

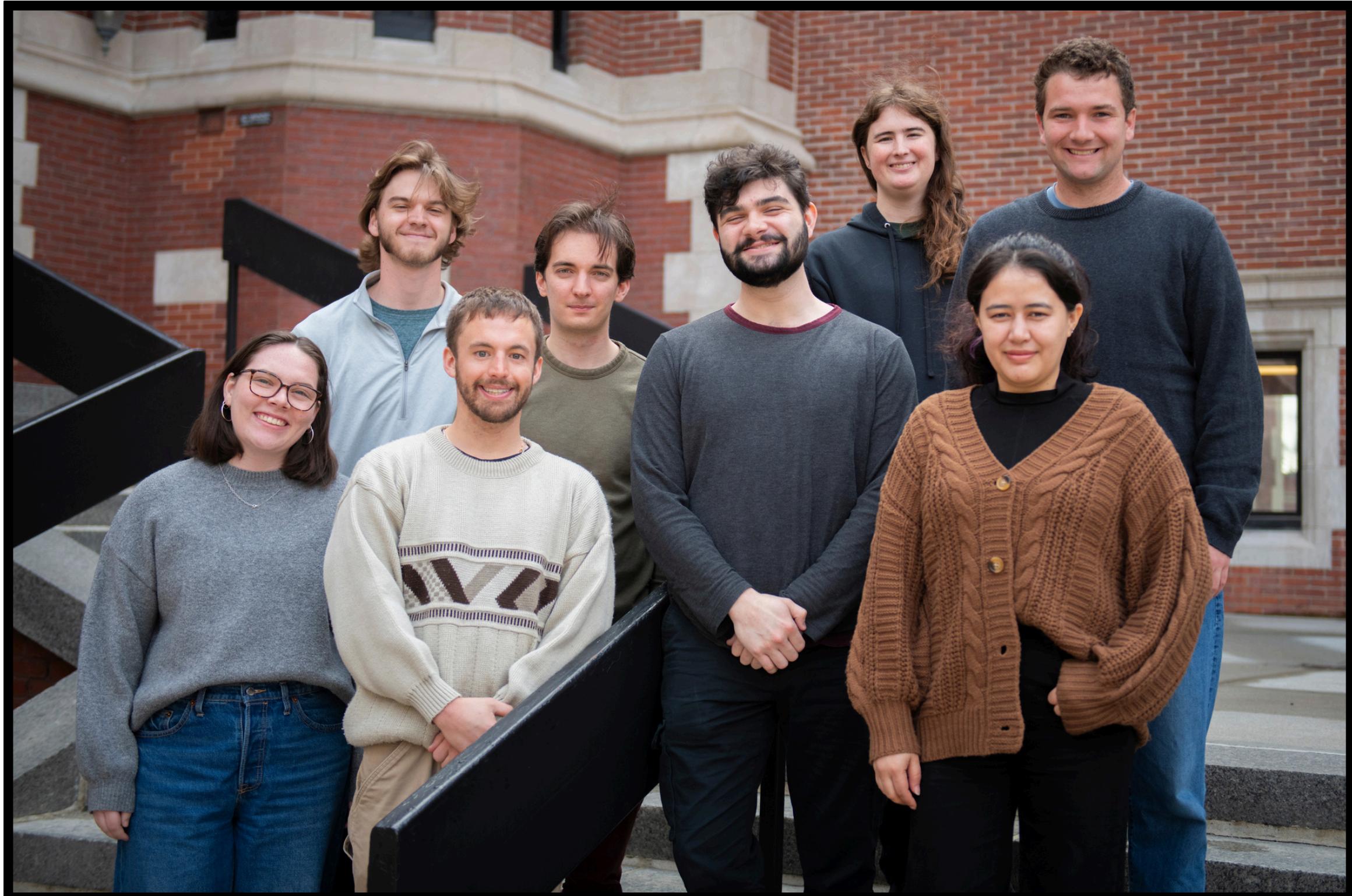


**CLARK CONSULTING GROUP**

# TRENDS IN TERRESTRIAL WCS MANAGEMENT UNITS: CENTRAL AND SOUTH AMERICA



# MEET THE TEAM



## Spring 2025 WCS Team

Adlai Nelson  
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Tanner Honnef  
Wynnie Gross

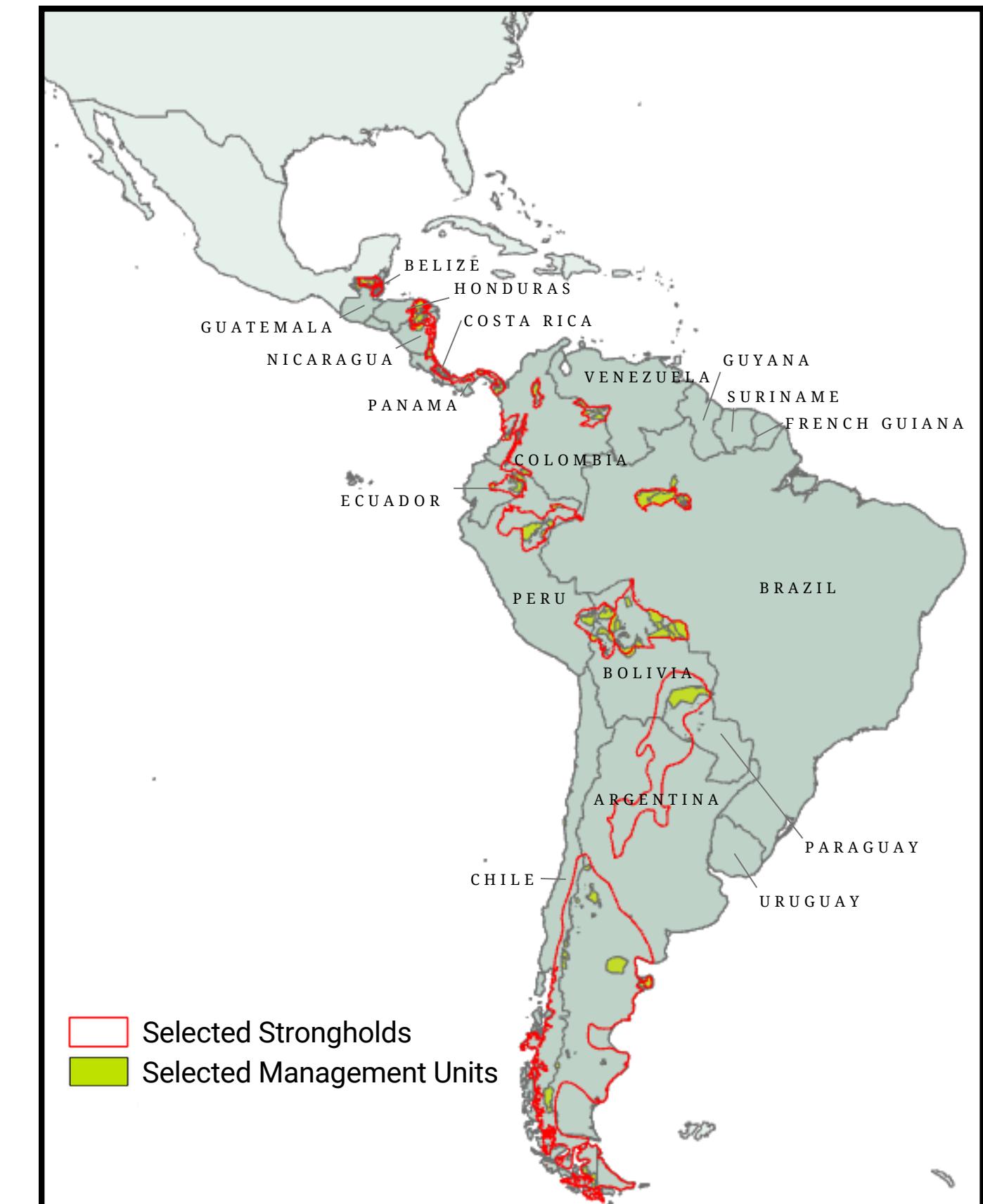
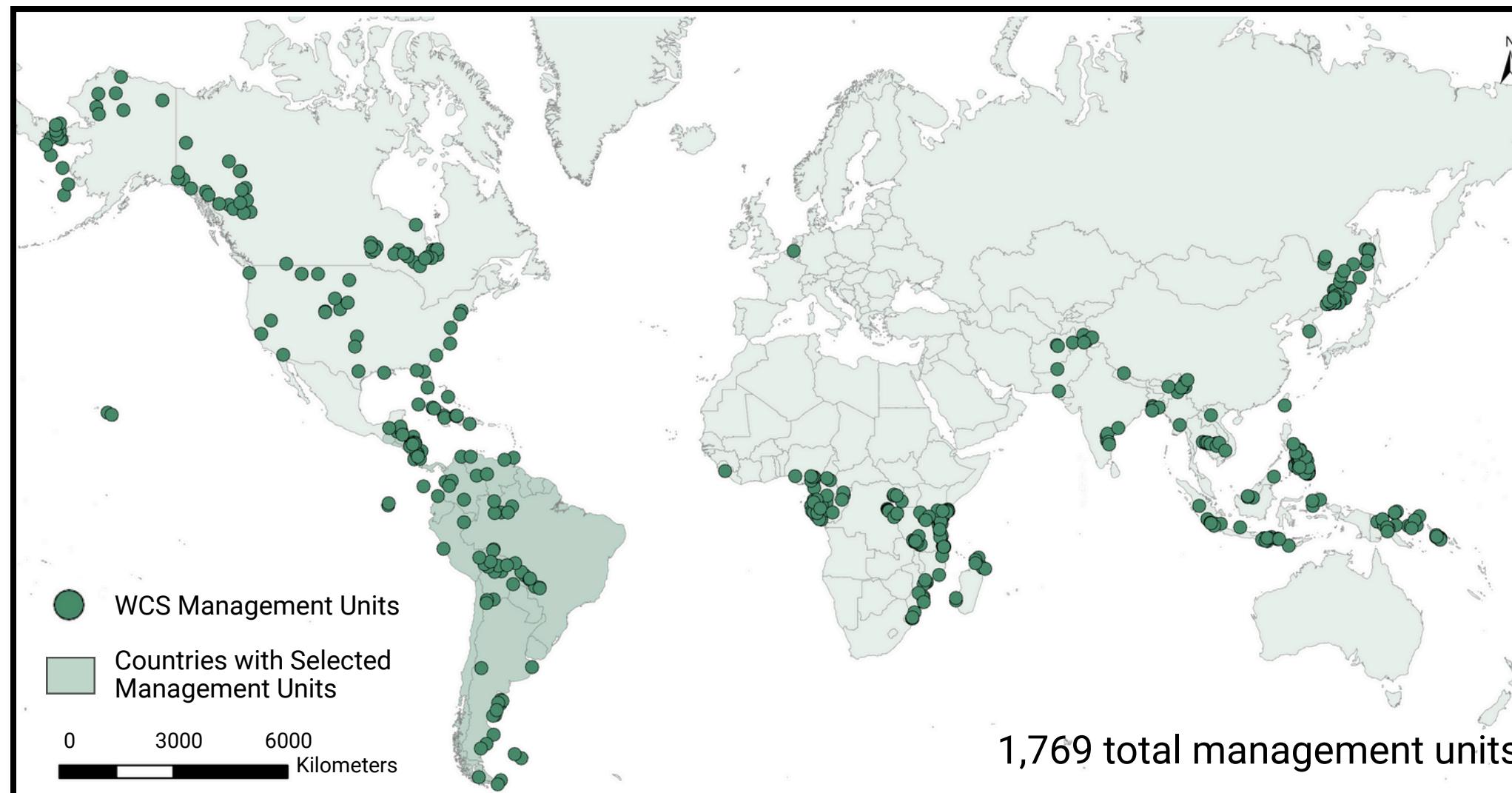
# CONTENTS

- Background and Objectives
- Management Unit Characteristics
- Results
  - Landscape Characteristics
    - Land Cover
    - Human Impact Index (HII)
    - Forest Landscape Integrity Index (FLII)
    - Fire
    - Nighttime Lights (NTL)
  - Climate
    - Temperature
    - Precipitation
  - Case Studies
    - Gran Chaco
    - RNSC los Clavellinos
- Conclusion
- ArcGIS Dashboard



# STUDY AREA: CENTRAL AND SOUTH AMERICA

- Varying management unit characteristics
- Ecological importance and biodiversity
- Vulnerability to anthropogenic disturbance
- Terrestrial ecosystems focus



# RESEARCH QUESTIONS AND PROJECT GOALS

## Guiding Questions

1. How do landscape characteristics and climate variables vary through time and across management units in the study area?
2. How do these trends differ at varying scales?
3. What do these trends imply for WCS management practices?

## Examining Trends in WCS Management Units

### **1. Analysis for Management Units**

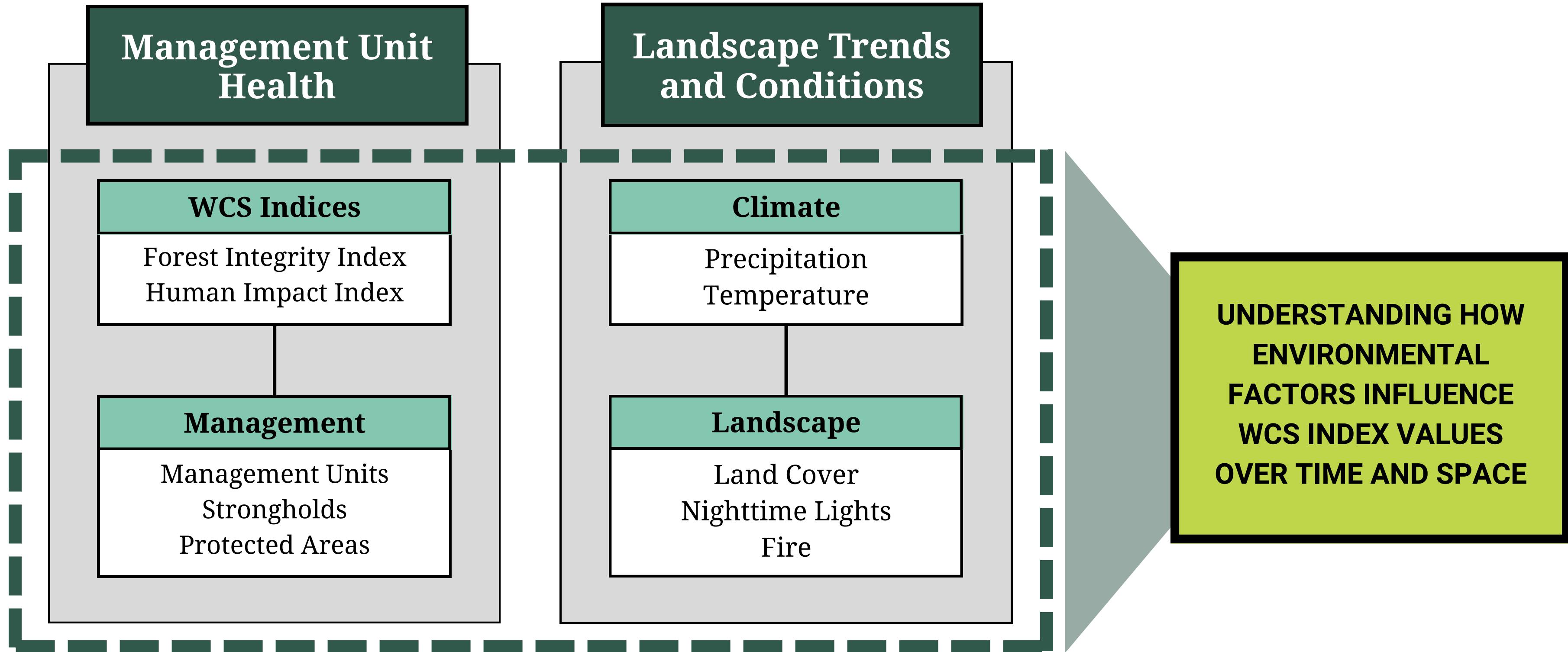
- WCS data trends
- Trends in external environmental indicators

### **2. Compare Across Time and Space**

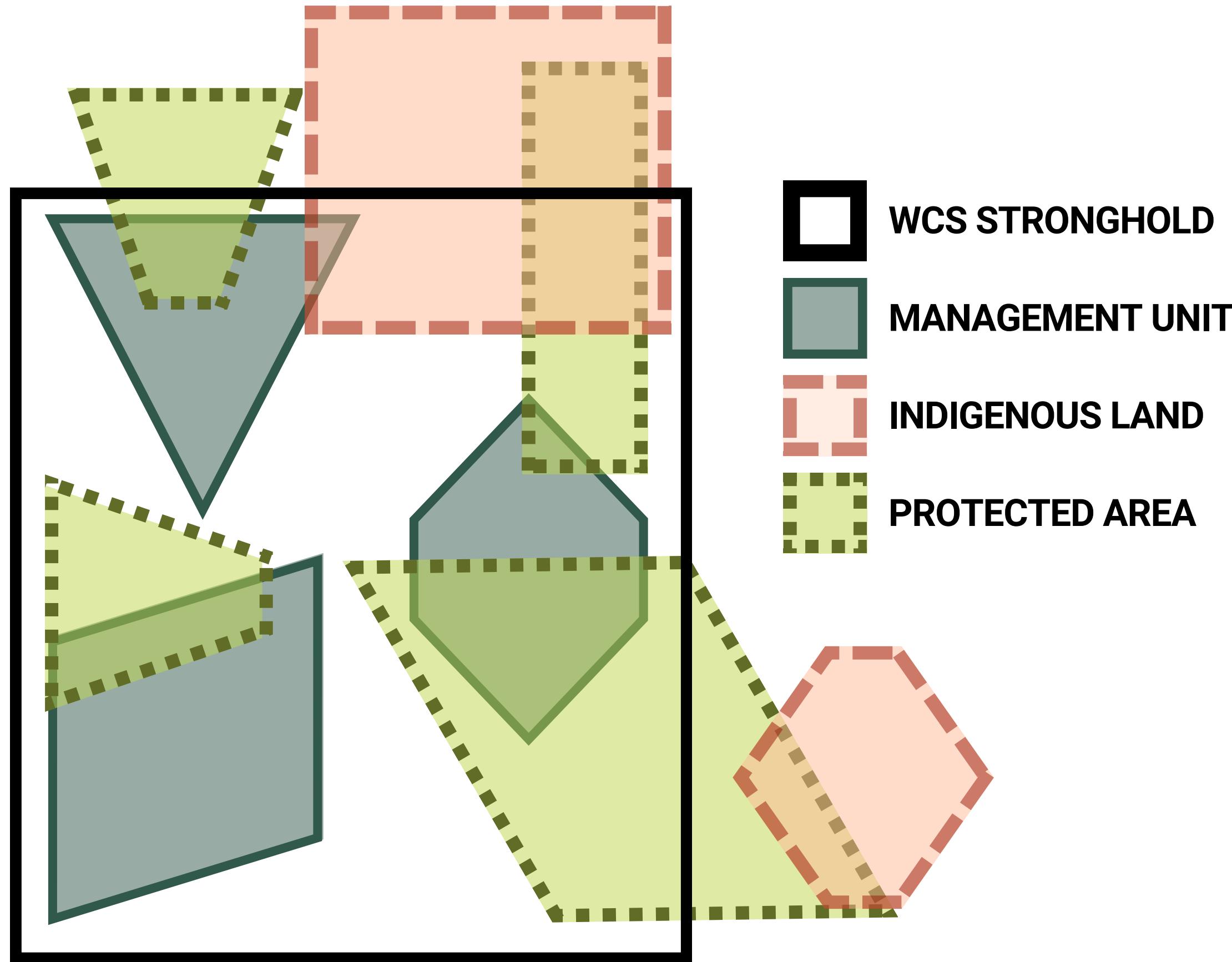
- Aggregate by both WCS stronghold and country to identify regional trends



