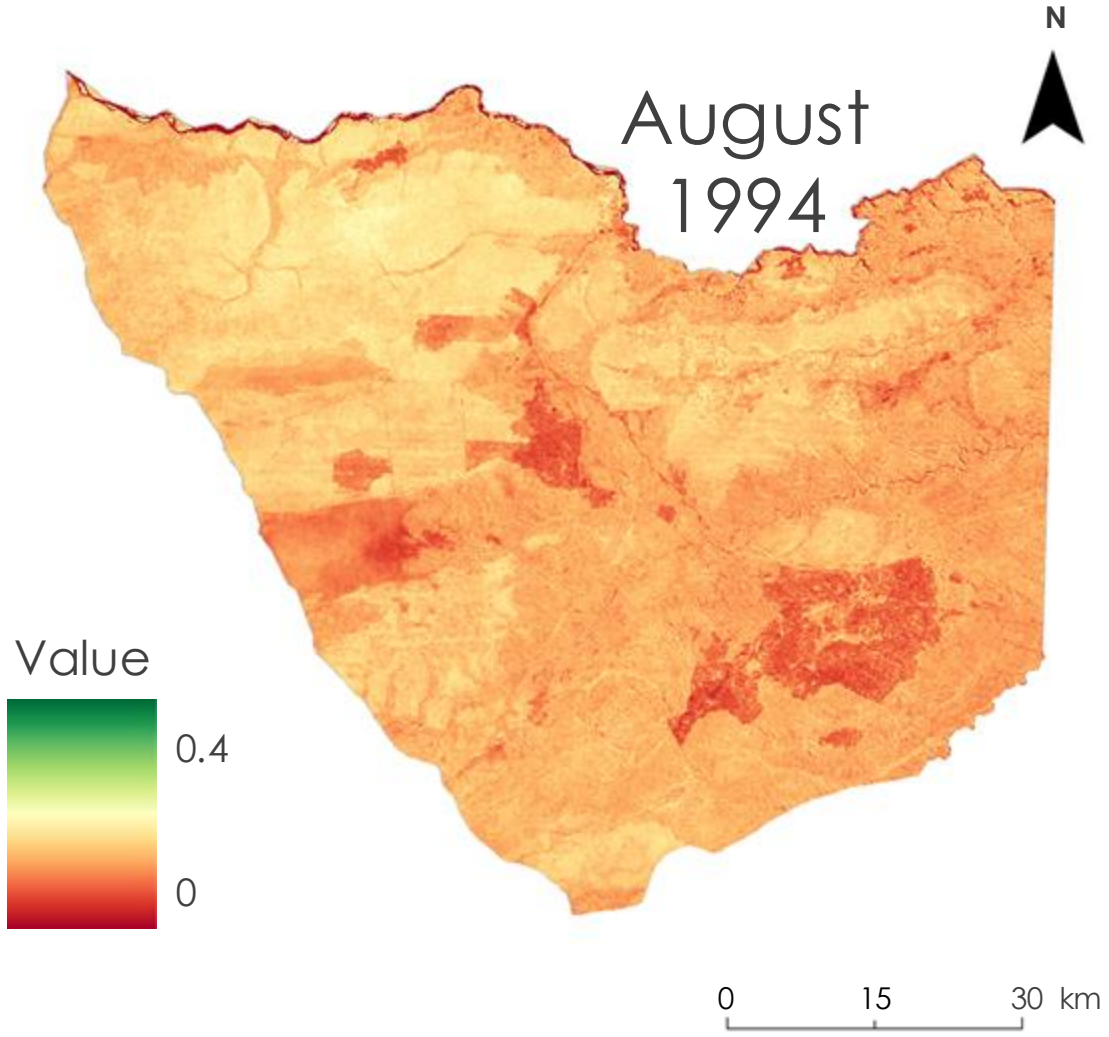
Land Type	% Change
Woodland	-43%
Bushland	+37%
Shrubland	+16%
Grassland	+55%
Bare Area	+102%
Cropland	-8%
Water	+29%