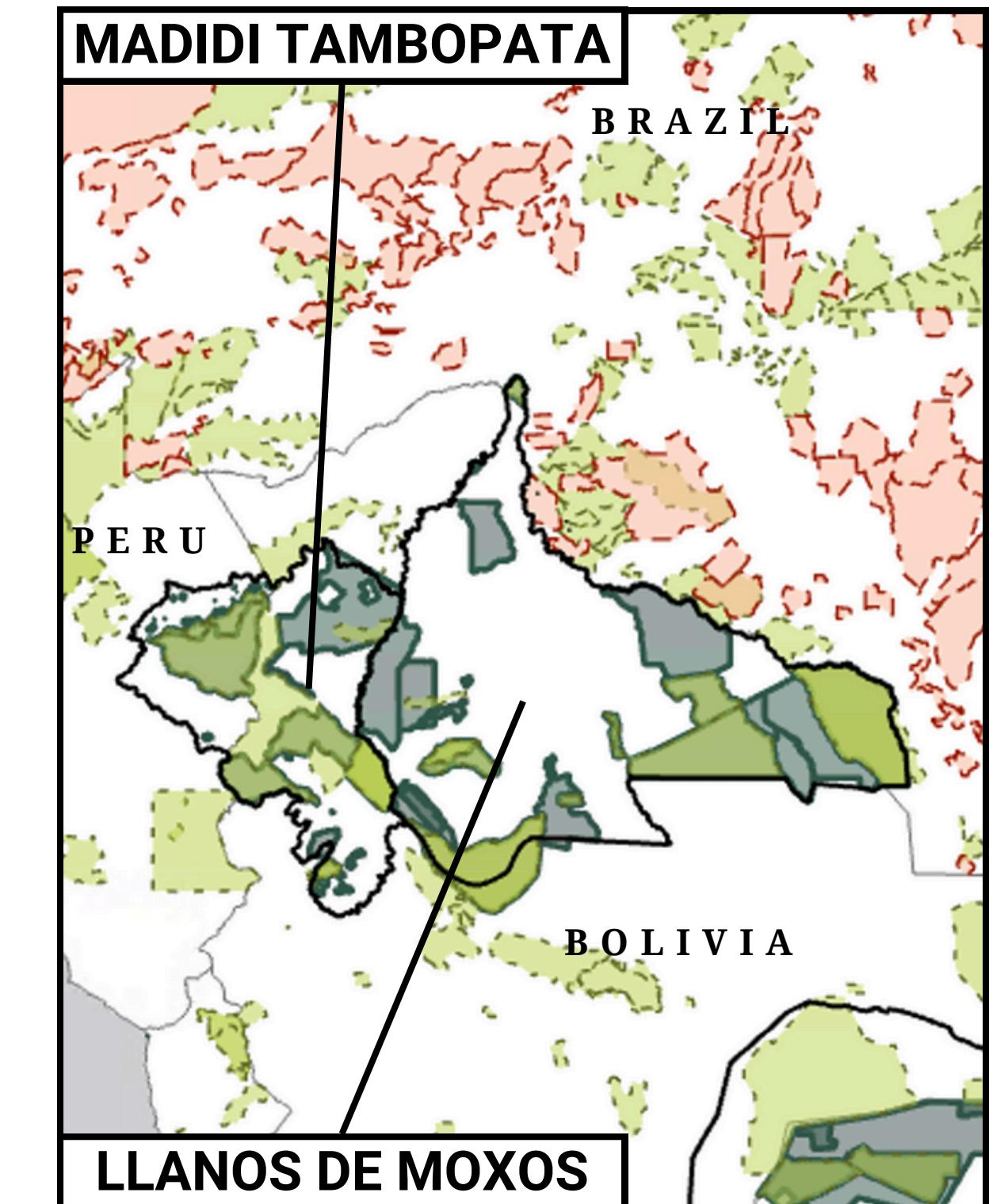
# FRAMEWORK FOR ANALYSIS



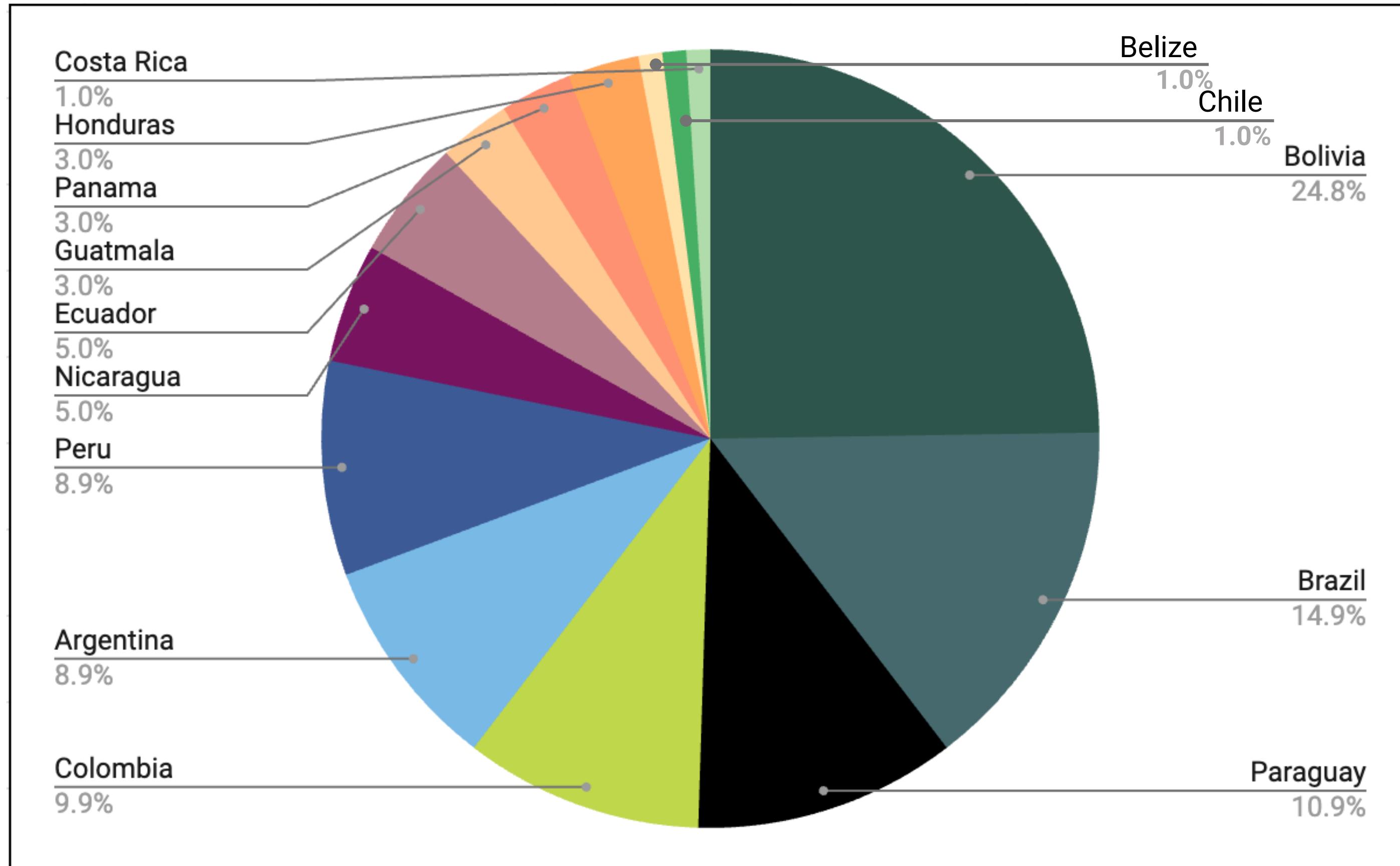
# CONCEPTUAL MODEL



## EXAMPLE

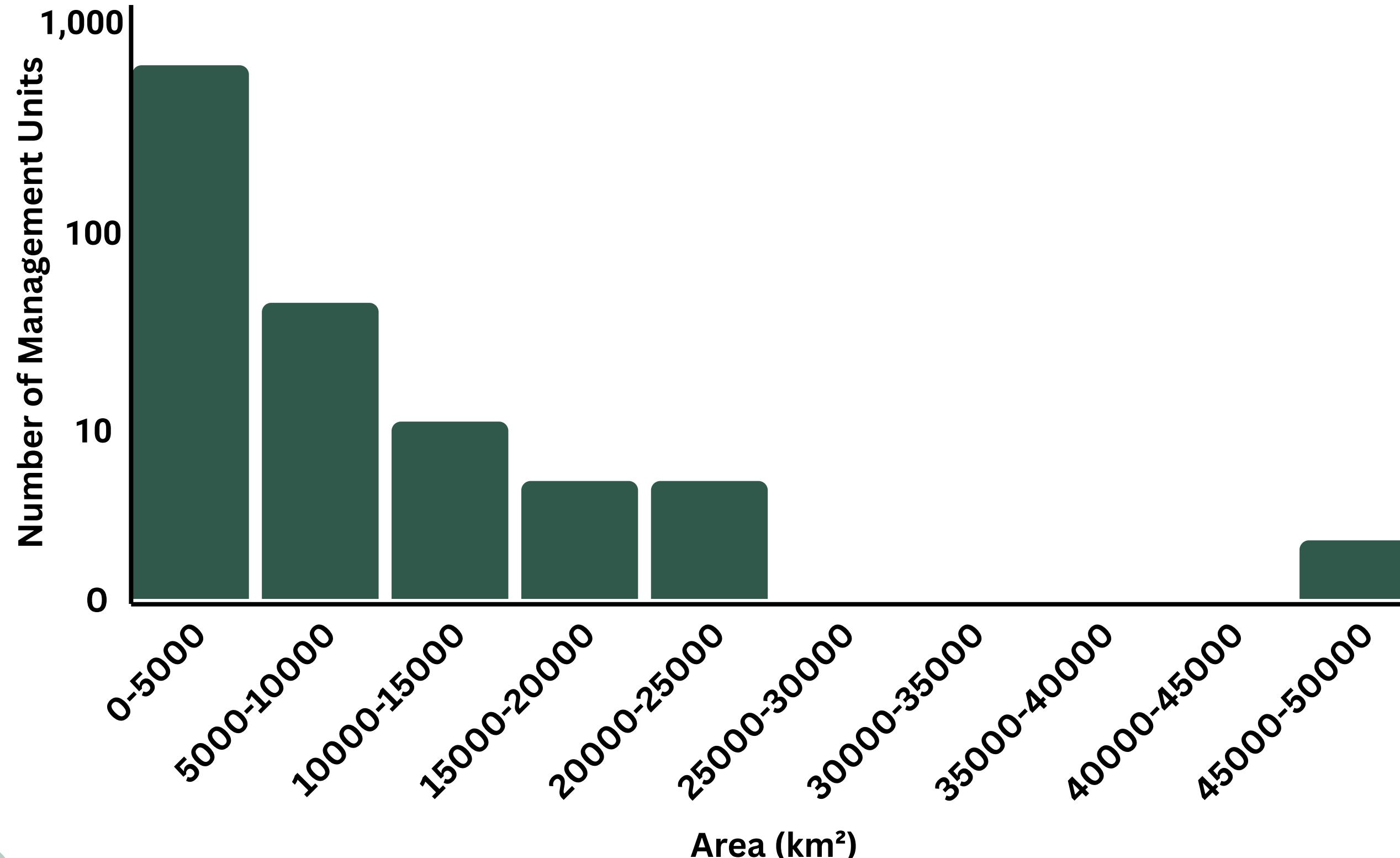


# MANAGEMENT UNIT AREA BY COUNTRY



# MANAGEMENT UNIT DISTRIBUTION

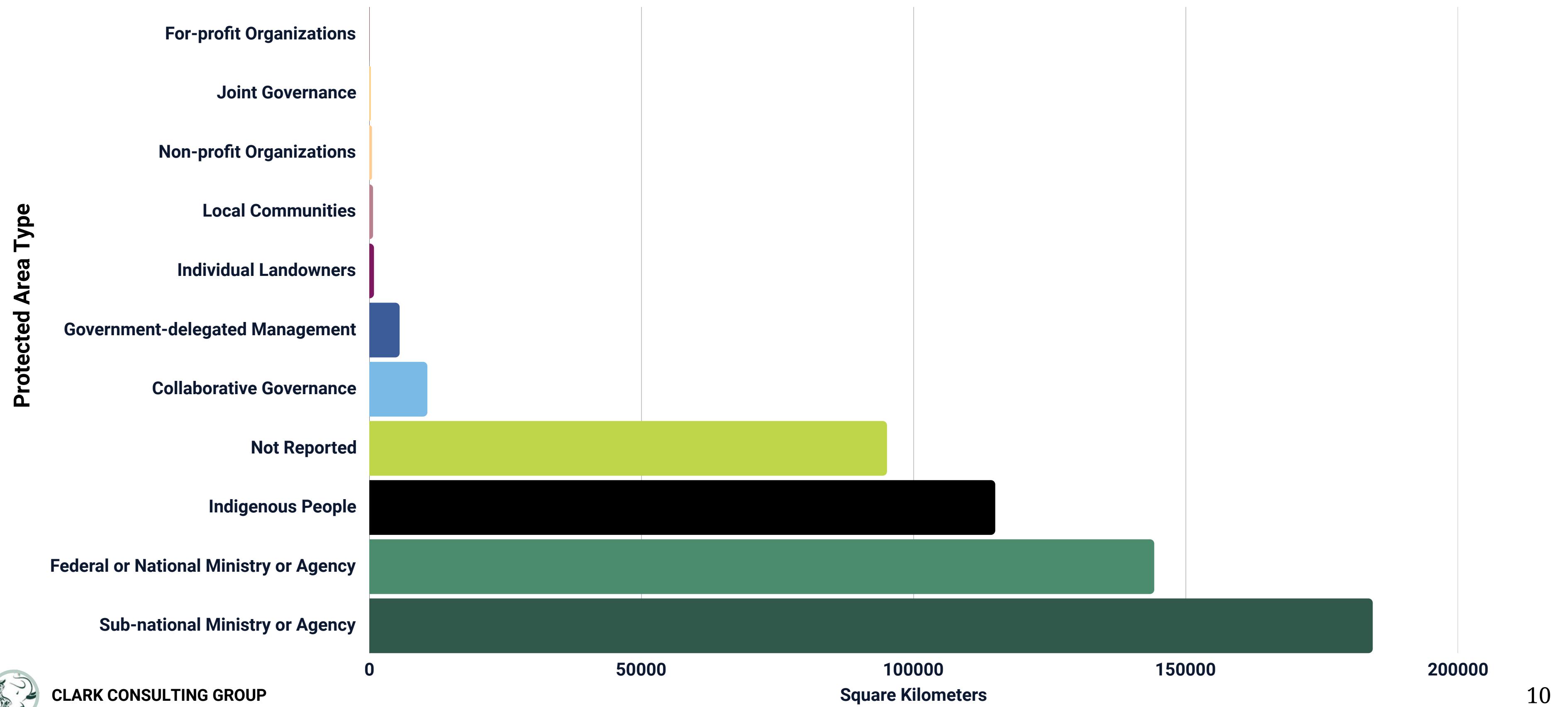
● Distribution of Management Unit Areas



Statistic	Area (km <sup>2</sup> )
Mean	863.29
Median	12.02
Minimum	0.002
Maximum	45,901.16
Sum	556,822.05



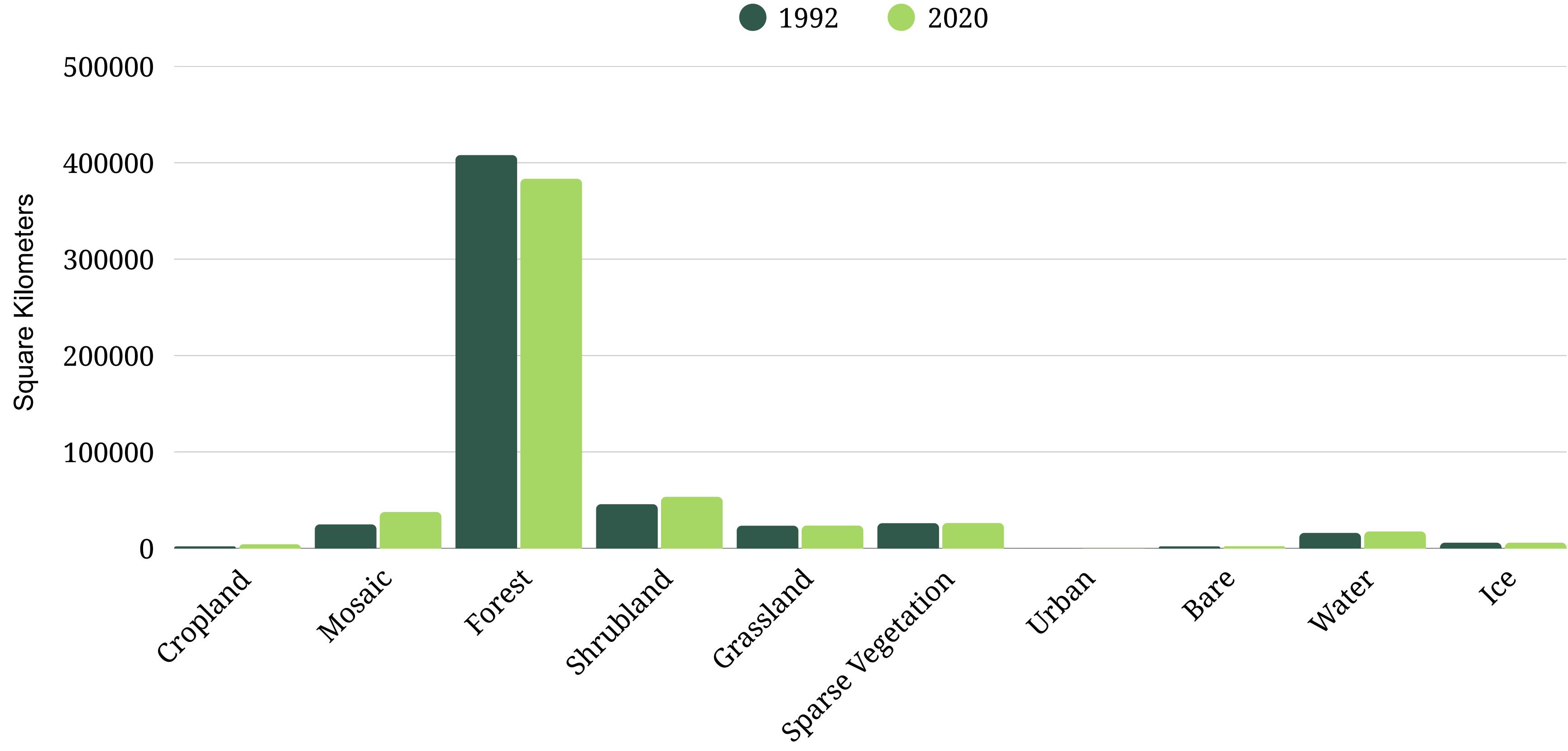
# OVERLAP OF MANAGEMENT UNITS AND PROTECTED AREAS



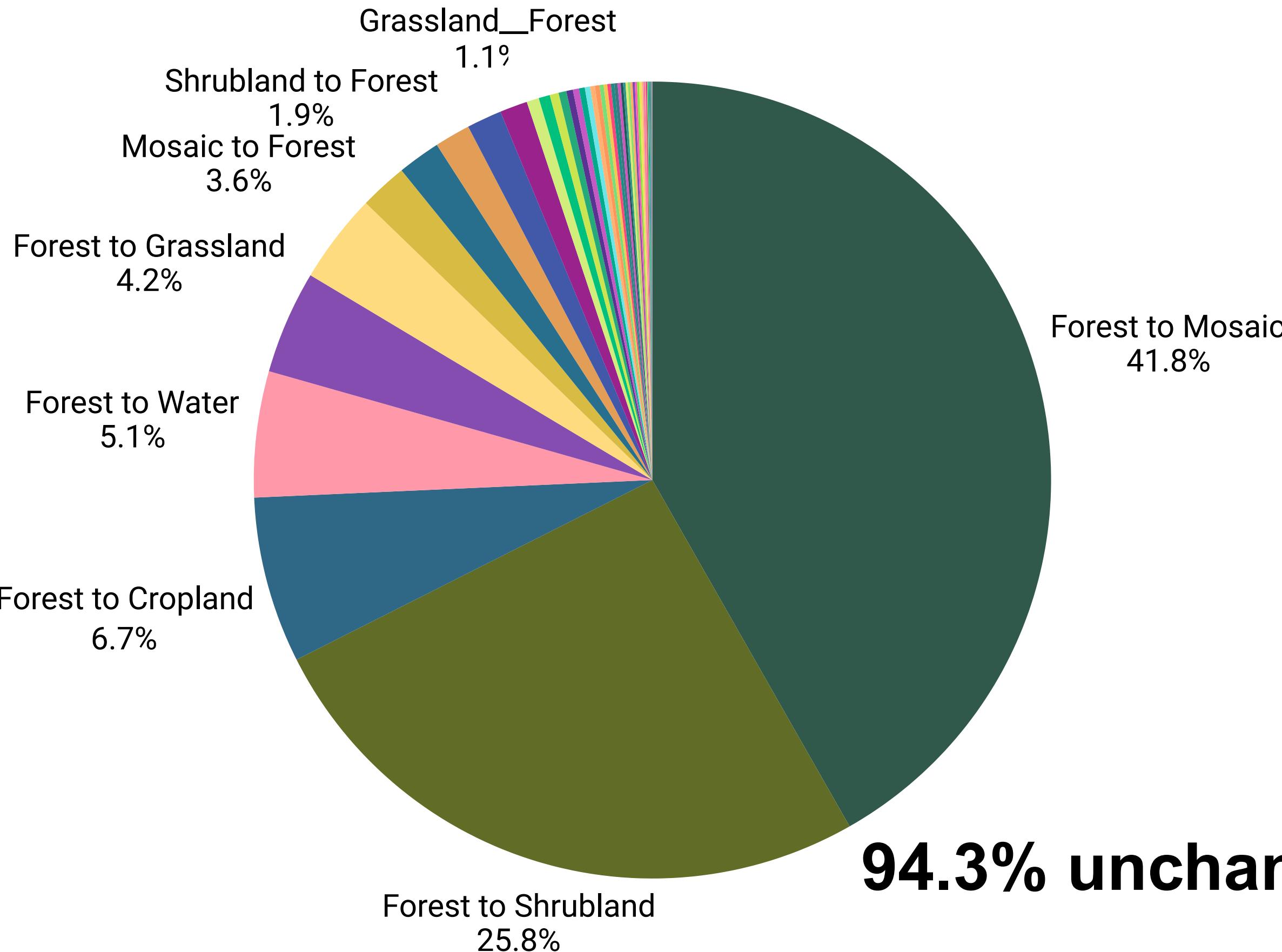
# LAND COVER COMPARISON ESA (1992 - 2020)