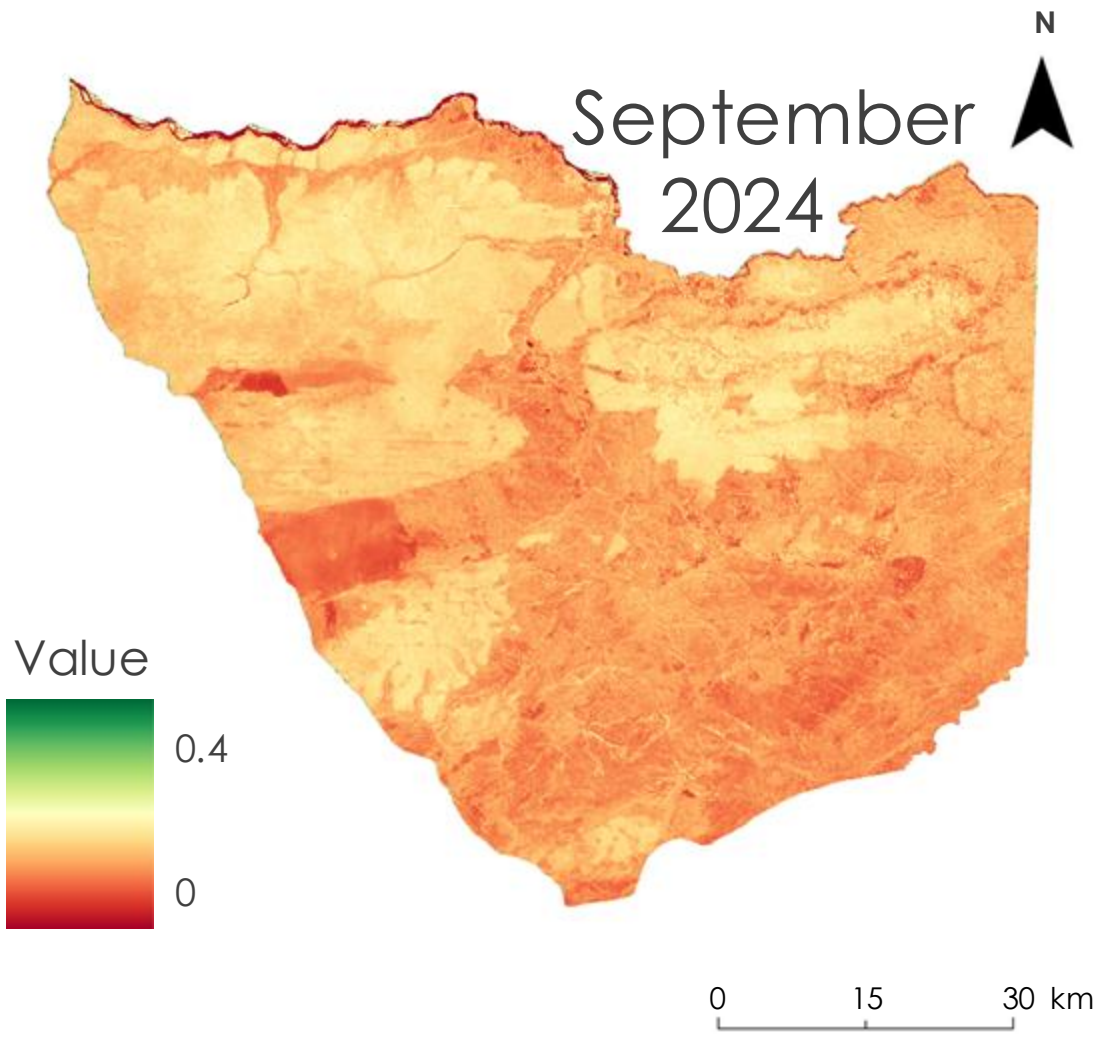
*Values rounded

2024 Nests by Landcover Class

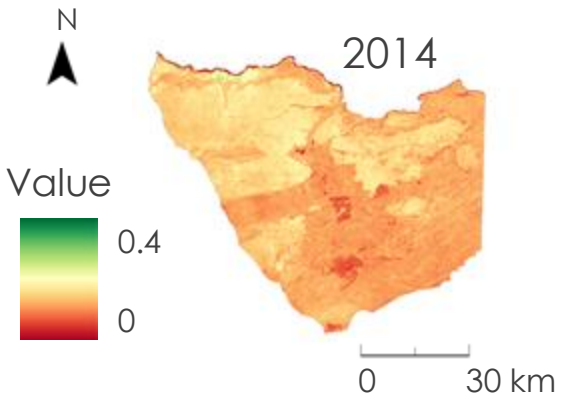


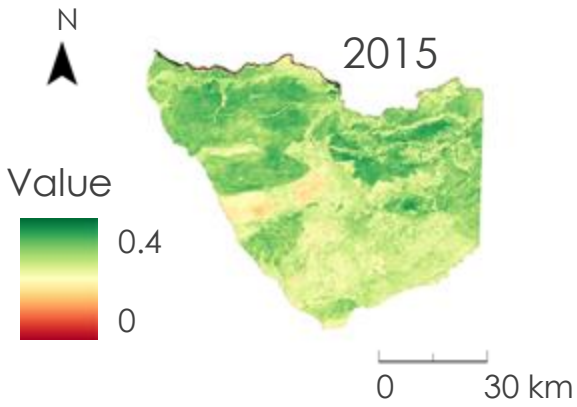
NDVI Results

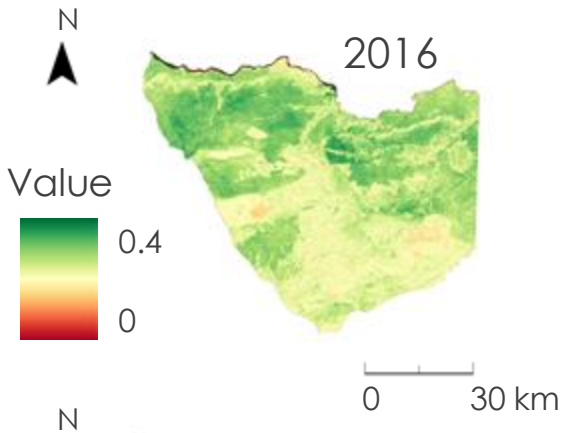


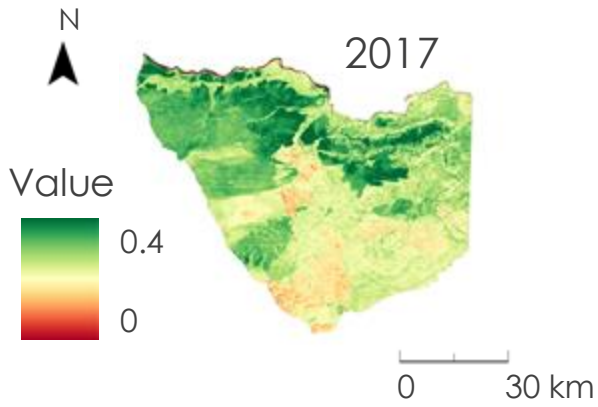


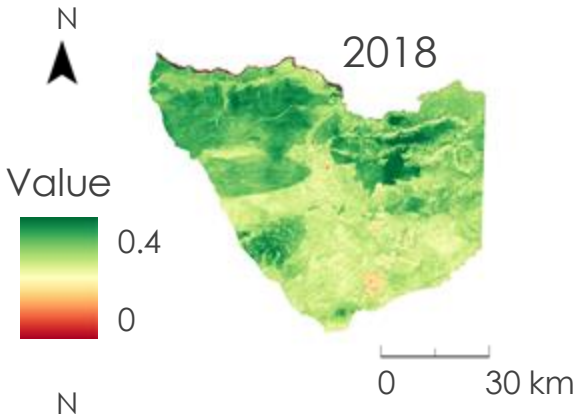
NDVI Results Across Dry Seasons

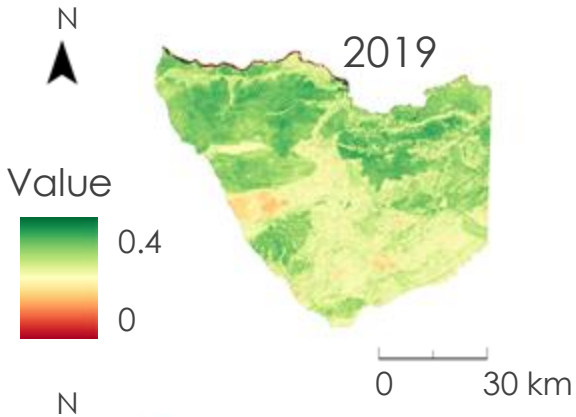


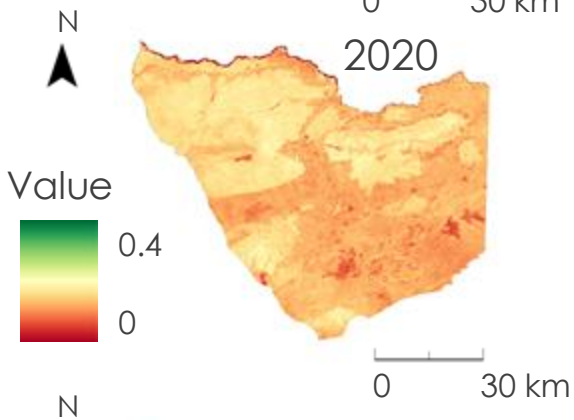