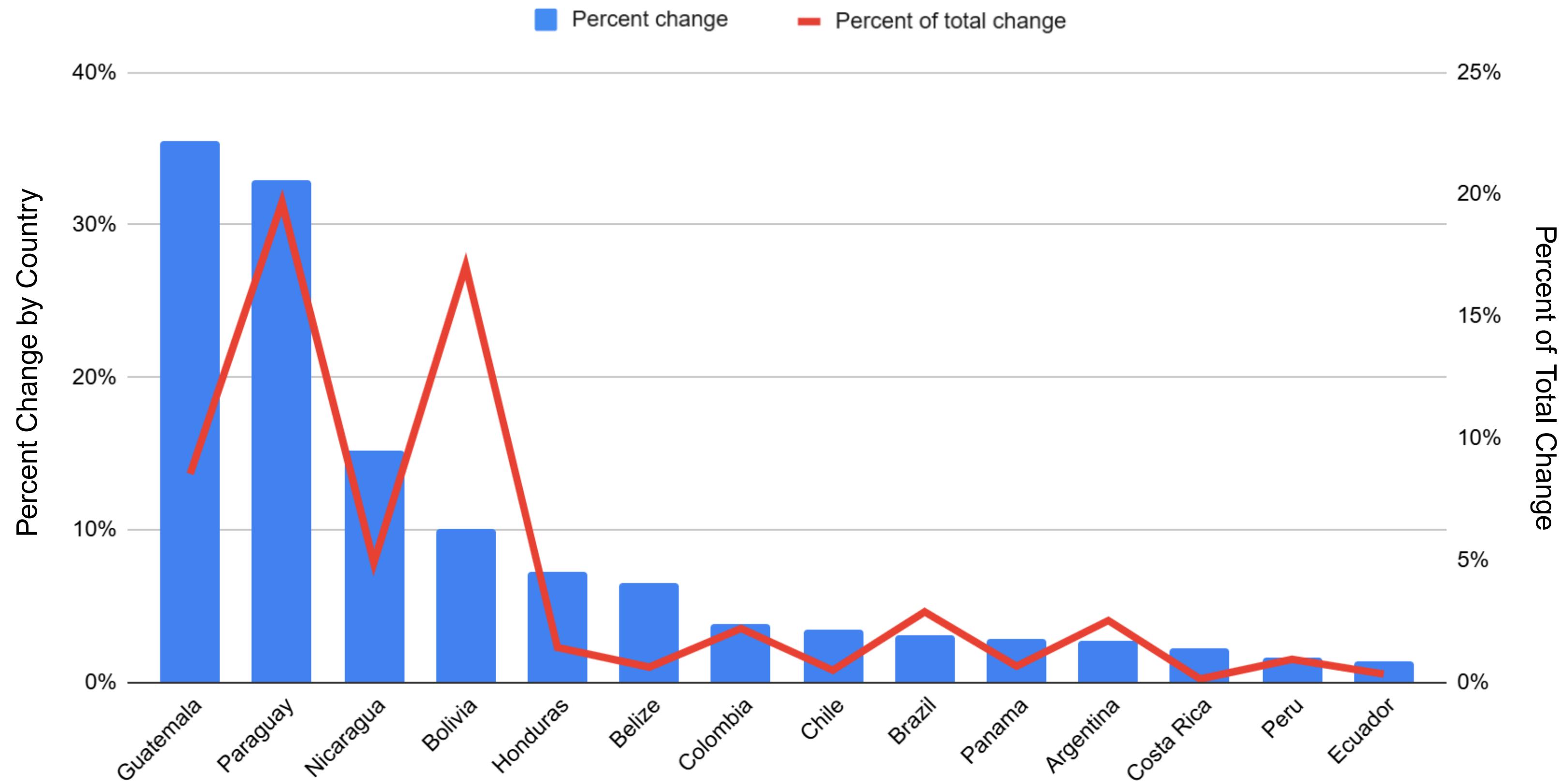
# MANAGEMENT UNIT LAND COVER



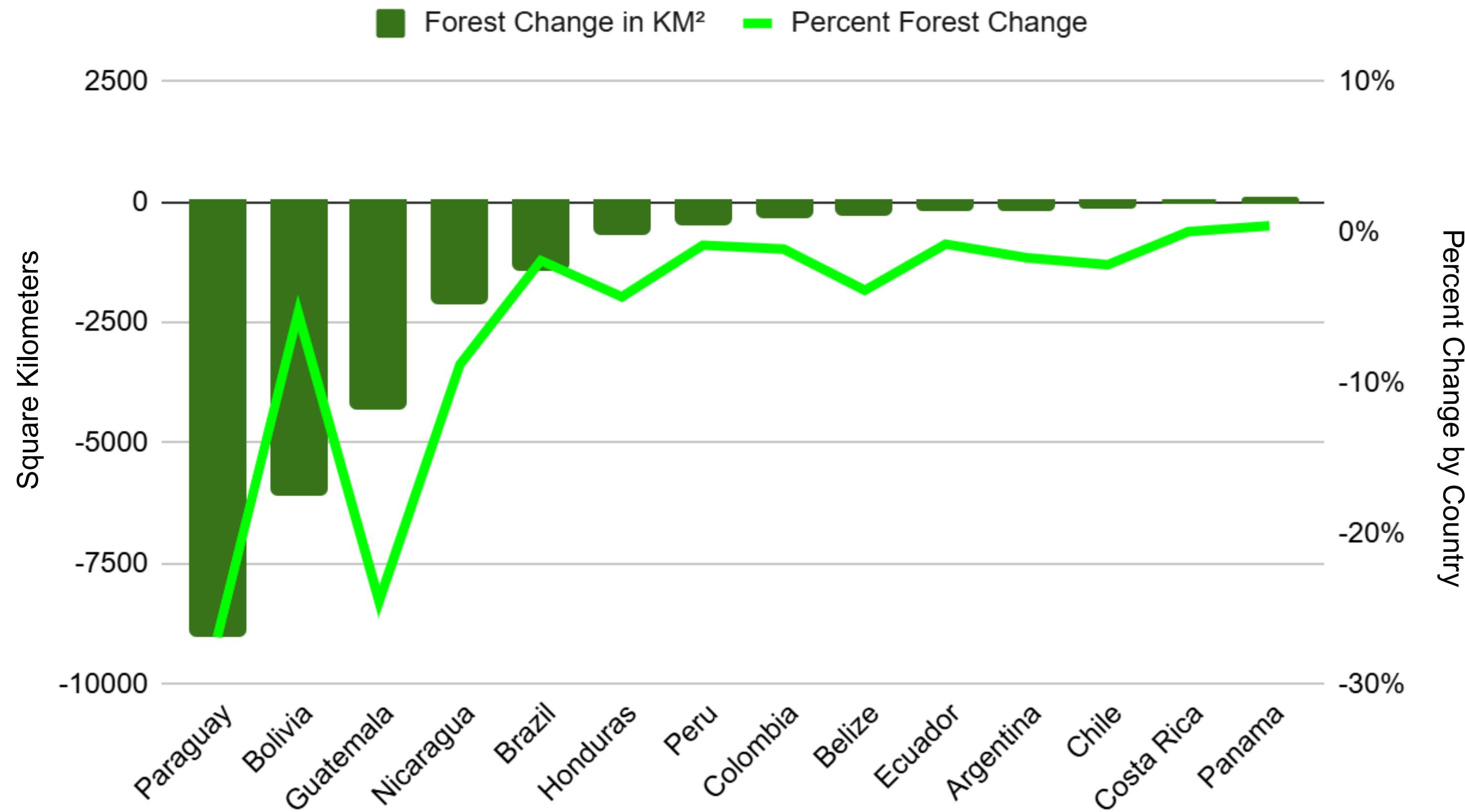
# MANAGEMENT UNIT CATEGORIES OF TRANSITION



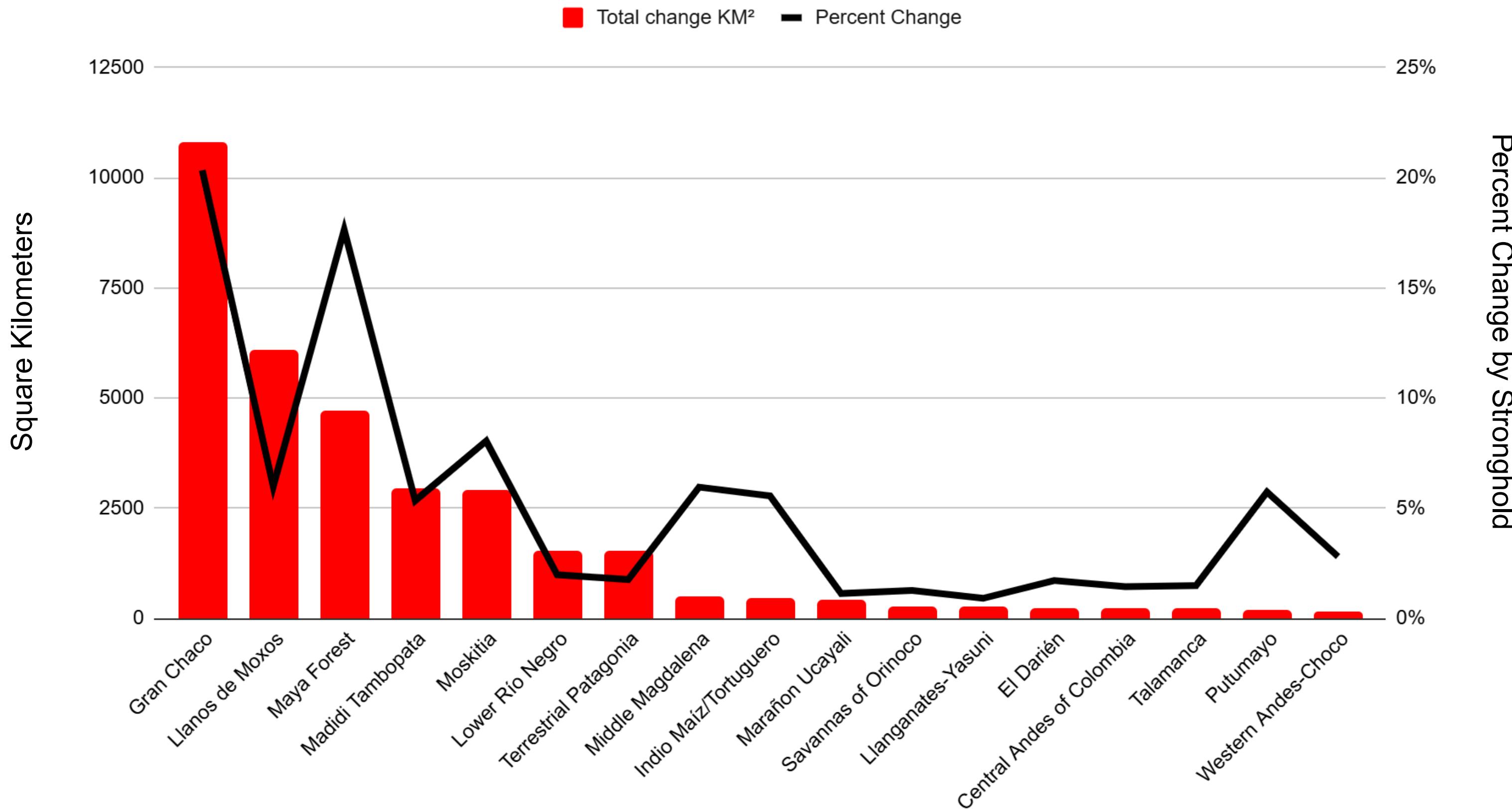
# PERCENT LAND COVER CHANGE, 1992 - 2020