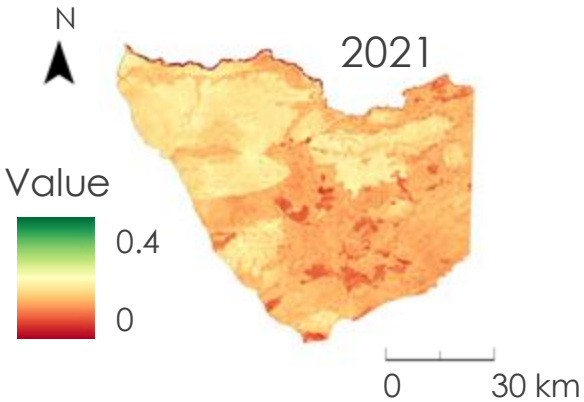


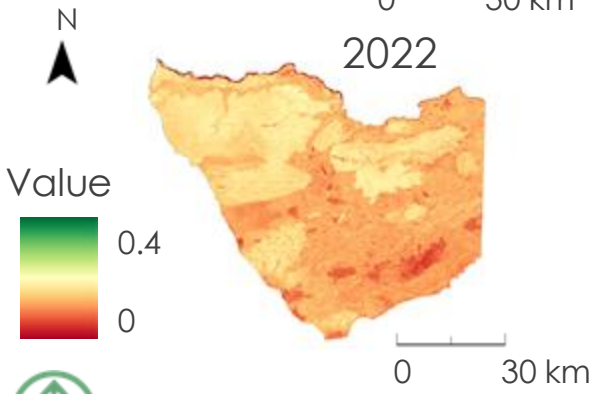


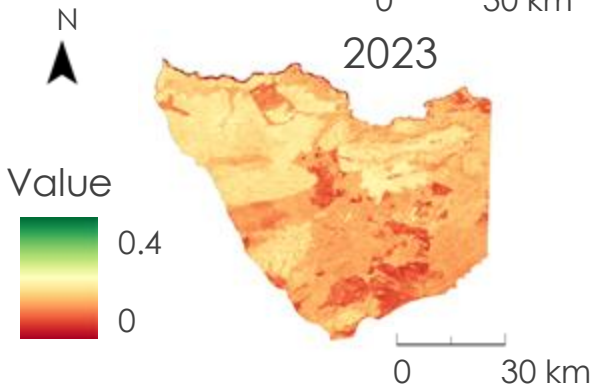


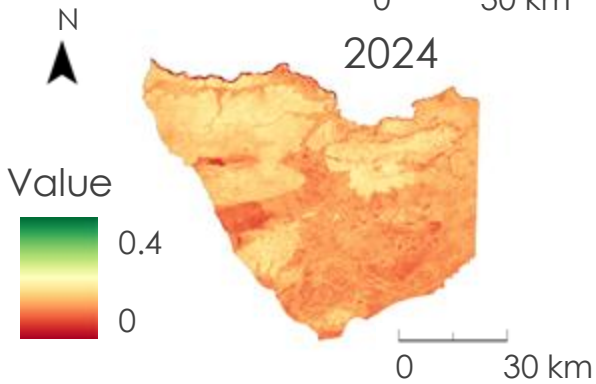