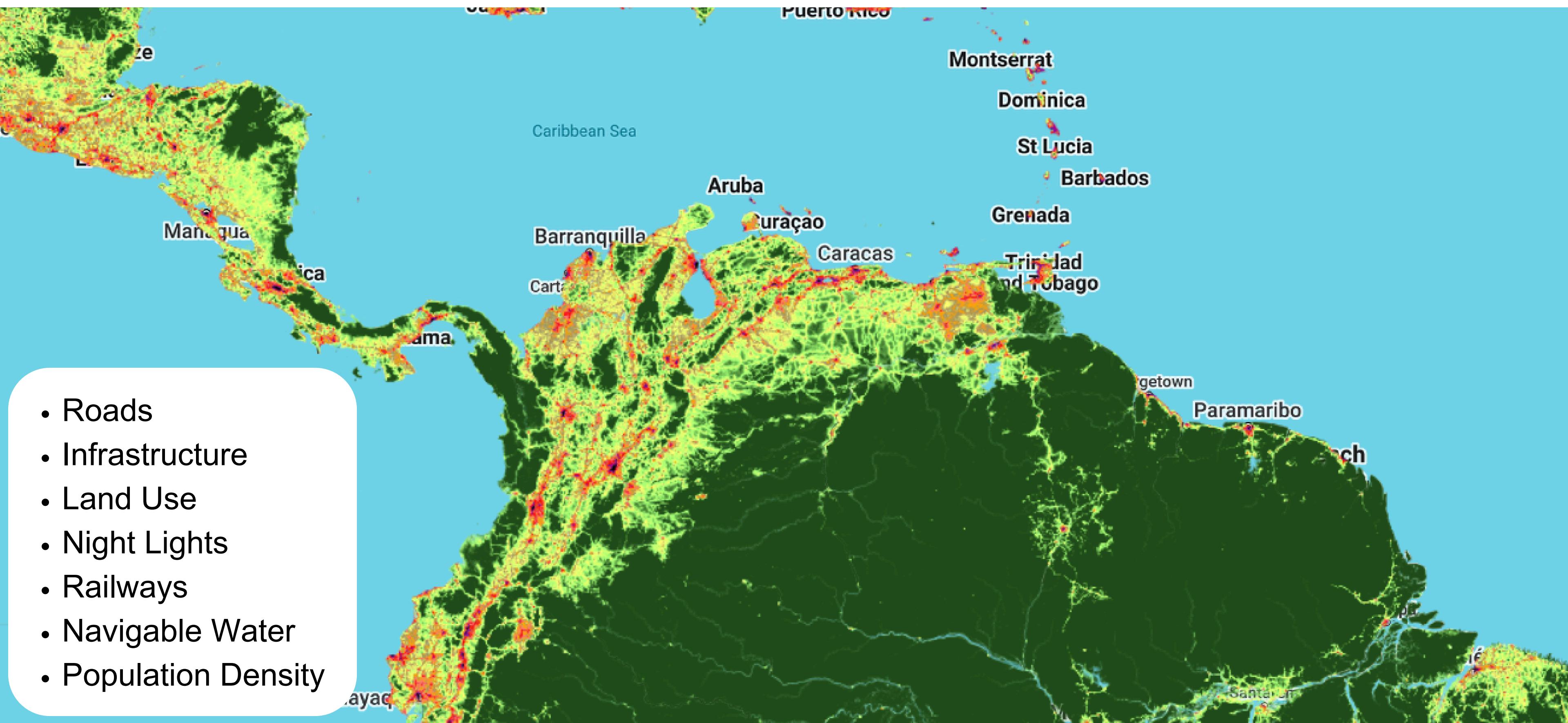
# FOREST CHANGE BY COUNTRY, 1992 - 2020



# LAND COVER CHANGE BY STRONGHOLD 1992 - 2020



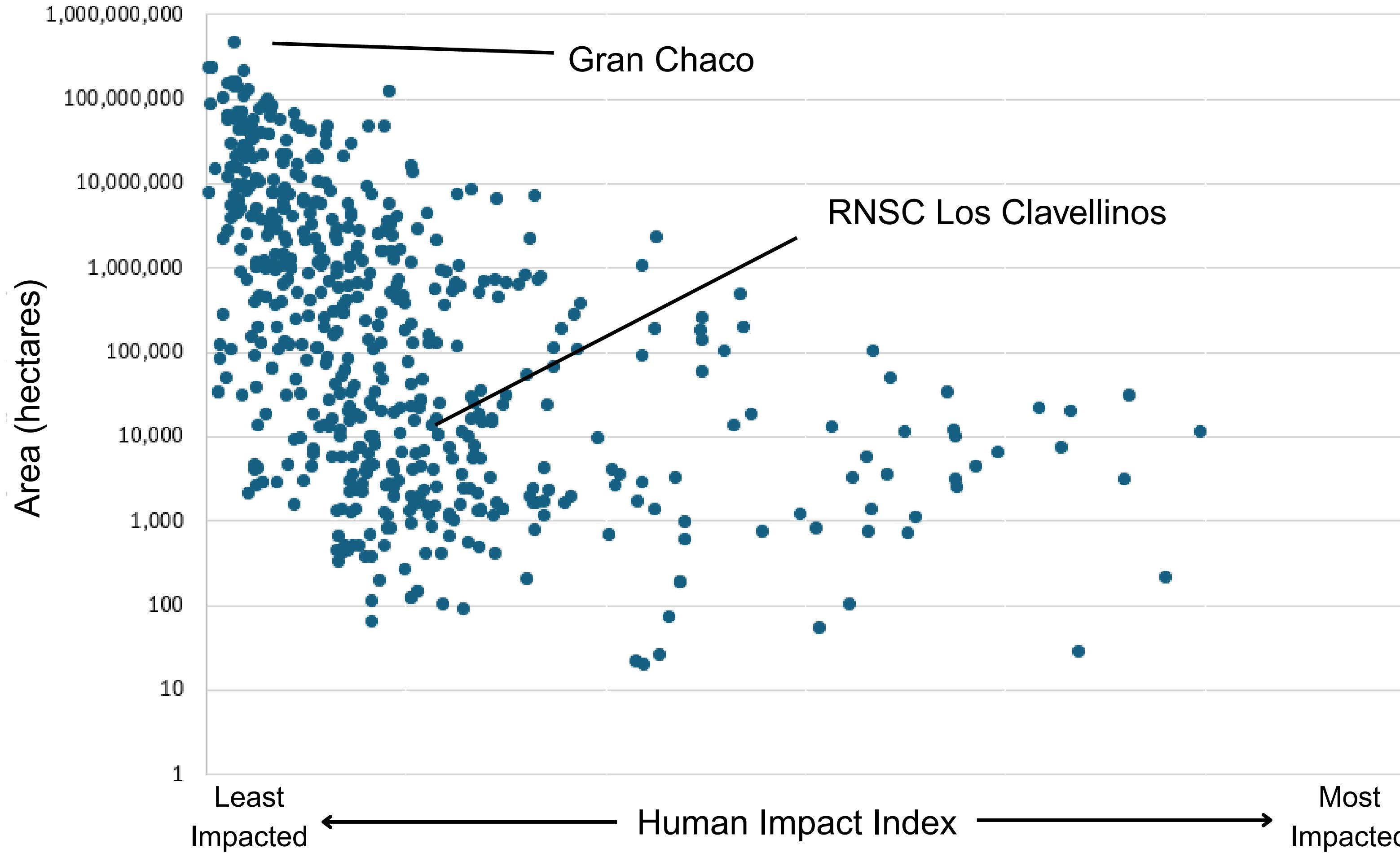
# HUMAN IMPACT INDEX



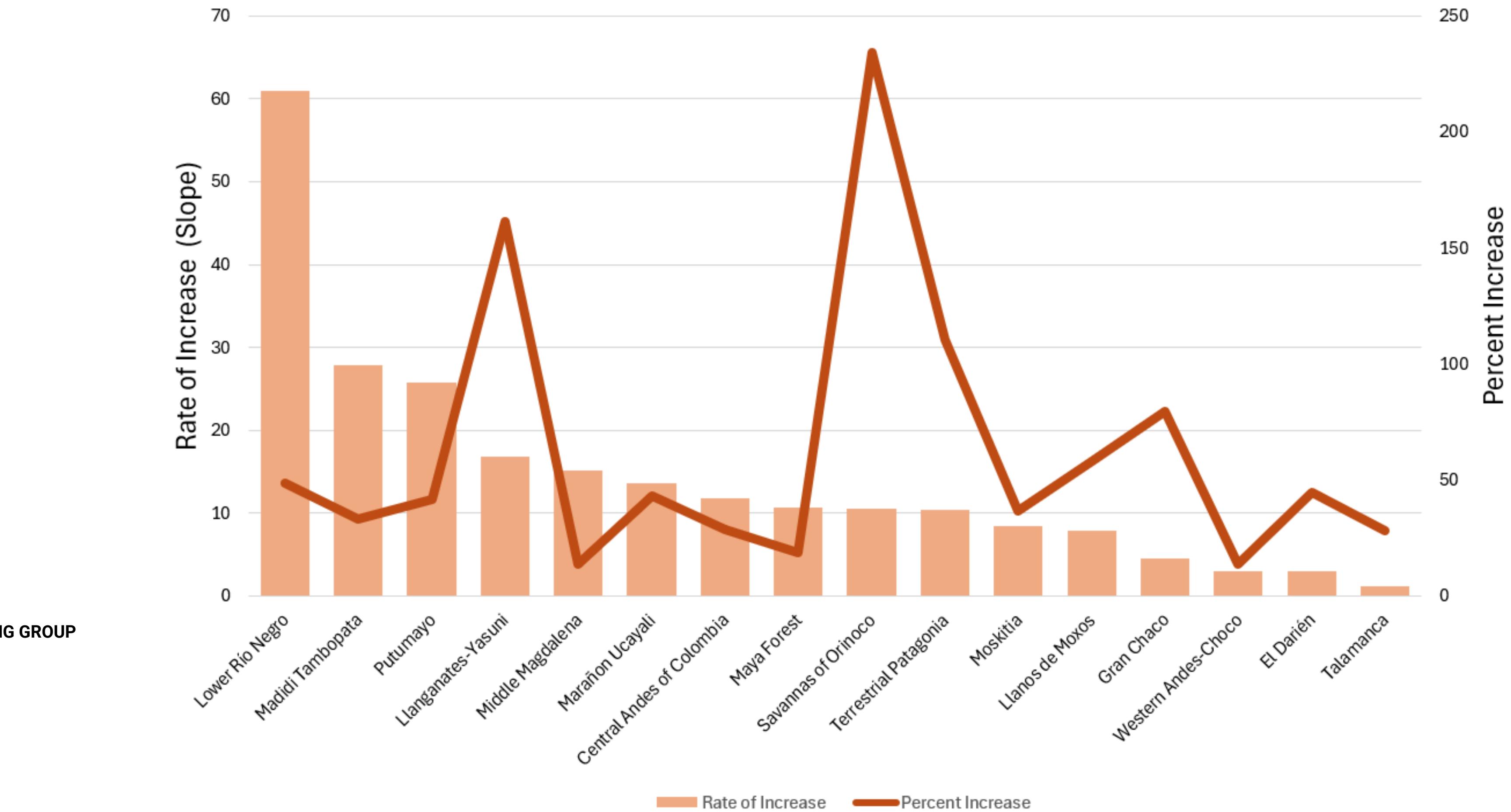
# HUMAN IMPACT BY MANAGEMENT UNIT AREA, 2020



# HUMAN IMPACT BY MANAGEMENT UNIT AREA, 2020



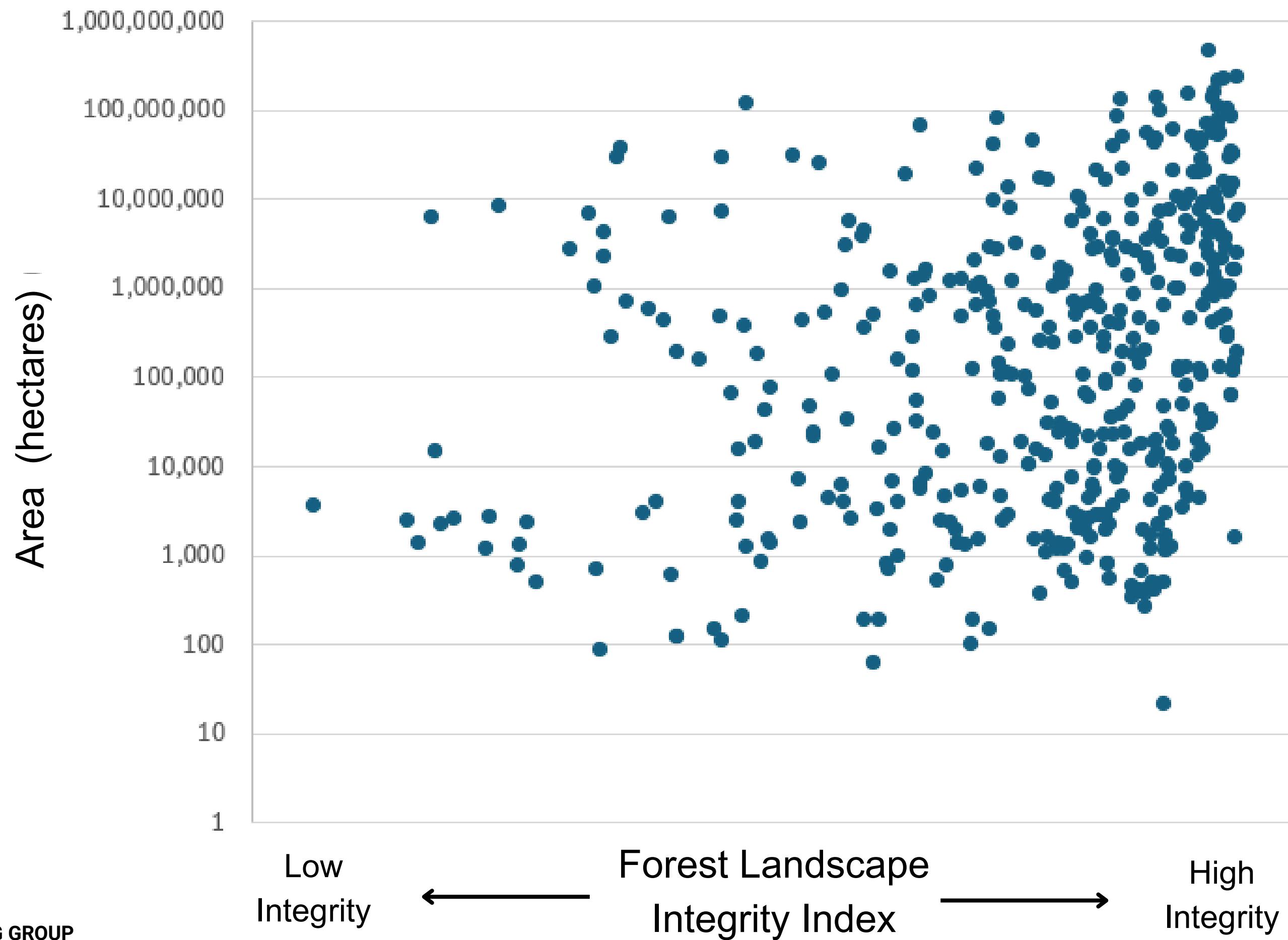
# TRENDS IN HII BY STRONGHOLD, 2001-2020



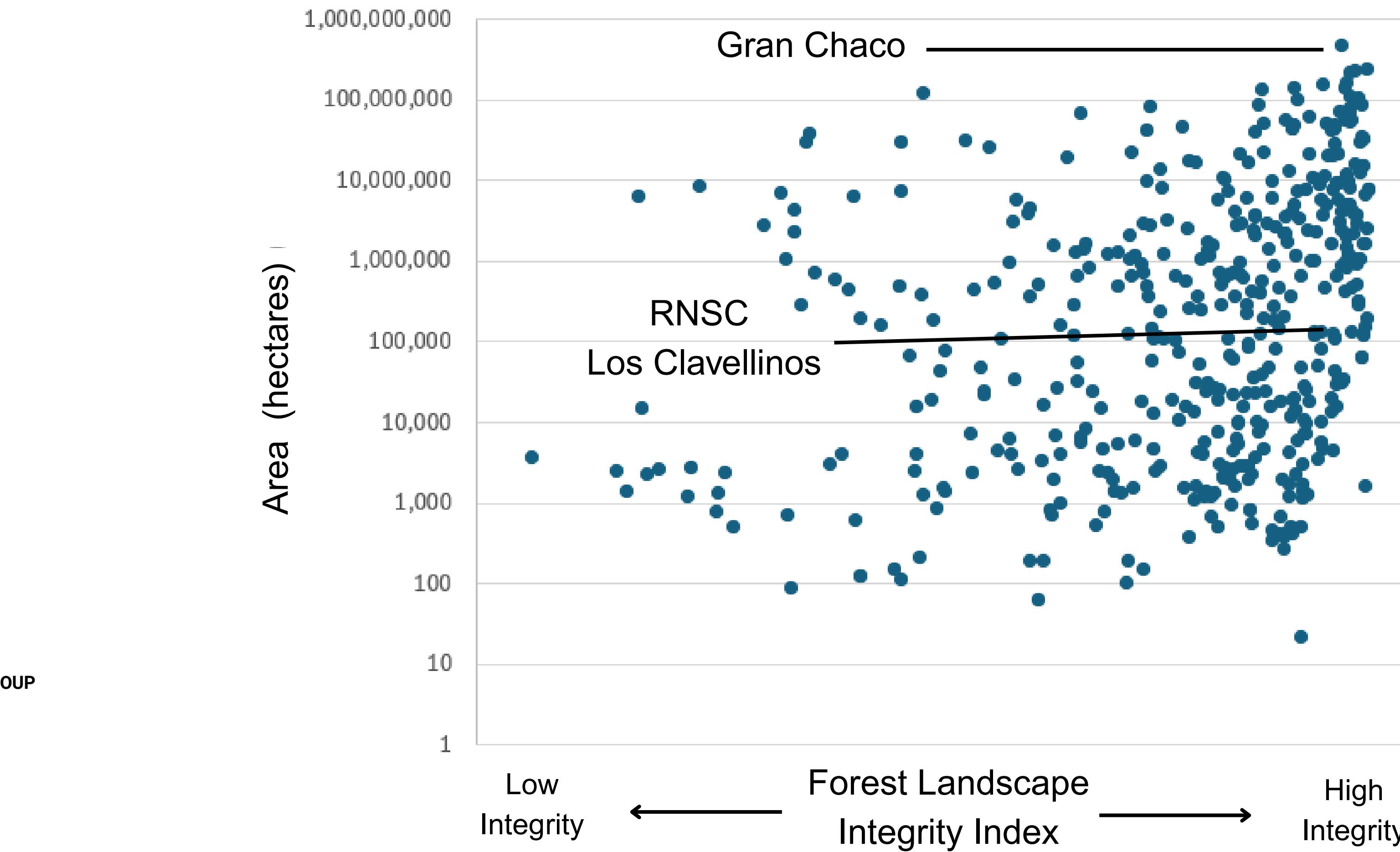
# FOREST LANDSCAPE INTEGRITY INDEX



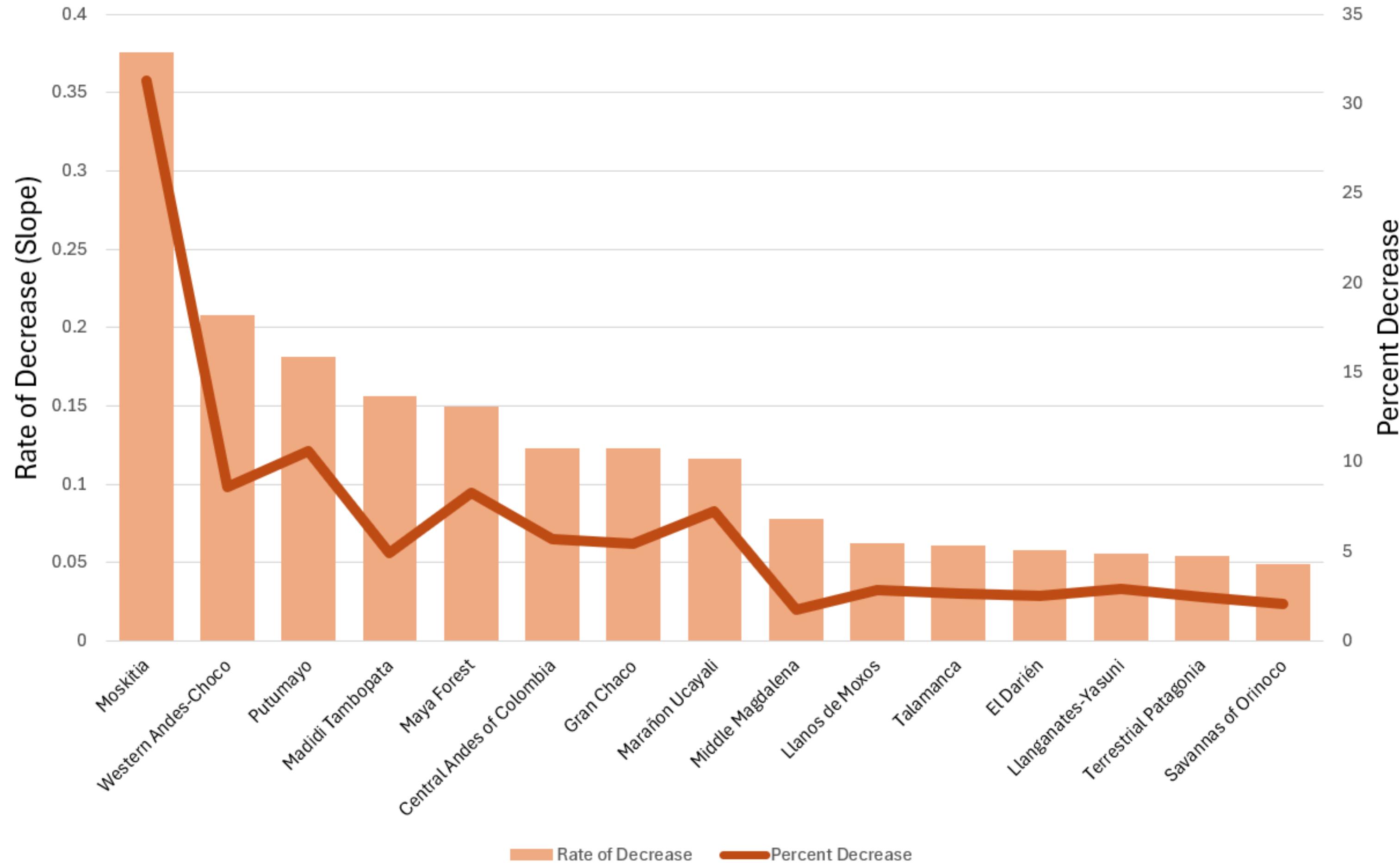
# FOREST INTEGRITY BY MANAGEMENT UNIT AREA, 2021



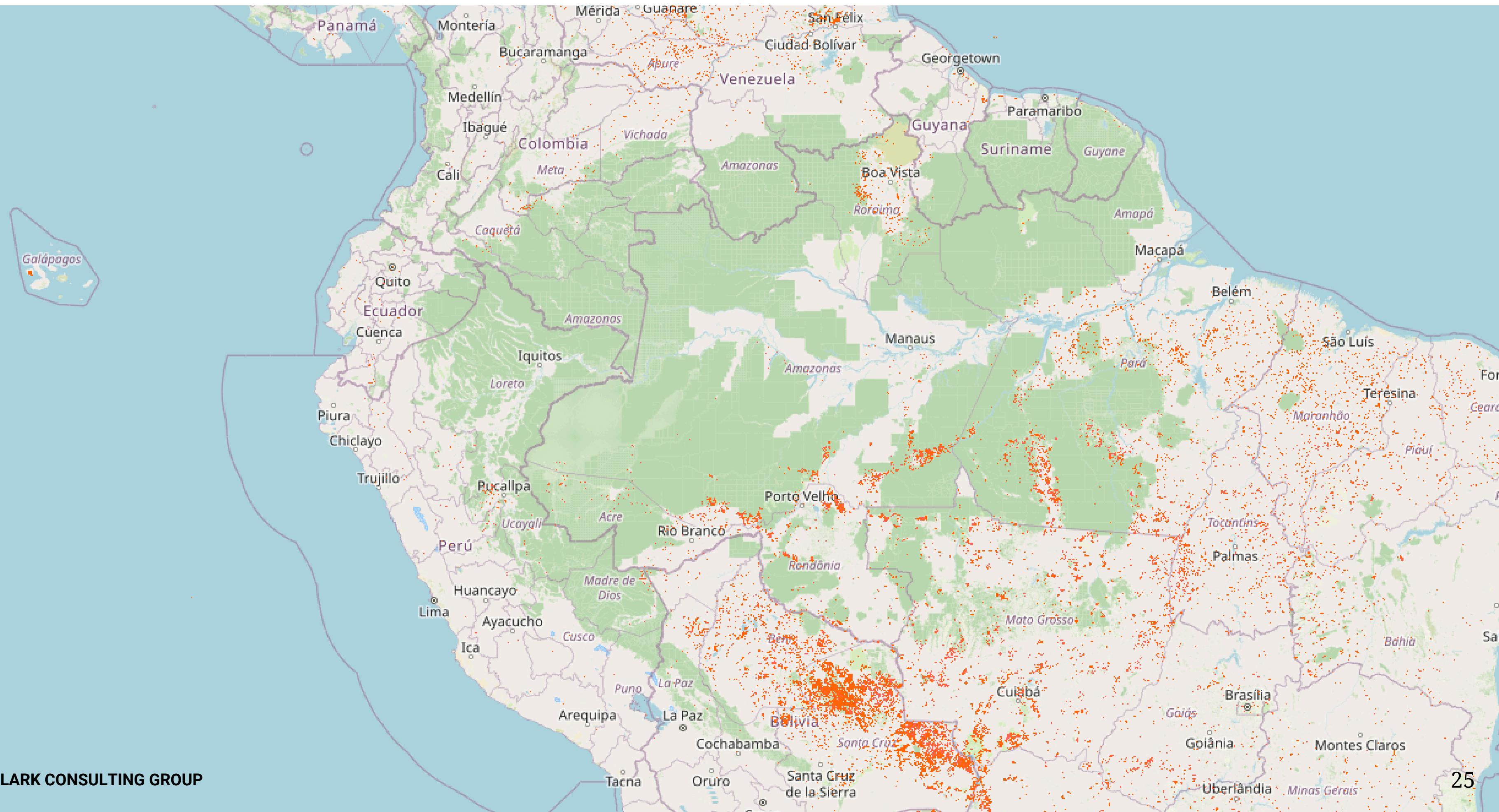
# FOREST INTEGRITY BY MANAGEMENT UNIT AREA, 2021



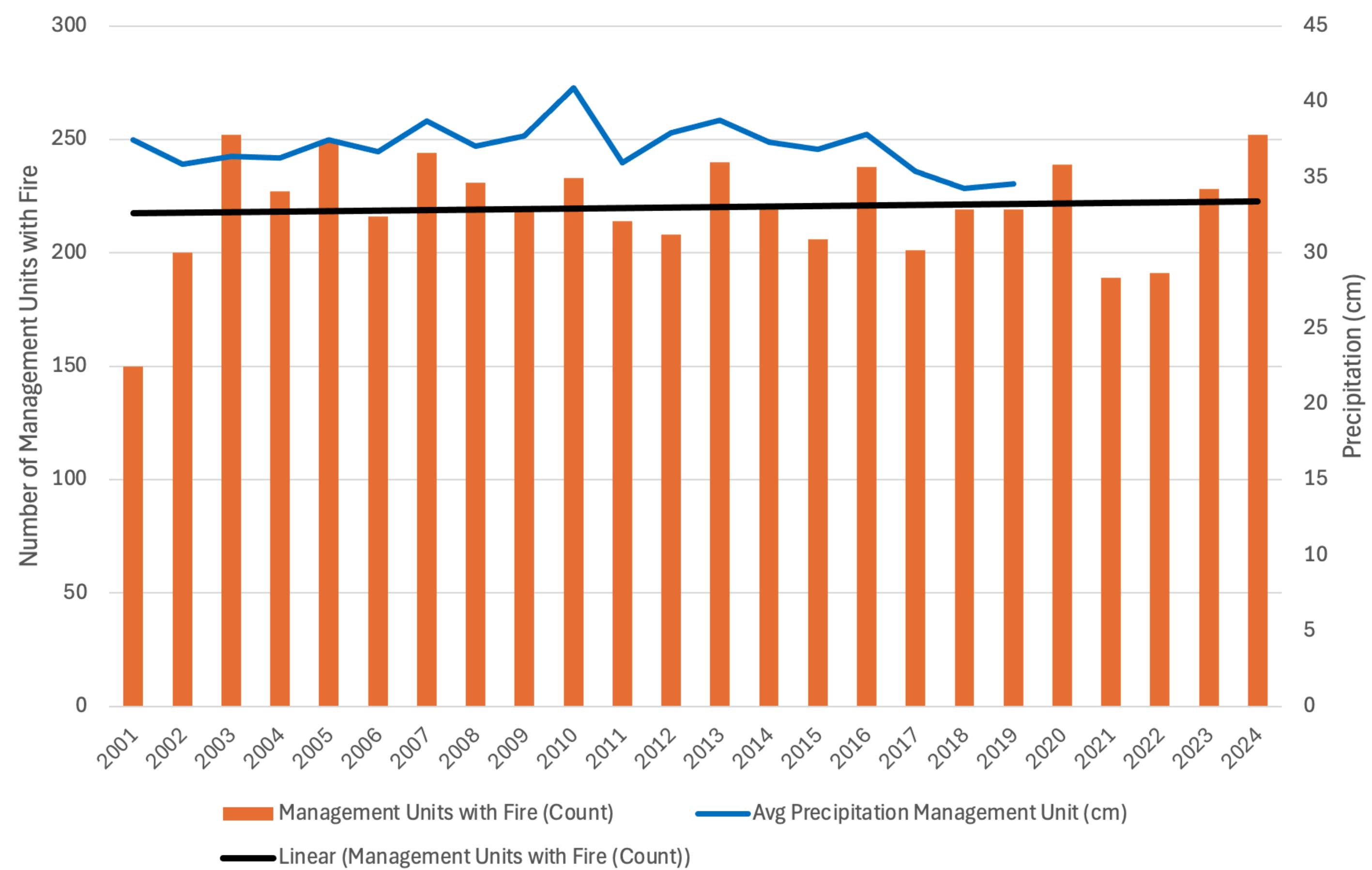
# TRENDS IN FLII BY STRONGHOLD, 2017-2021



FIRE ACTIVITY | NASA ANNUAL COMPOSITE 2024

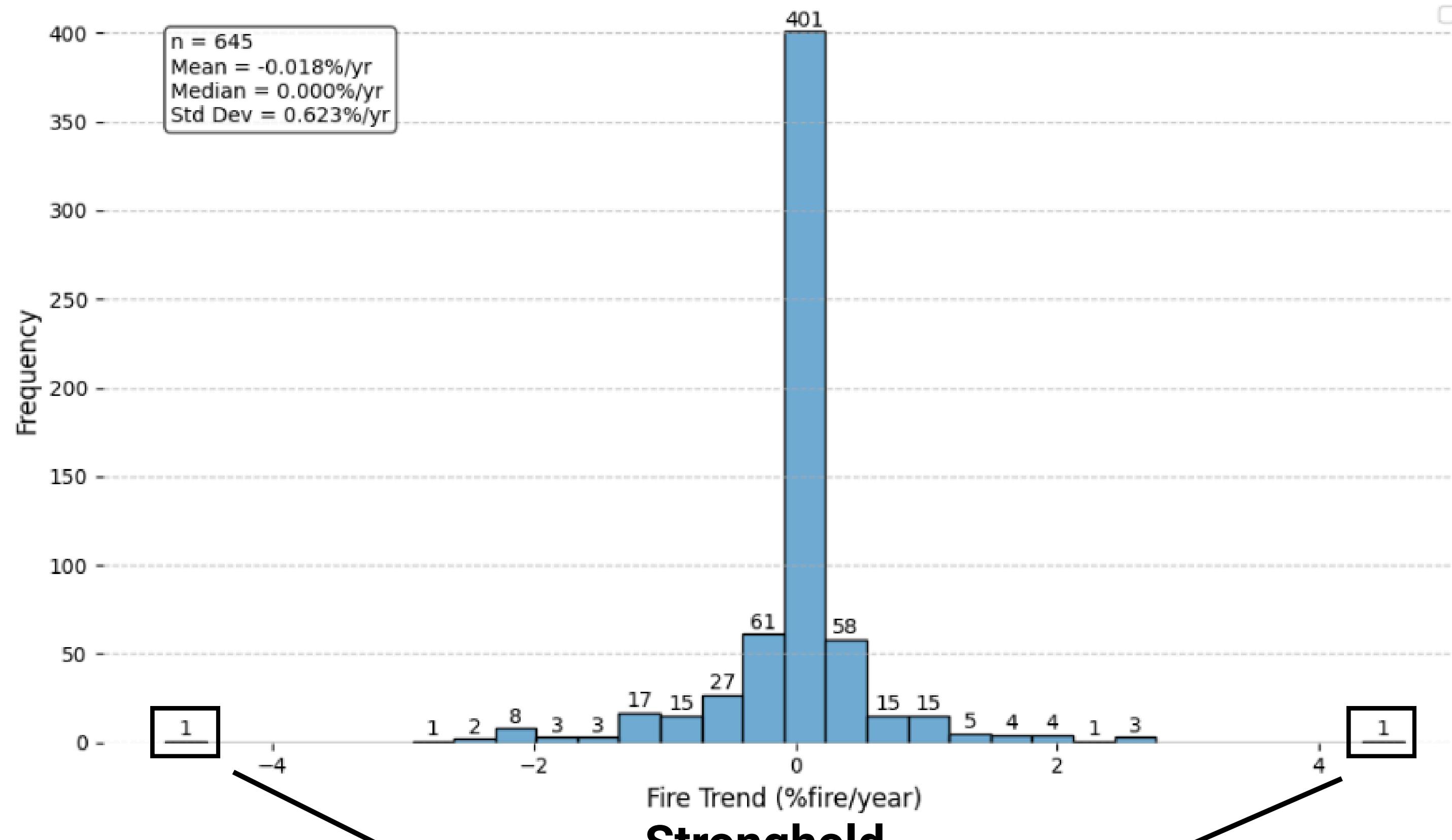


# TRENDS IN FIRE BY MANAGEMENT UNIT, 2001-2024



# TRENDS IN FIRE BY MANAGEMENT UNIT, 2001-2024

Distribution of Fire Trends Across Protected Areas (2001-2024)



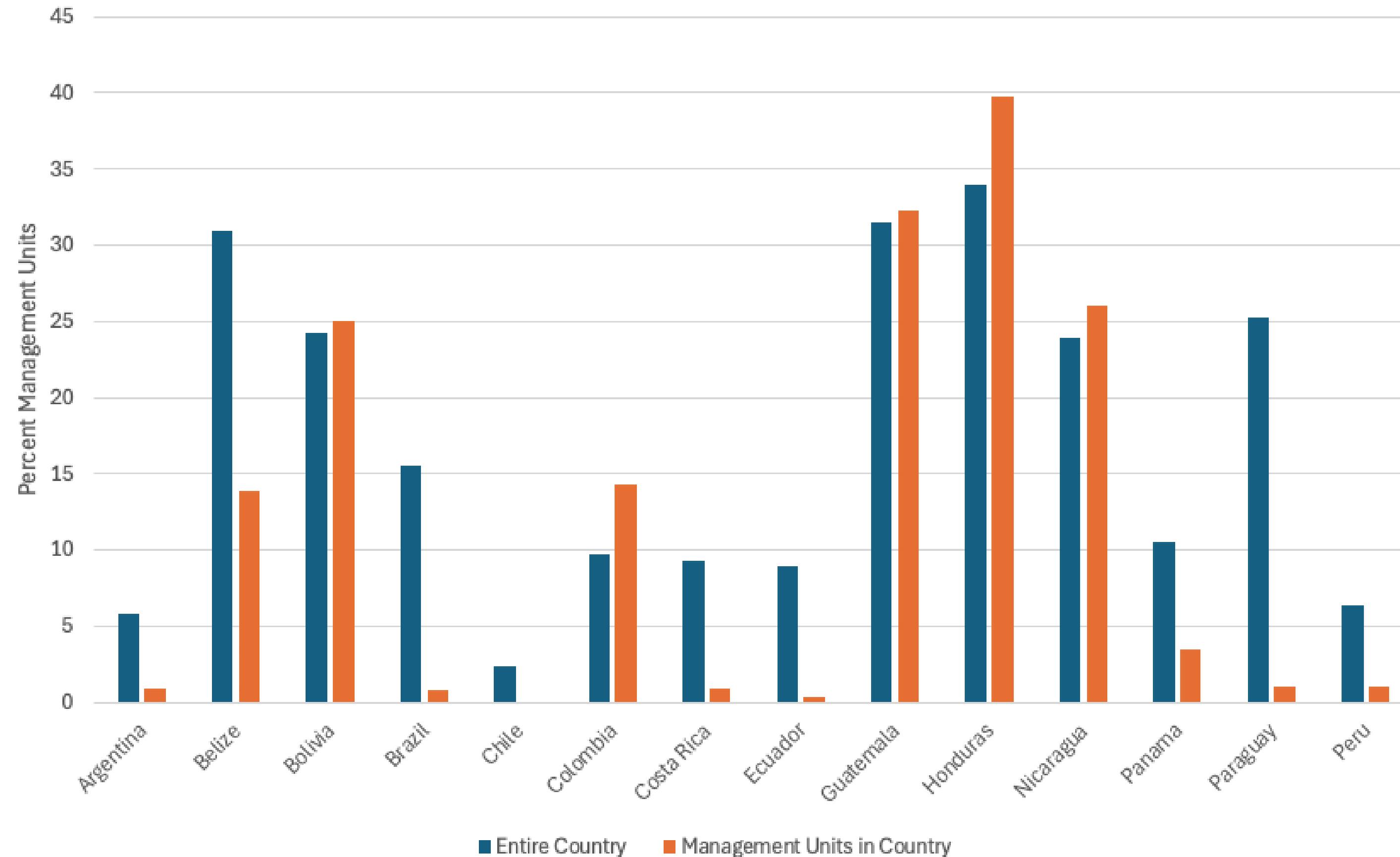
**Stronghold**

**Madidi Tambopata, Peru**

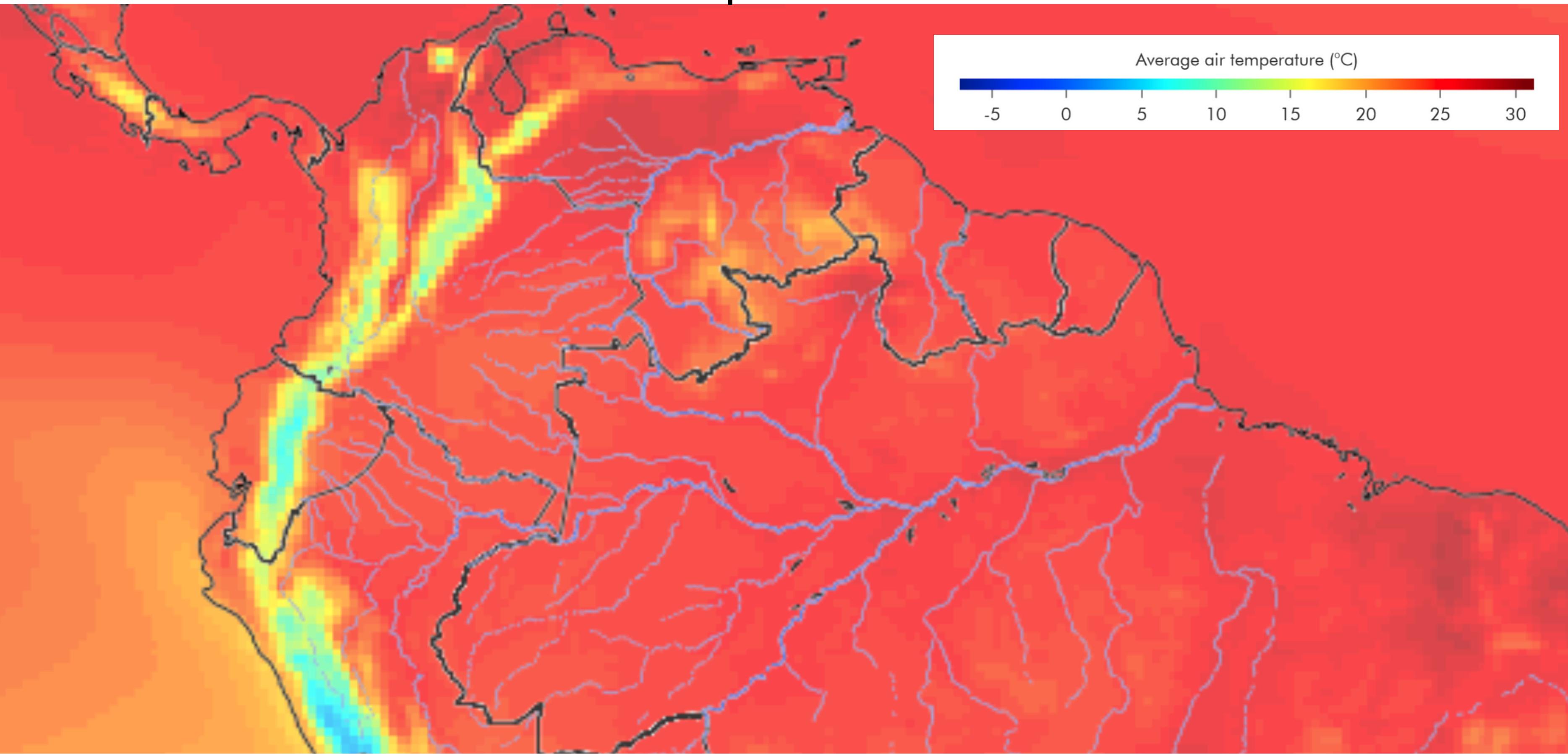


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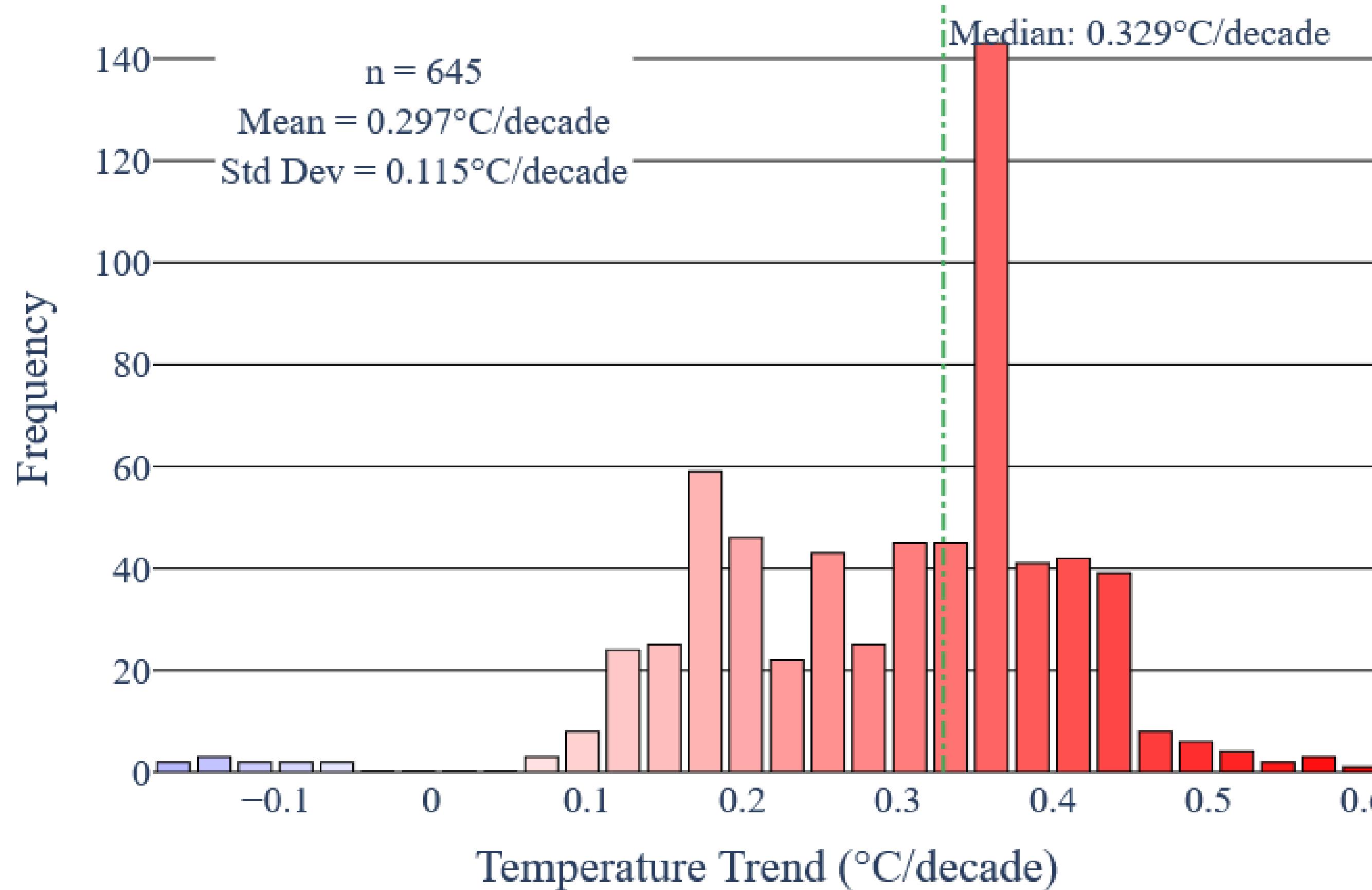
# FIRE IN 2024 (MANAGEMENT UNITS AND COUNTRIES)



# TEMPERATURE TRENDS | ERA5 ANNUAL COMPOSITE



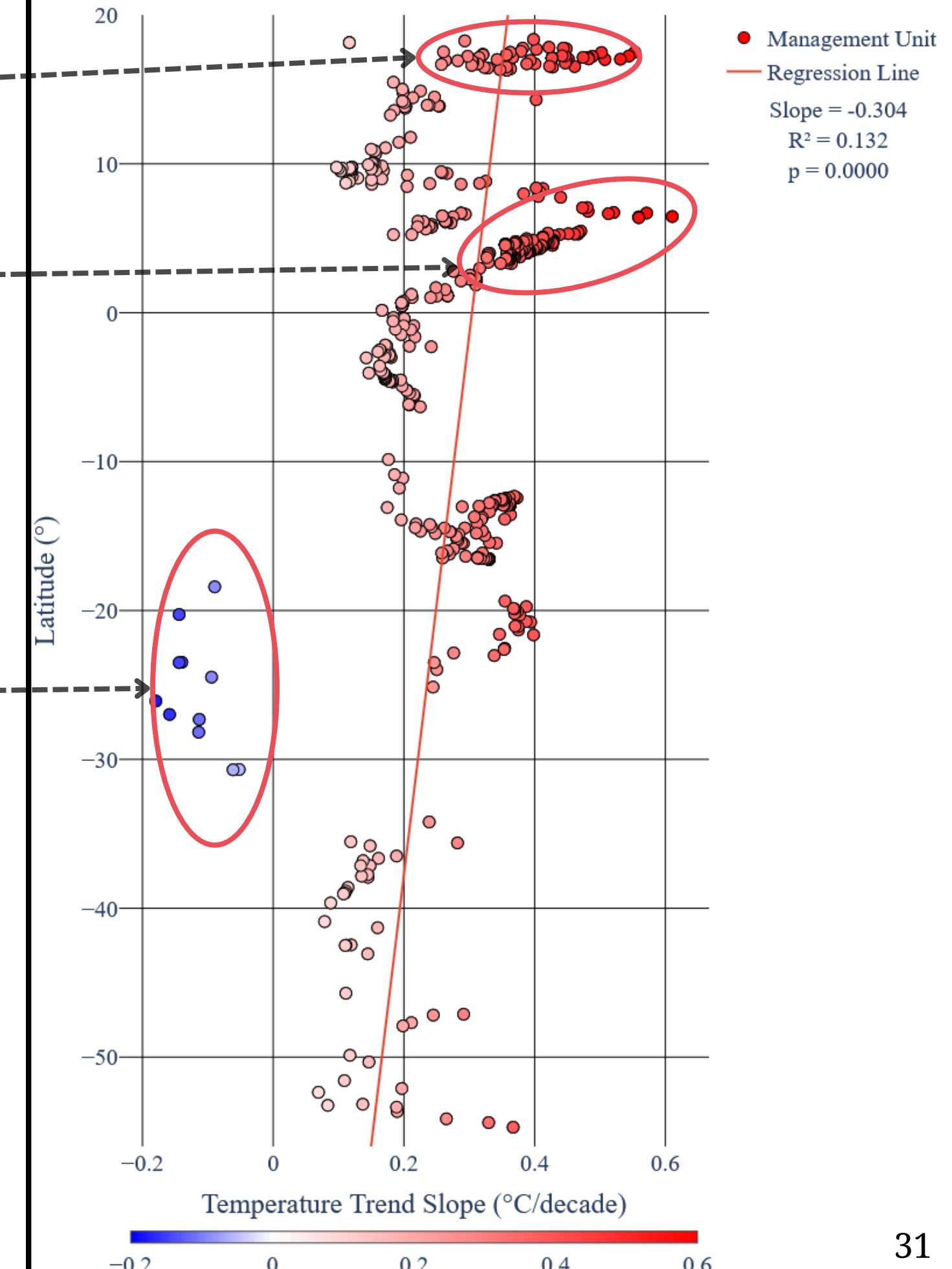
# TRENDS IN TEMP BY MANAGEMENT UNIT, 1980-2020