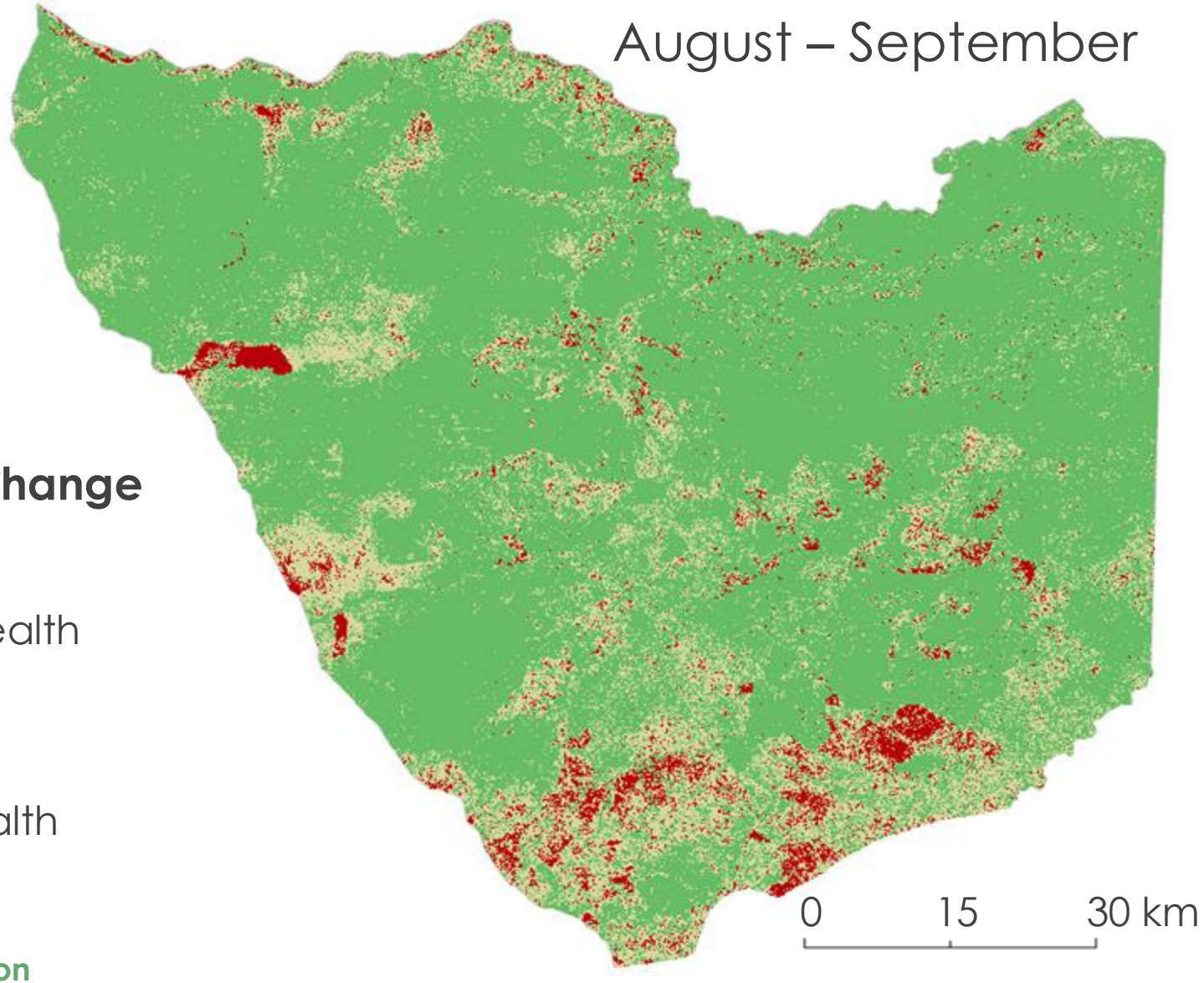








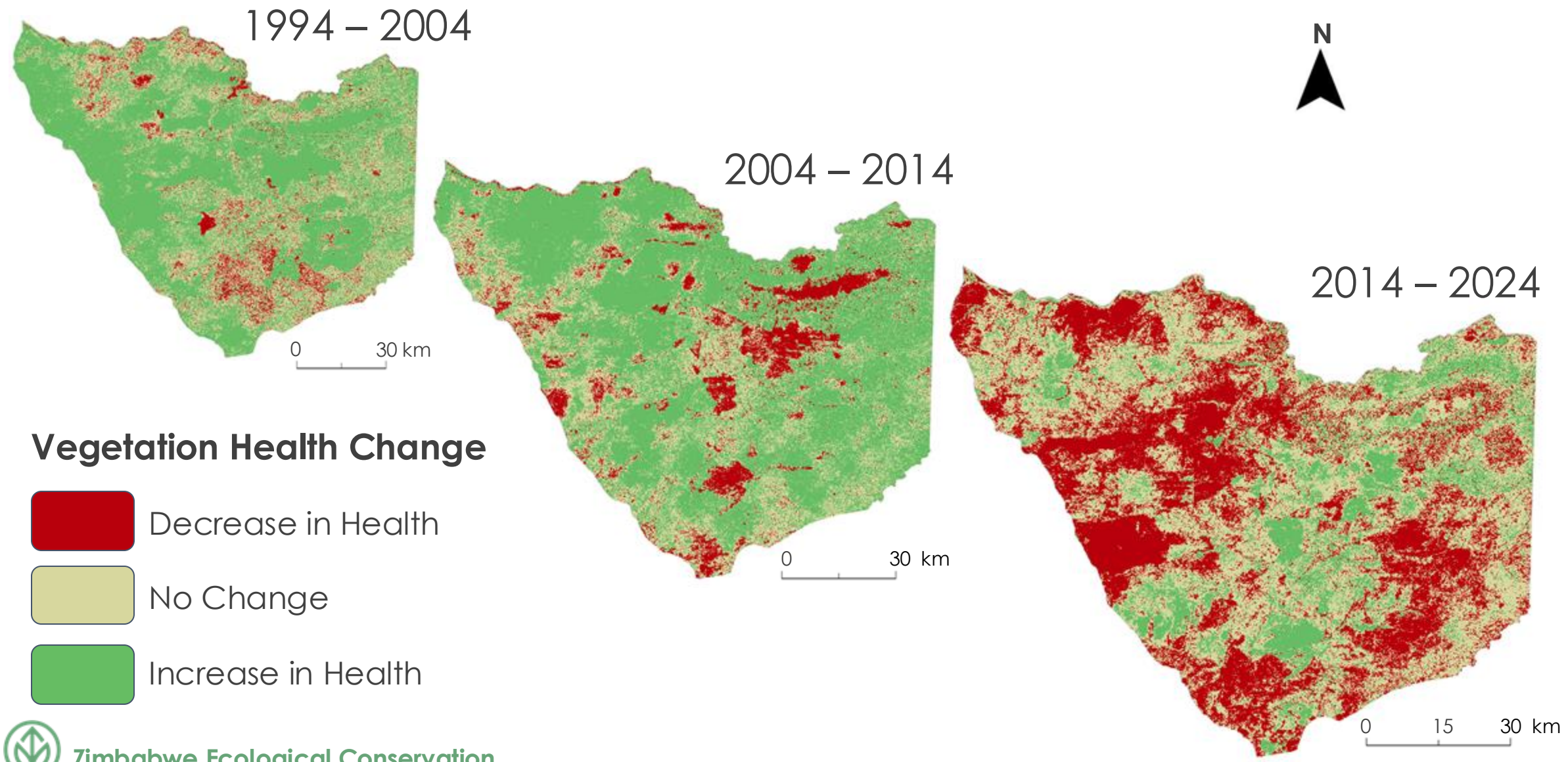
NDVI Change Detection from 1994 to 2024



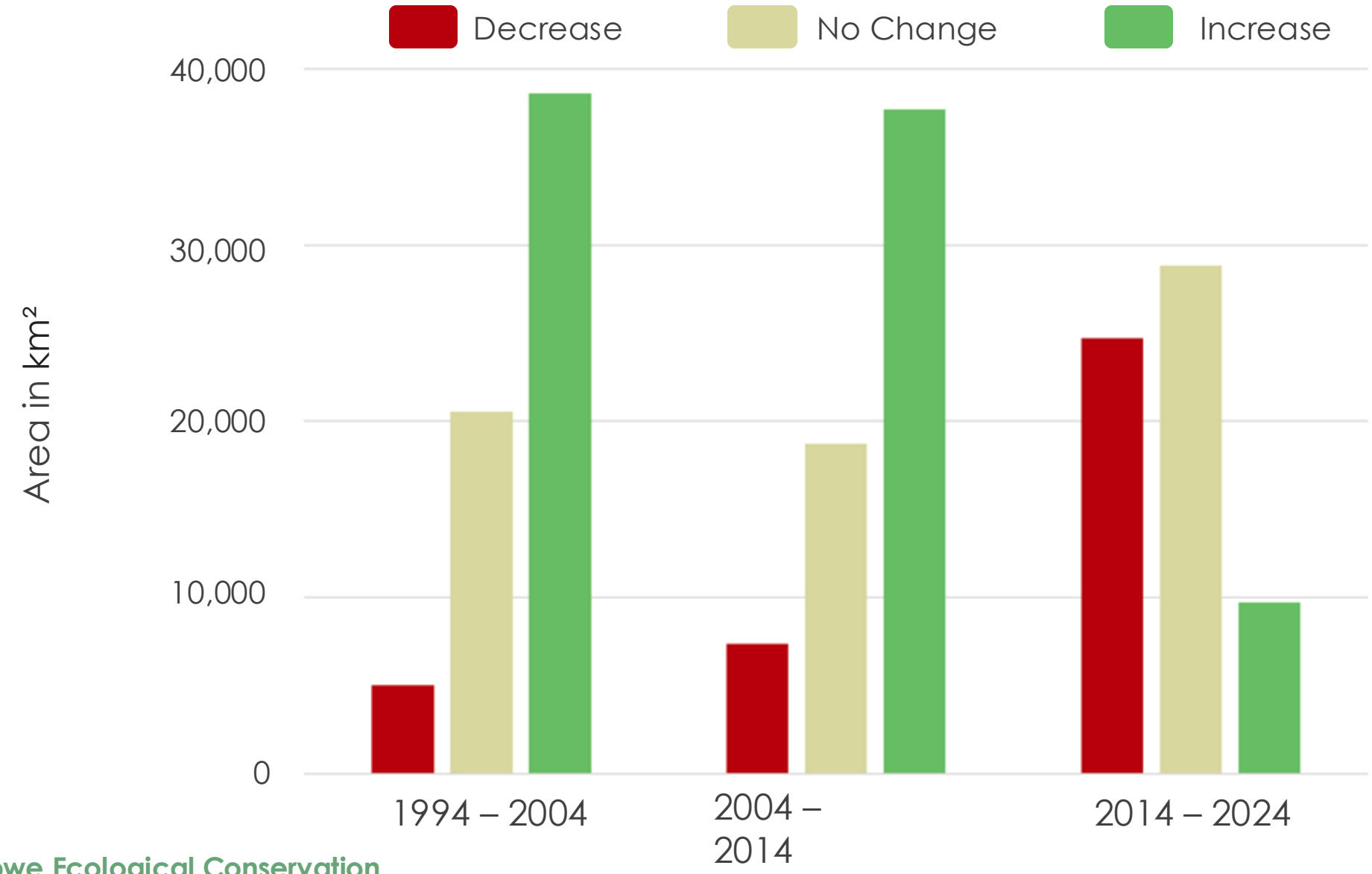
Vegetation Health Change from 1994 – 2024