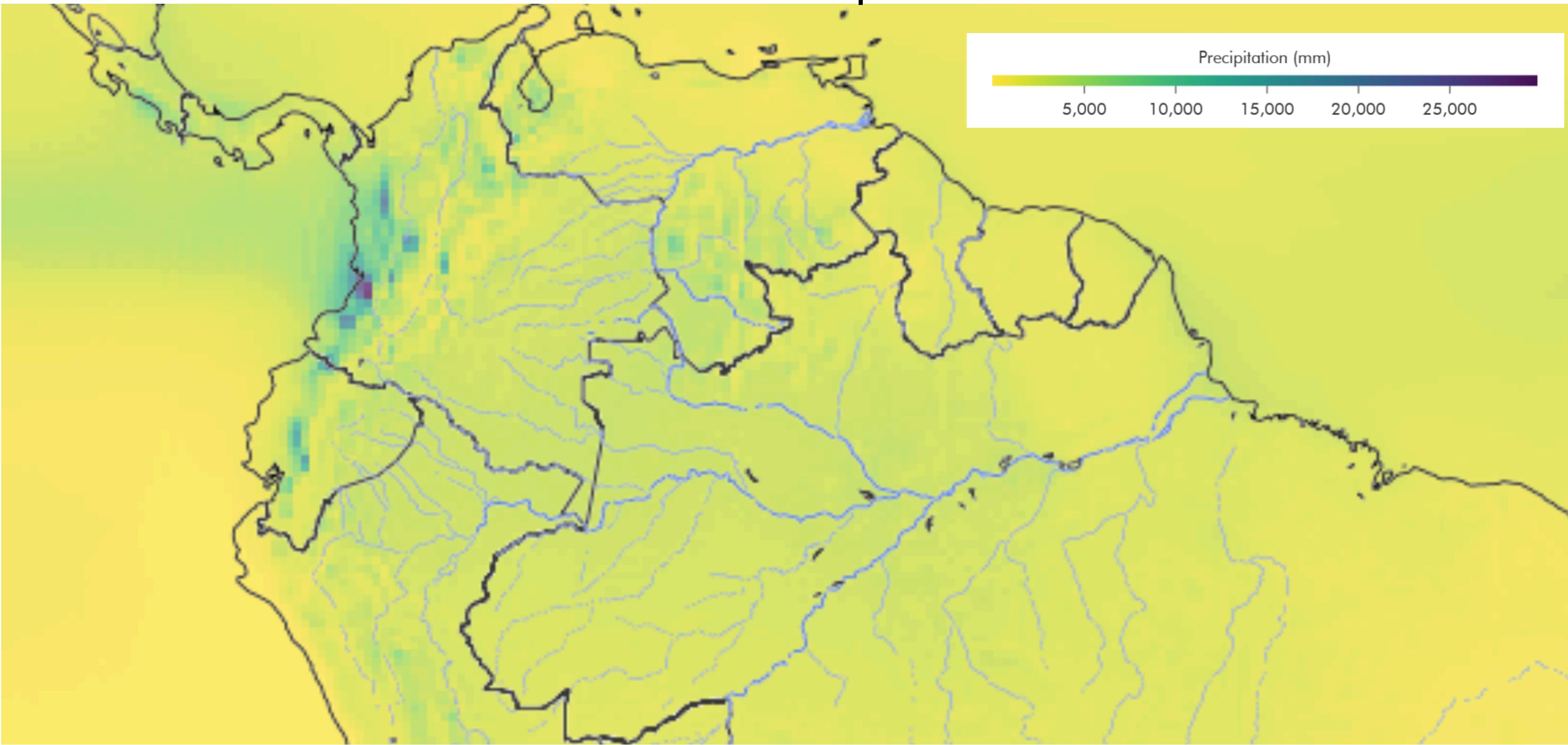
# LATITUDINAL TRENDS IN TEMPERATURE



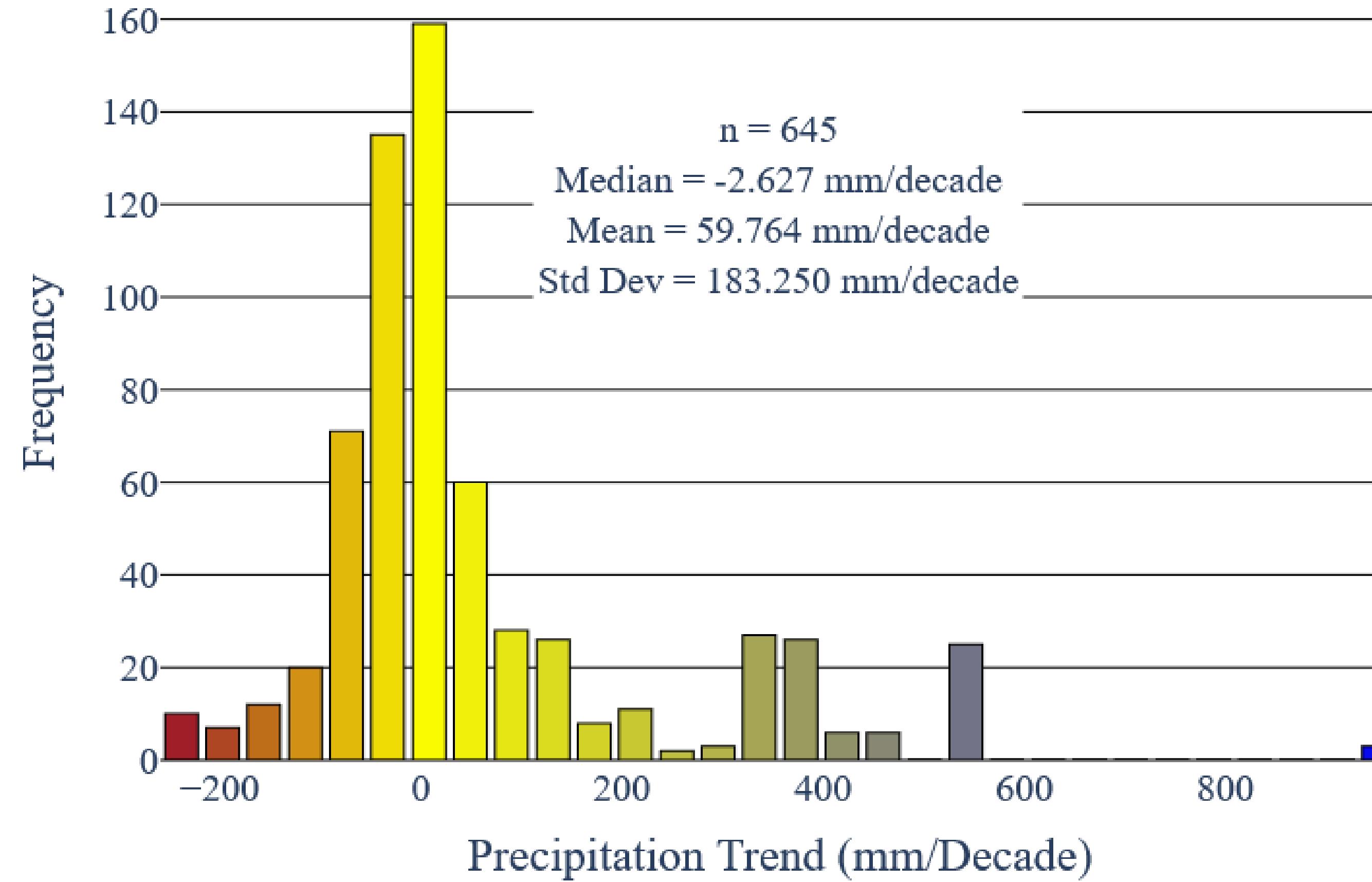
Latitudinal Variation in Warming Trends



# PRECIPITATION TRENDS | ERA5 ANNUAL SUM



# TRENDS IN PRECIPITATION BY MANAGEMENT UNIT, 1980-2019

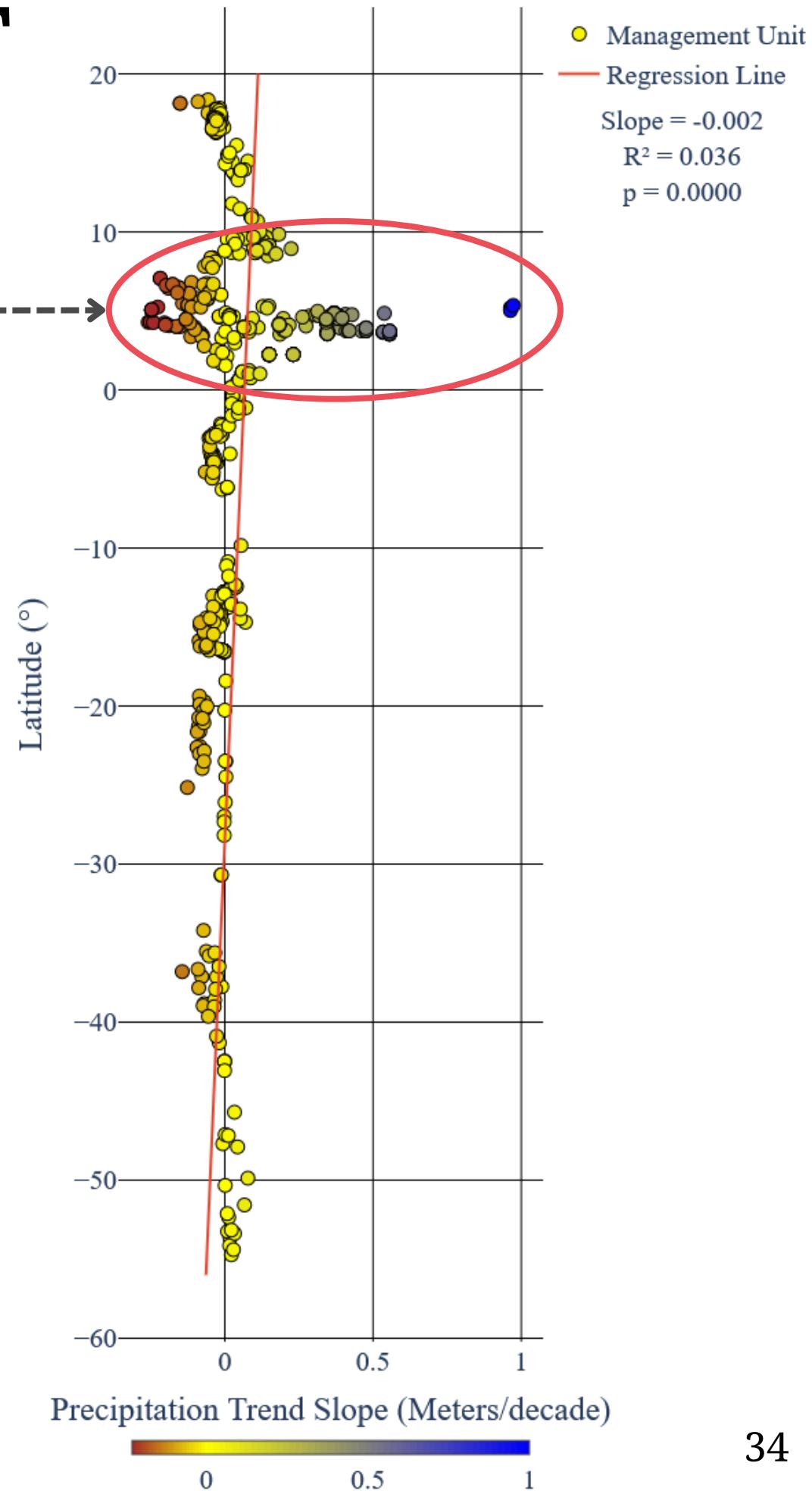


# LATITUDINAL TRENDS IN PRECIPITATION BY MANAGEMENT UNIT

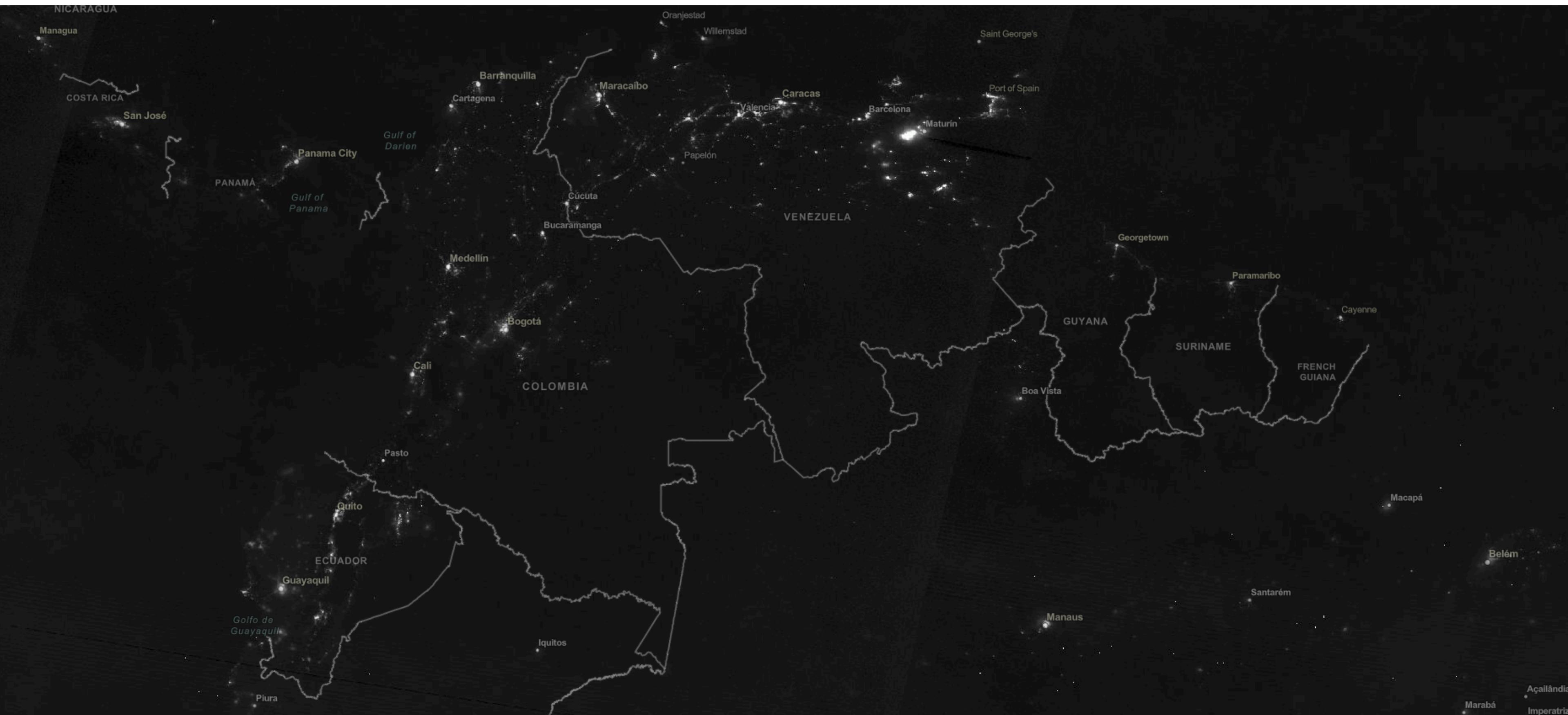


Large cluster of management units in Colombia and Central America with high climate variability

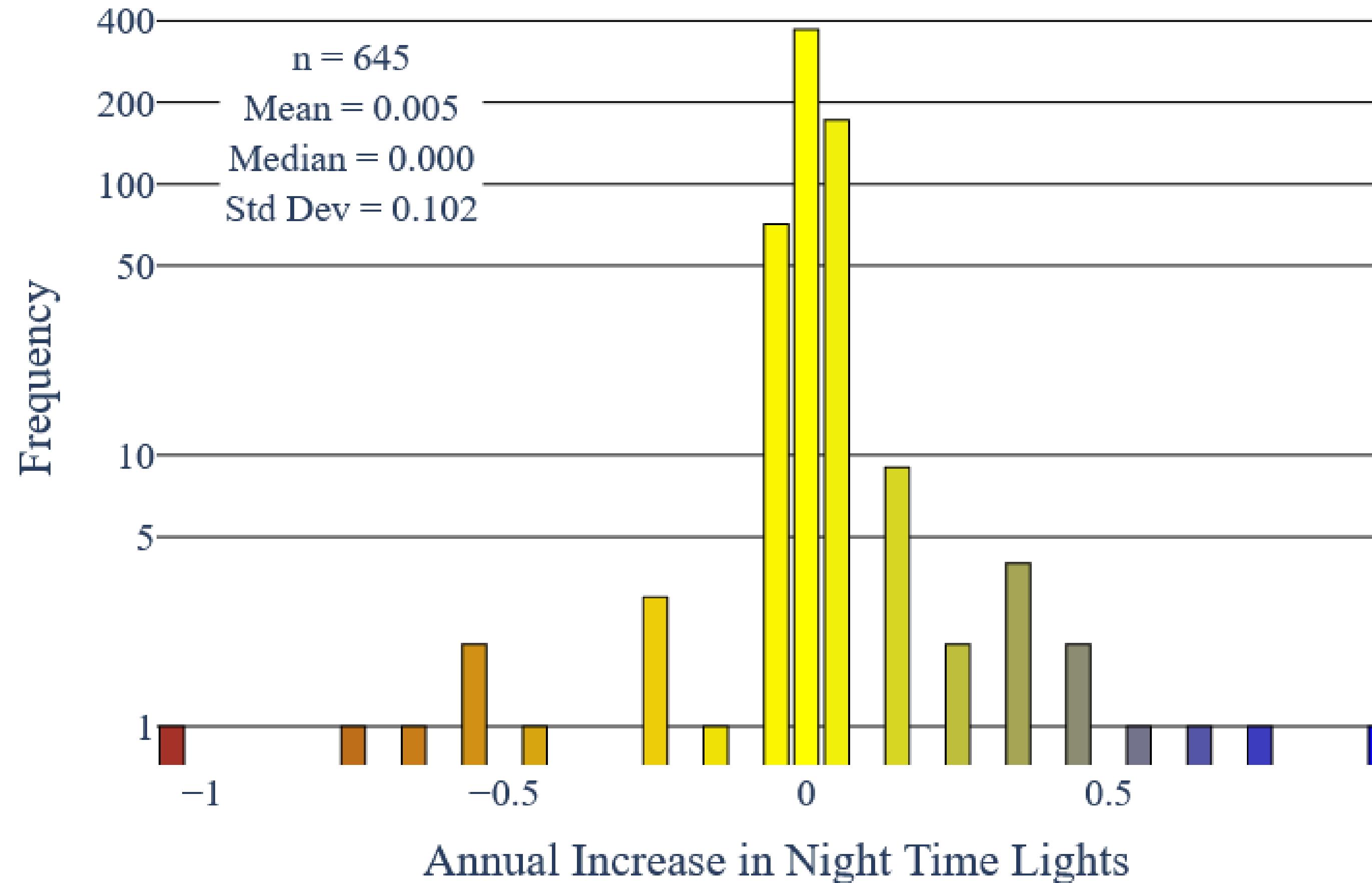
Latitudinal Variation in Precipitation Trends



# NIGHTTIME LIGHT TRENDS | VIIRS ANNUAL COMPOSITE

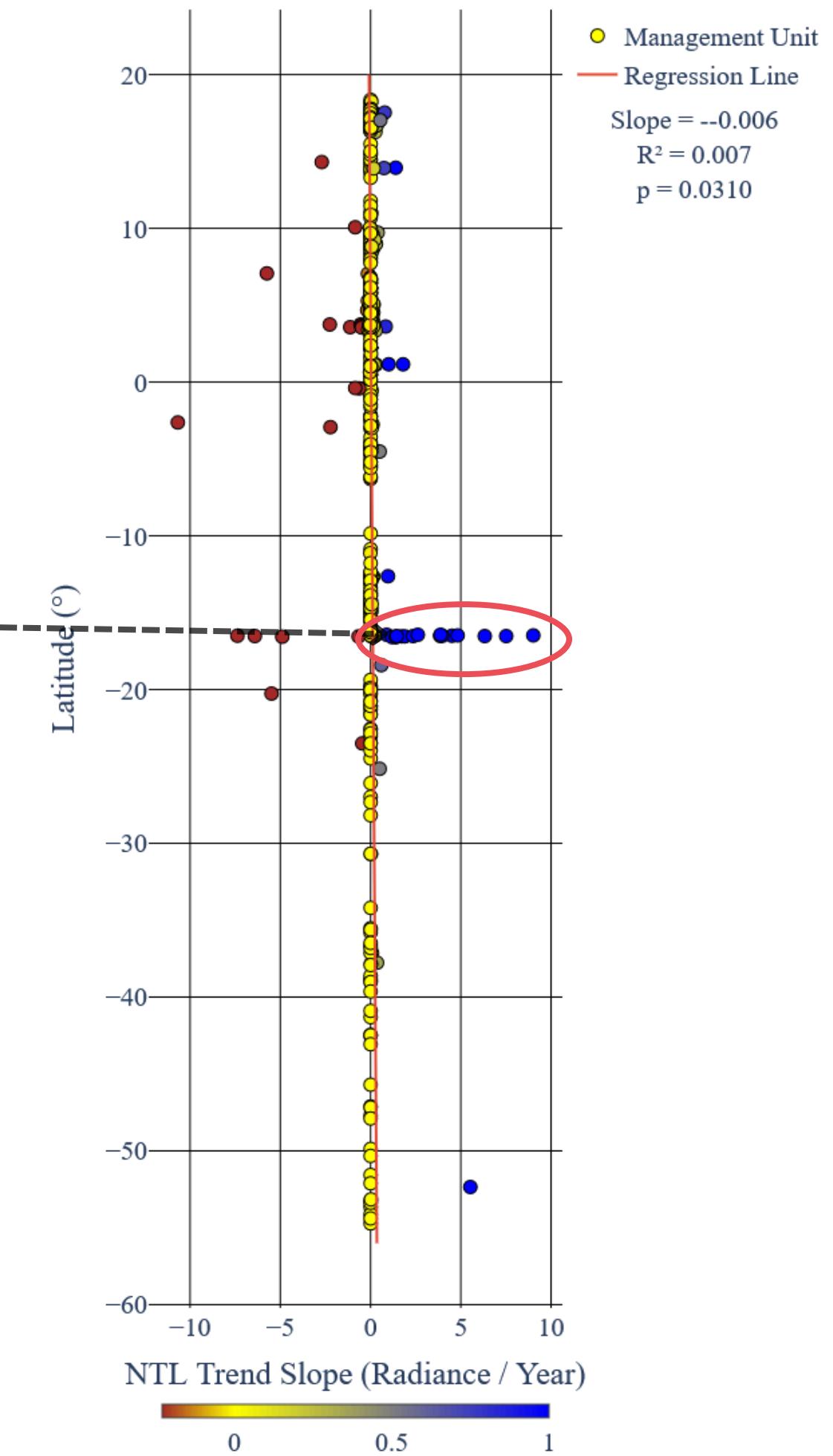
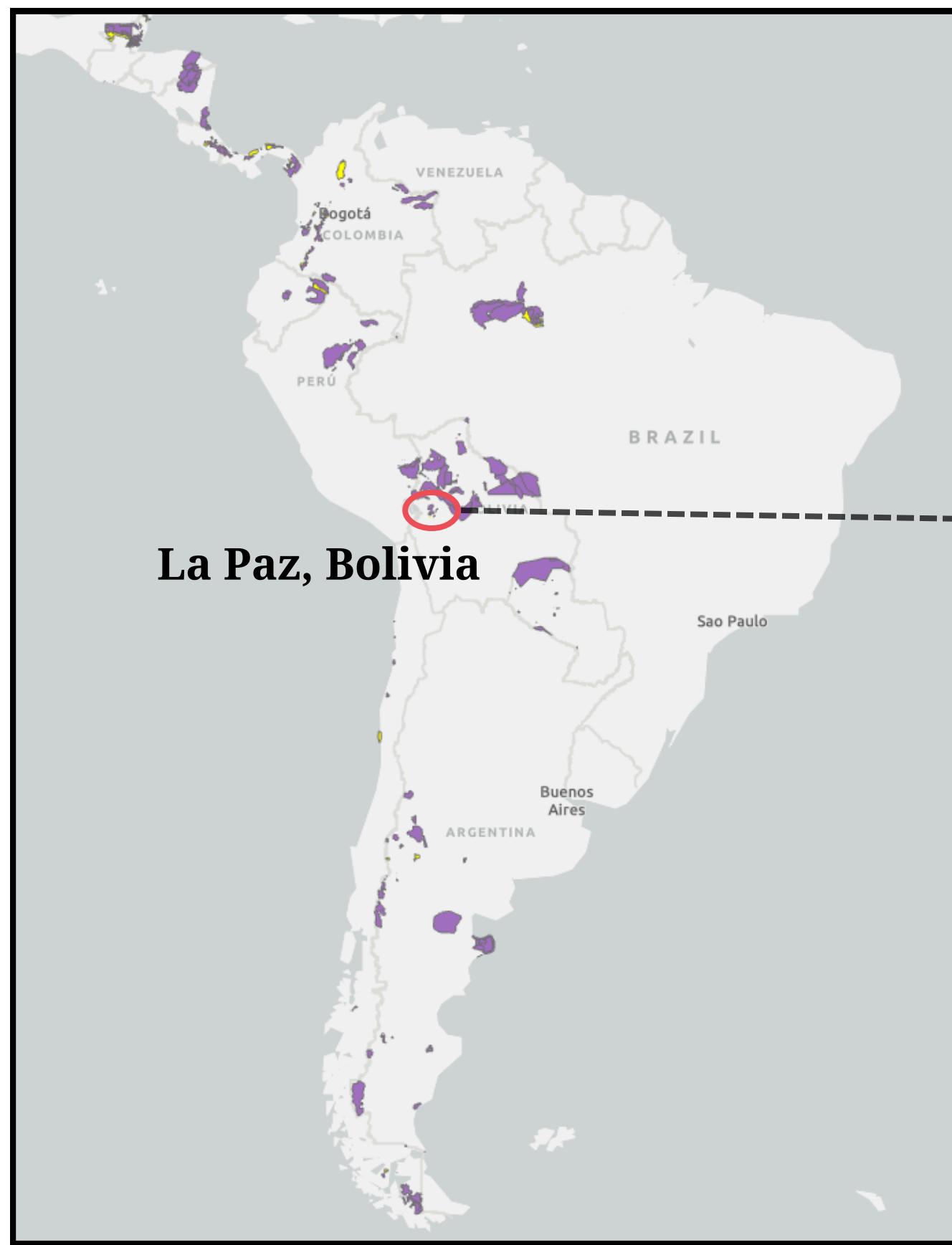


# TRENDS IN NTL BY MANAGEMENT UNIT, 2014-2020

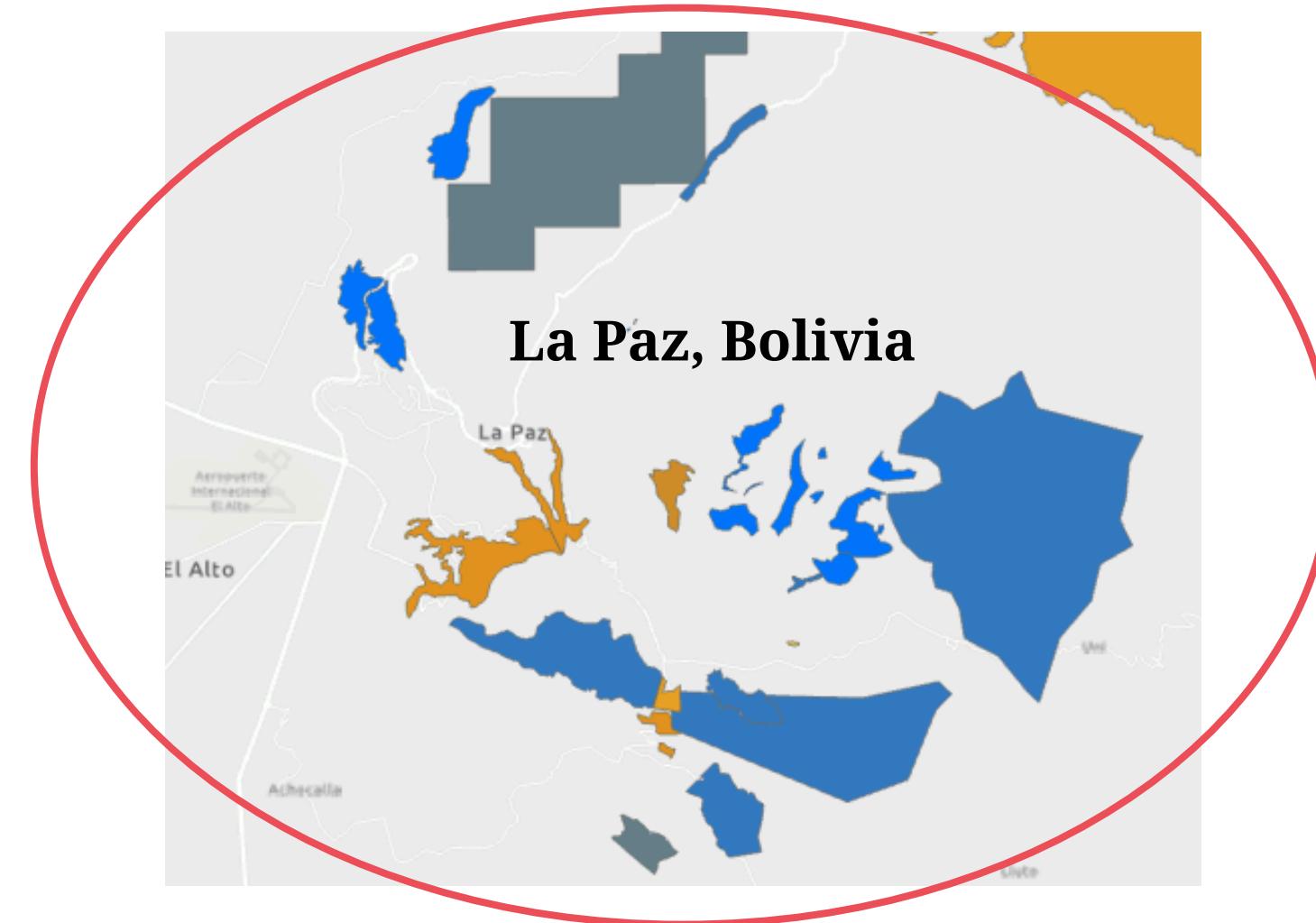


# LATITUDINAL TRENDS IN NTL

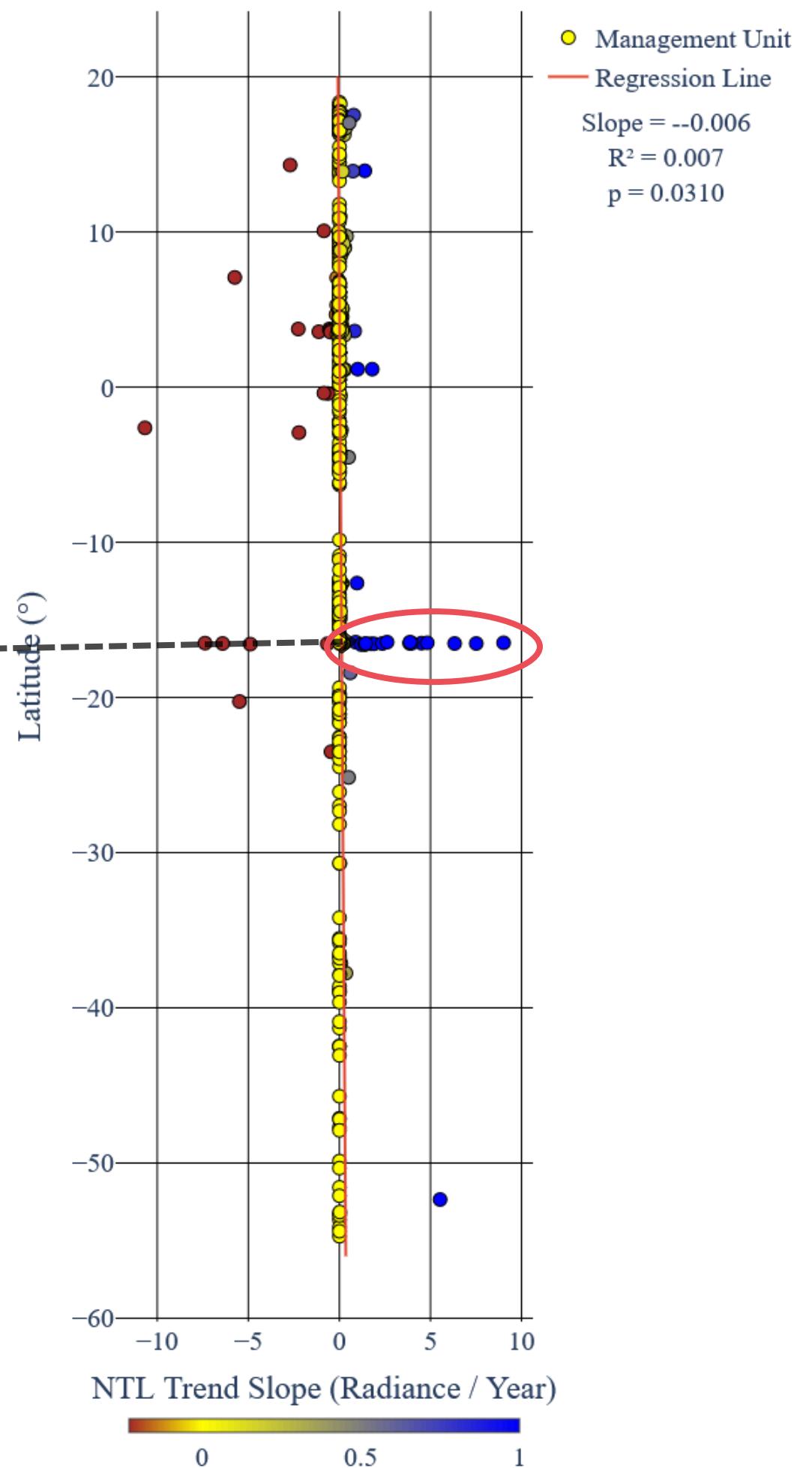
Latitudinal Variation in NTL Trends



# LATITUDINAL TRENDS IN NTL



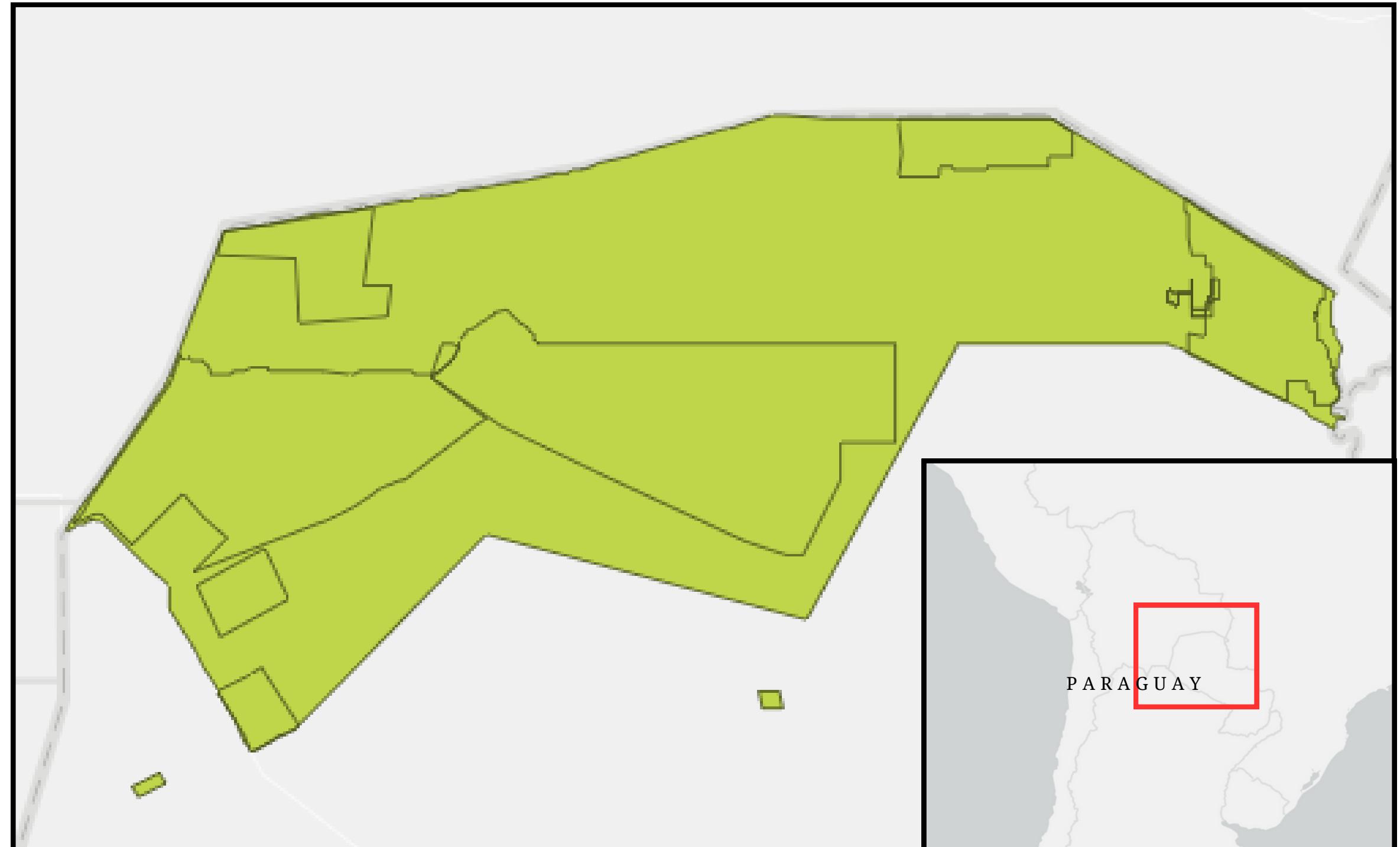
Latitudinal Variation in NTL Trends



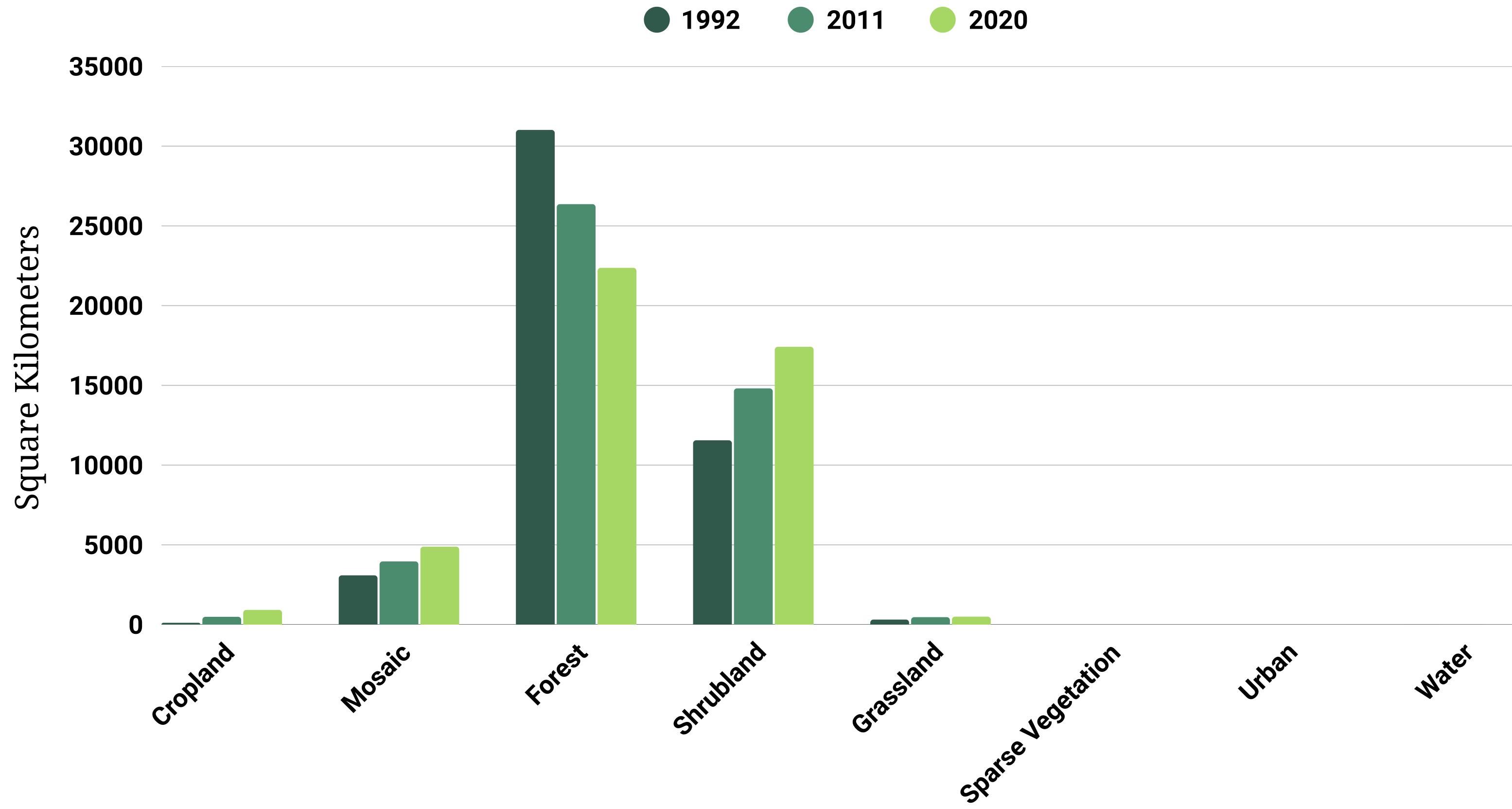
# MANAGEMENT UNIT CASE STUDY - GRAN CHACO