- Decrease in Health
- No Change
- Increase in Health

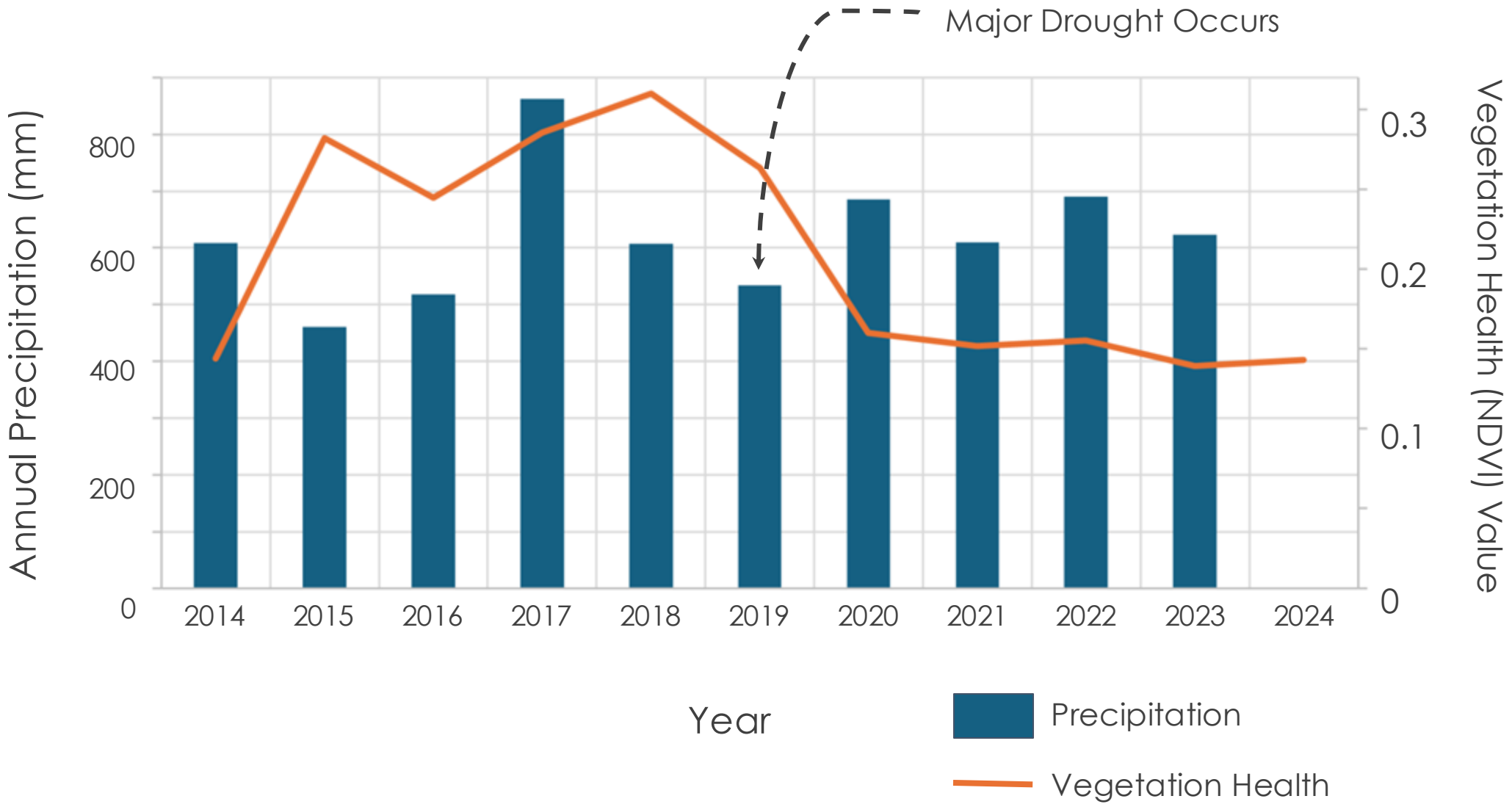
NDVI Change Detection by Decade



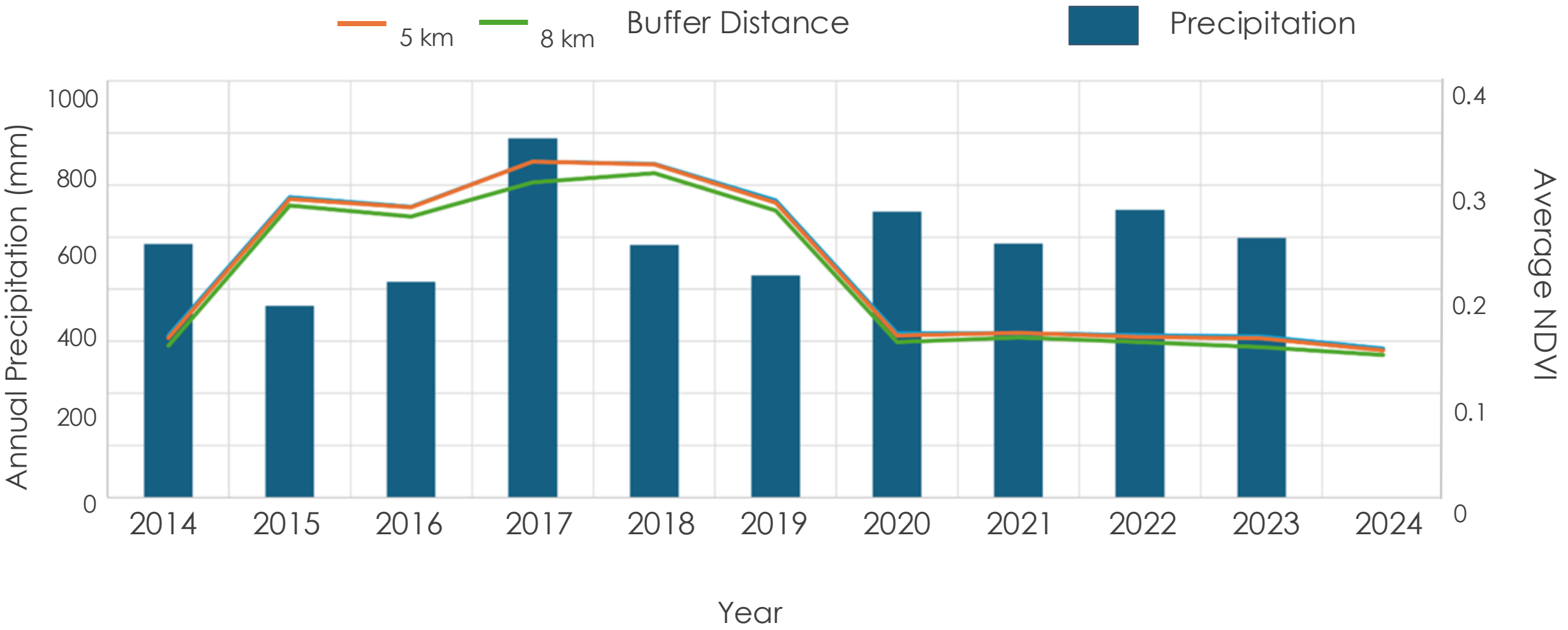
Change Detection Areas



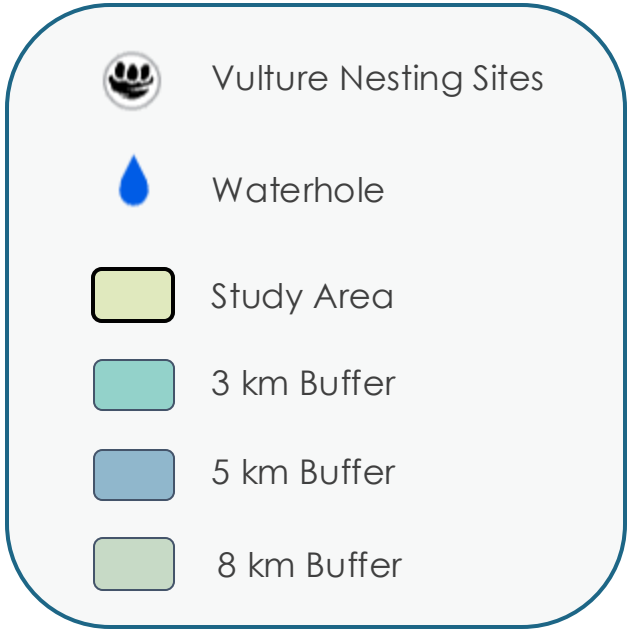
Vegetation Effects on Nesting

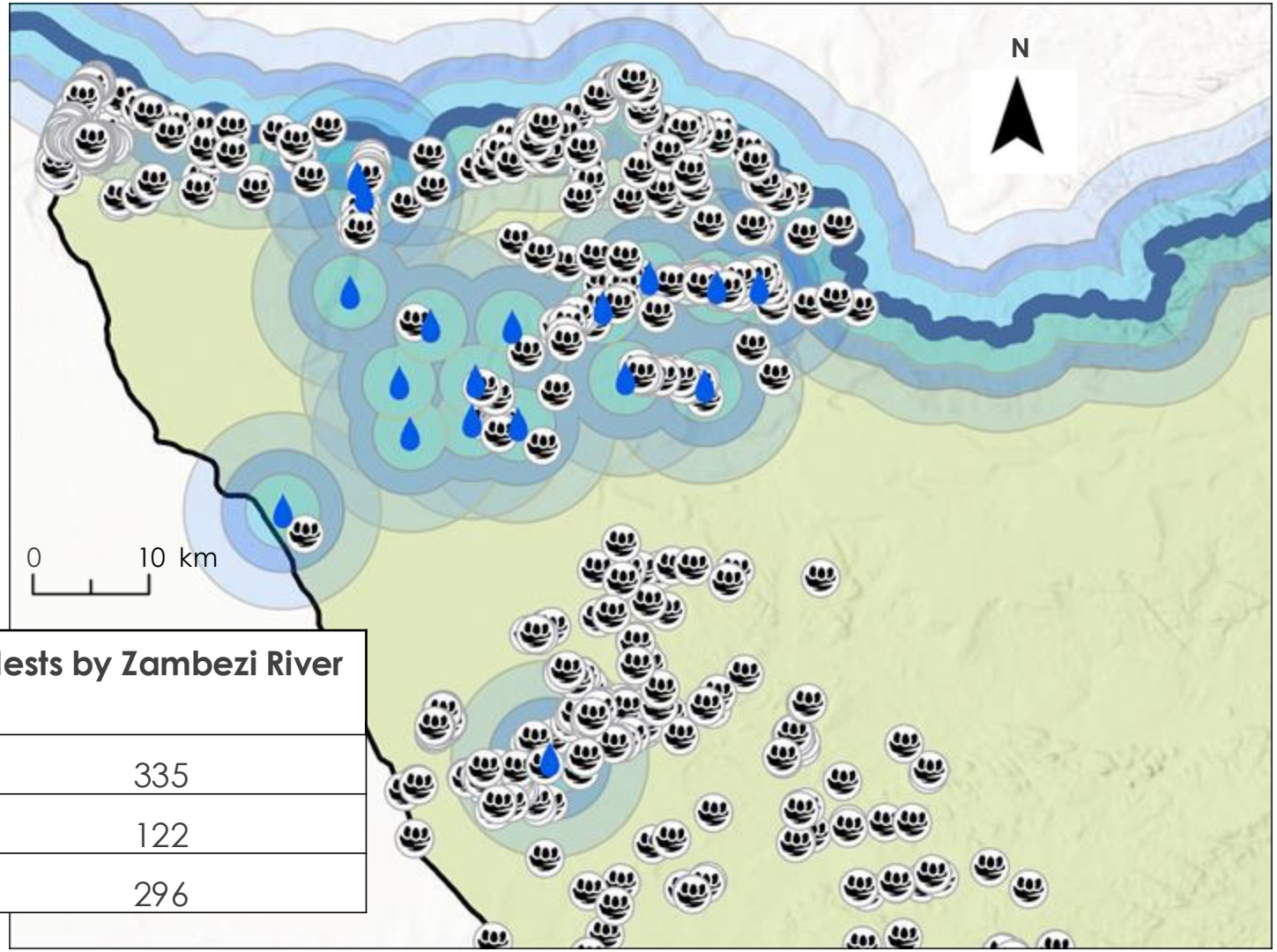


Vegetation Around Waterholes



Nesting Around Waterholes





Distance from Water Source	Nests by Waterholes	Nests by Zambezi River
Less than 3 km	255	335
3 – 5 km	100	122
5 – 8 km	97	296

Errors & Uncertainties


Image Credit: USGS

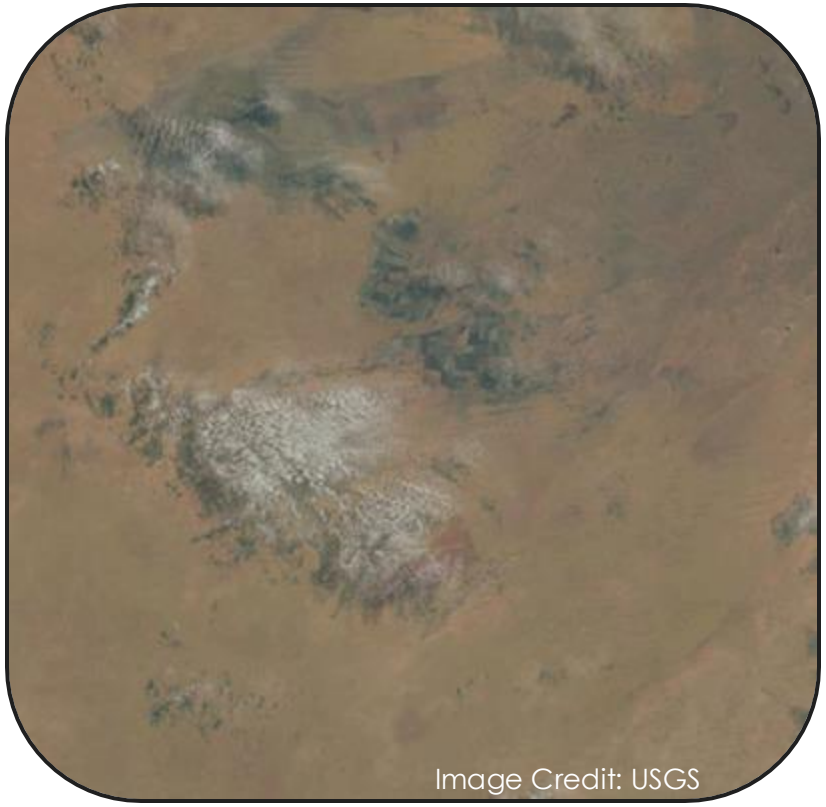


Image Credit: USGS


Image Credit: USGS

Burn Scars Vary from Year to Year

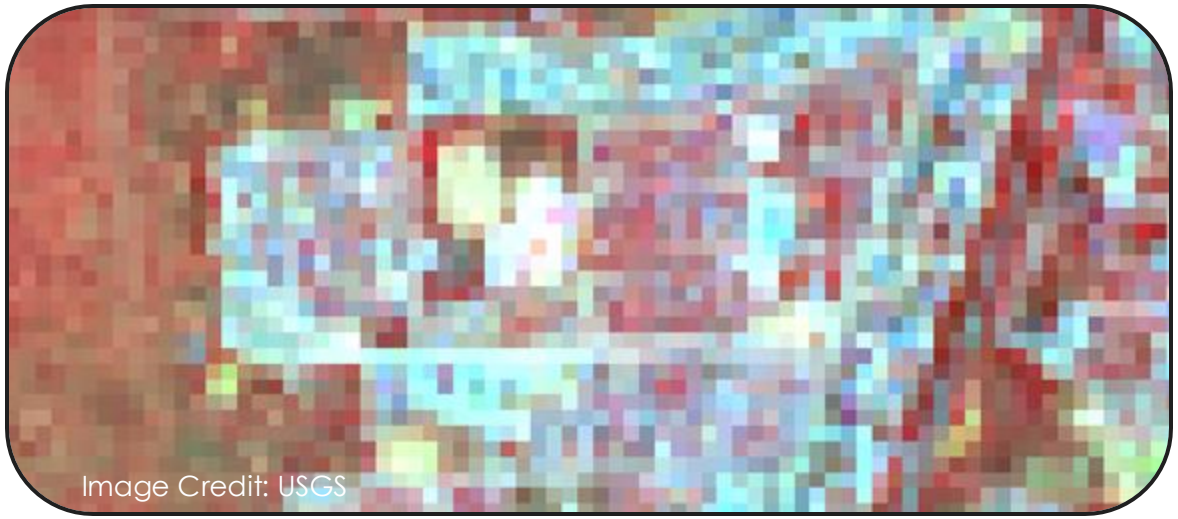
Cloud Cover limits Data Availability

Unevenly Distributed Training Points with no Accuracy Assessment

Feasibility

Outputs

- Vegetation health
- Landcover classification



Limitations

- Timeline
- Data resolution

Conclusions

End products can be used for outreach and decision-making involving:

- Artificial Waterhole Impact
- White-Backed Vulture Conservation
- Tree Cover Recovery

Variables for Vulture Nests

Within 3–8 km of water

Dense tree areas bordering open space

Trees 16–17m tall

Image Credit: Joseph Heymans

Acknowledgements

Science Advisors

- Dr. Marguerite Madden

DEVELOP Lead

- Dr. Jennifer Mathis

Project Partners

- Connected Conservation
- Victoria Falls Wildlife Trust

Image Credit: Ian White

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