## Characteristics:

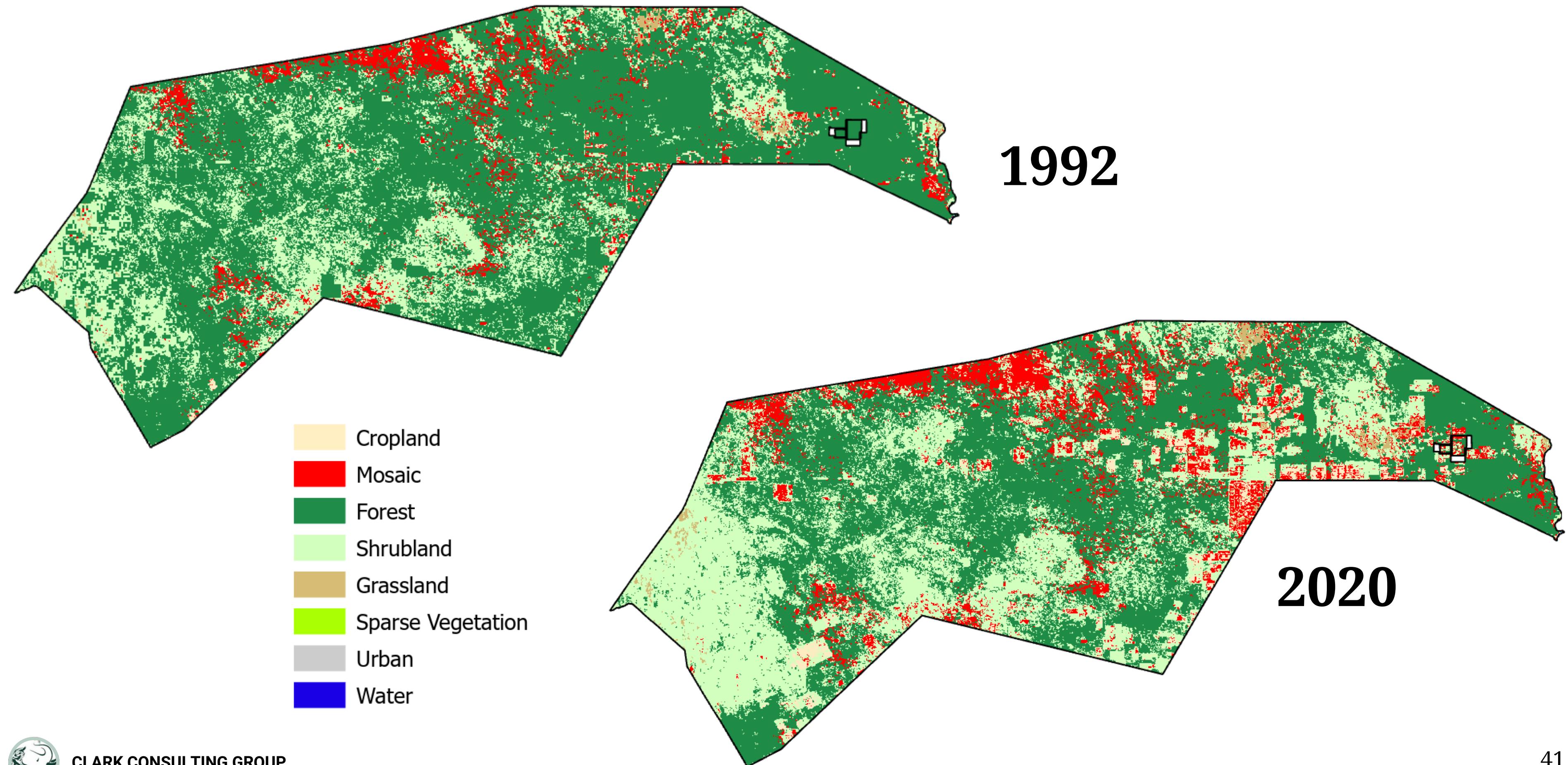
- Complexity: containing many overlapping management units.
- Size: large ( $45,782 \text{ km}^2$ )
- Extensive land change: decrease in forest, increase in shrub and mosaic land cover.
- Relatively stable human impact and forest landscape index values.
- Represents 28% of all land cover change across management units.



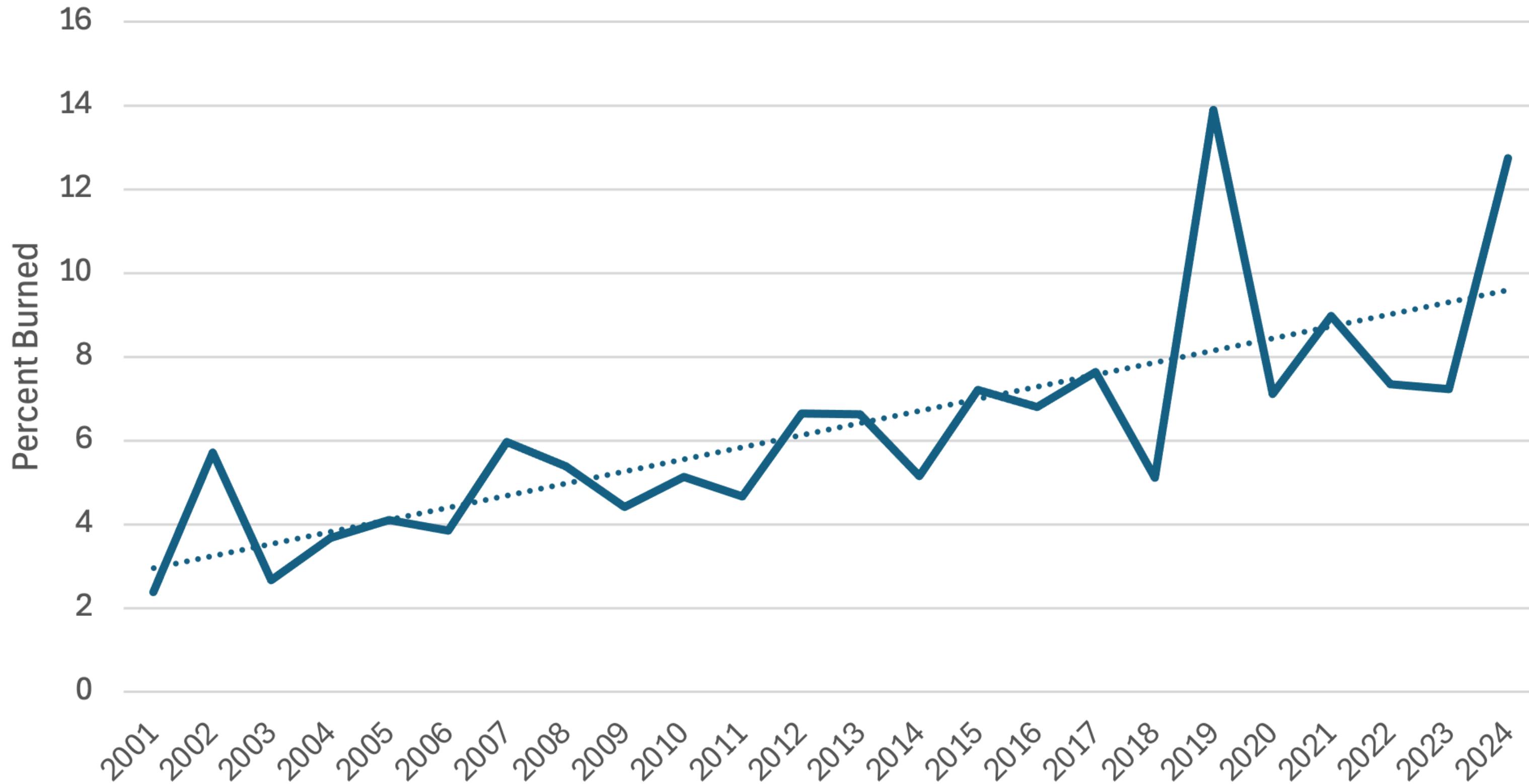
# CASE STUDY - GRAN CHACO



# CHANGE IN LAND COVER VISUALIZED



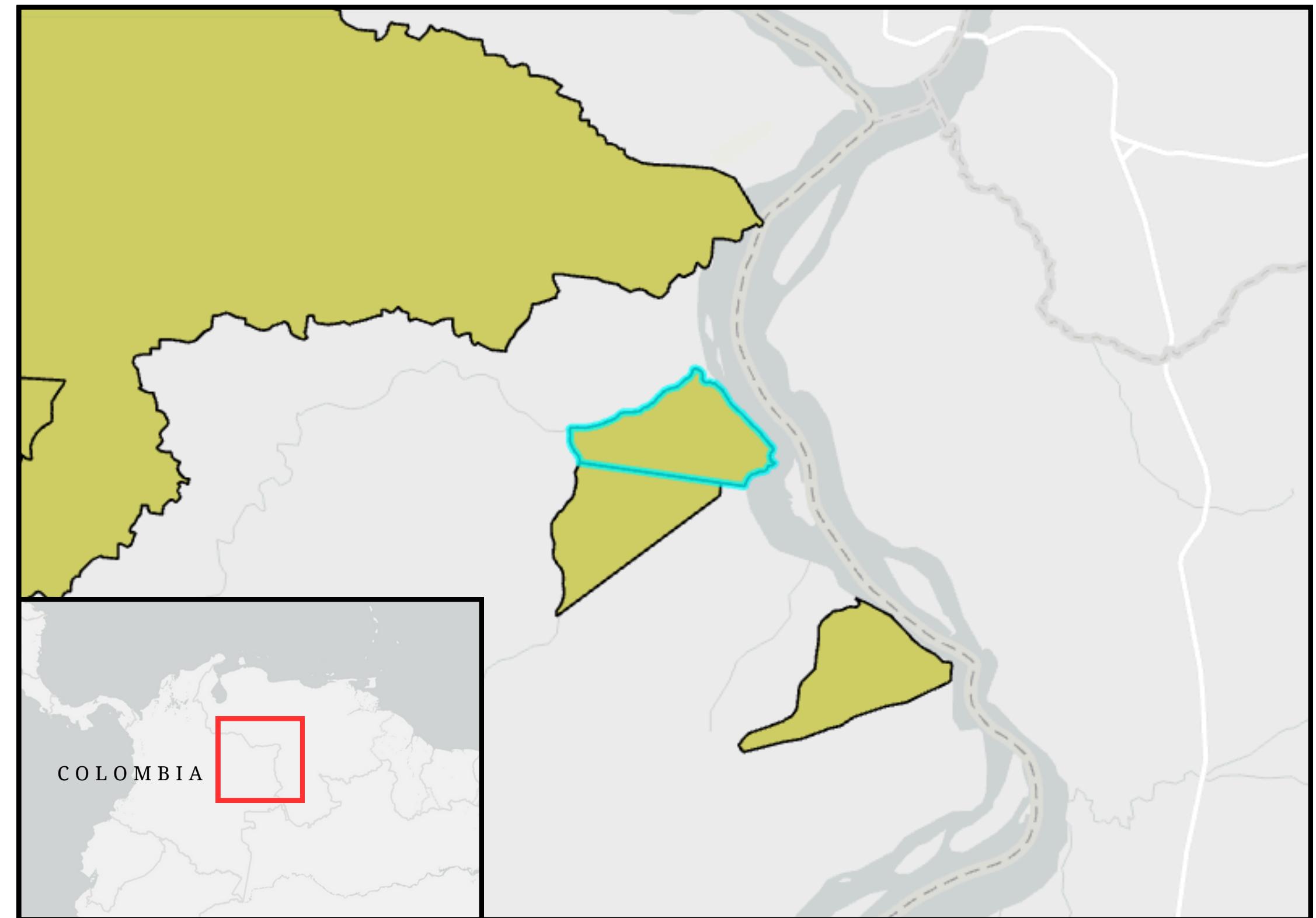
# GRAN CHACHO FIRE, 2001-2024



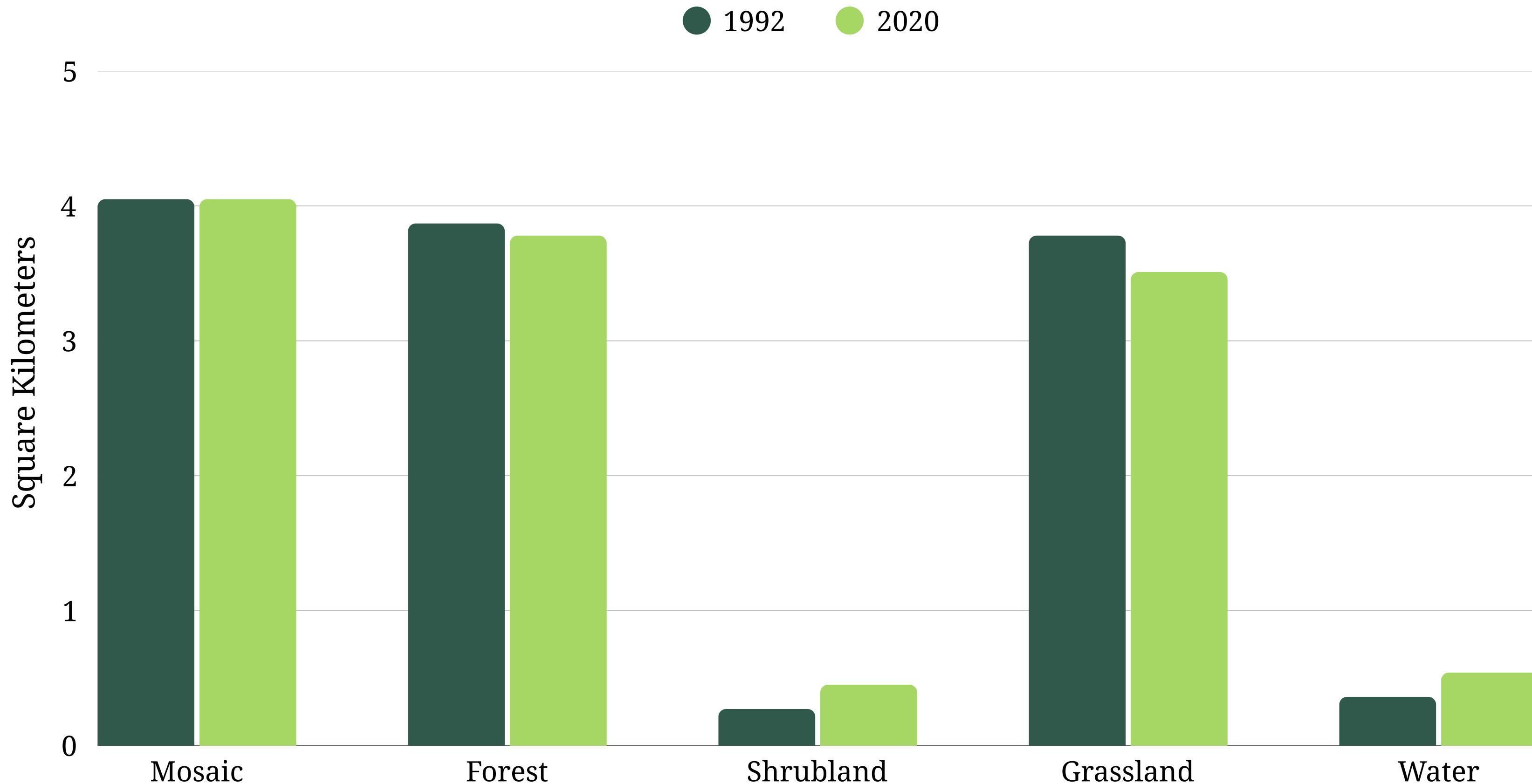
# CASE STUDY - RNSC LOS CLAVELLINOS

## Characteristics:

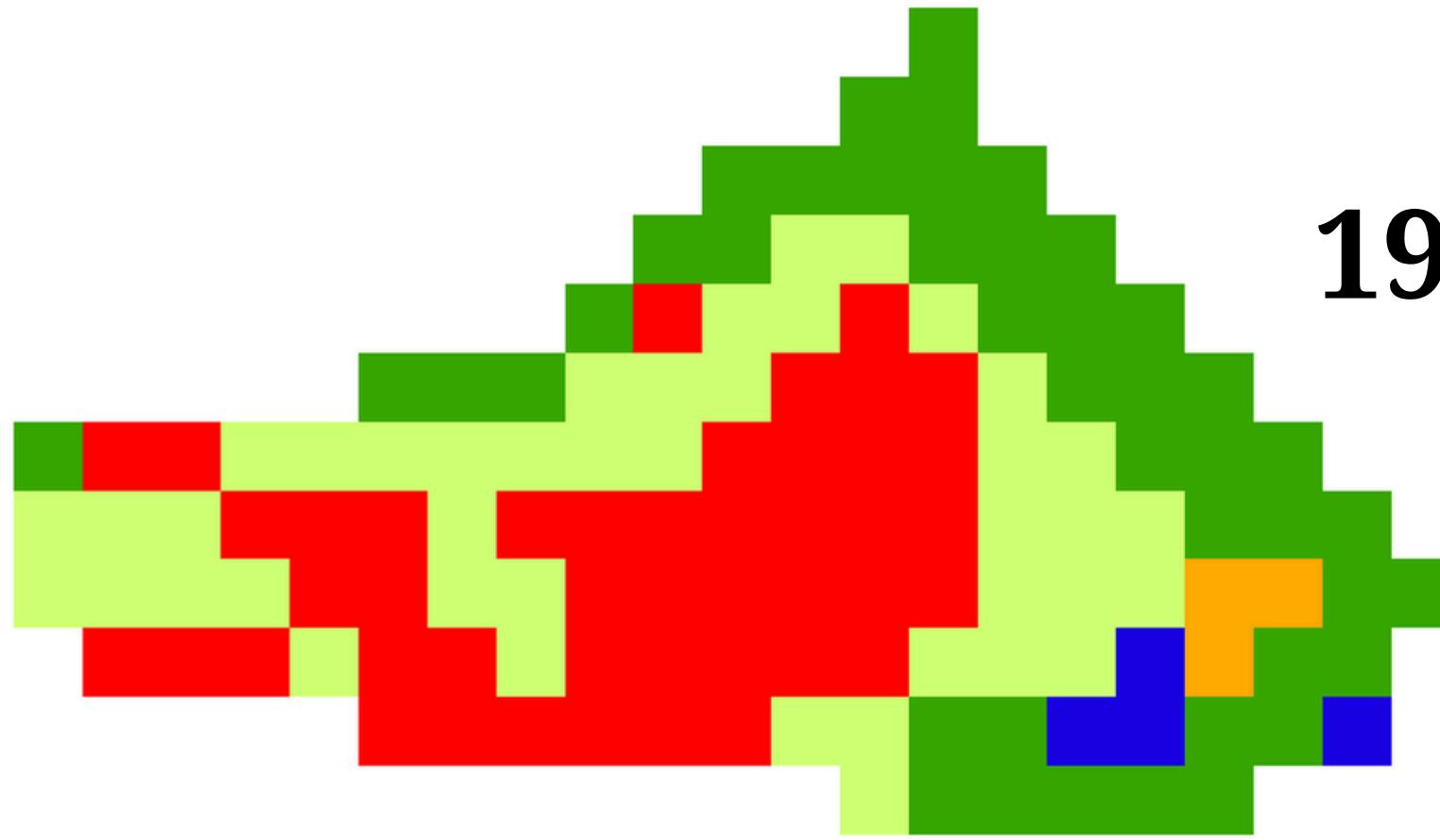
- Size: small ( $13 \text{ km}^2$ )
- Human Impact index: Increasing
- Even mixture of Mosaic, Forest and Grassland
- Stable land cover



# CASE STUDY - RNSC LOS CLAVELLINOS

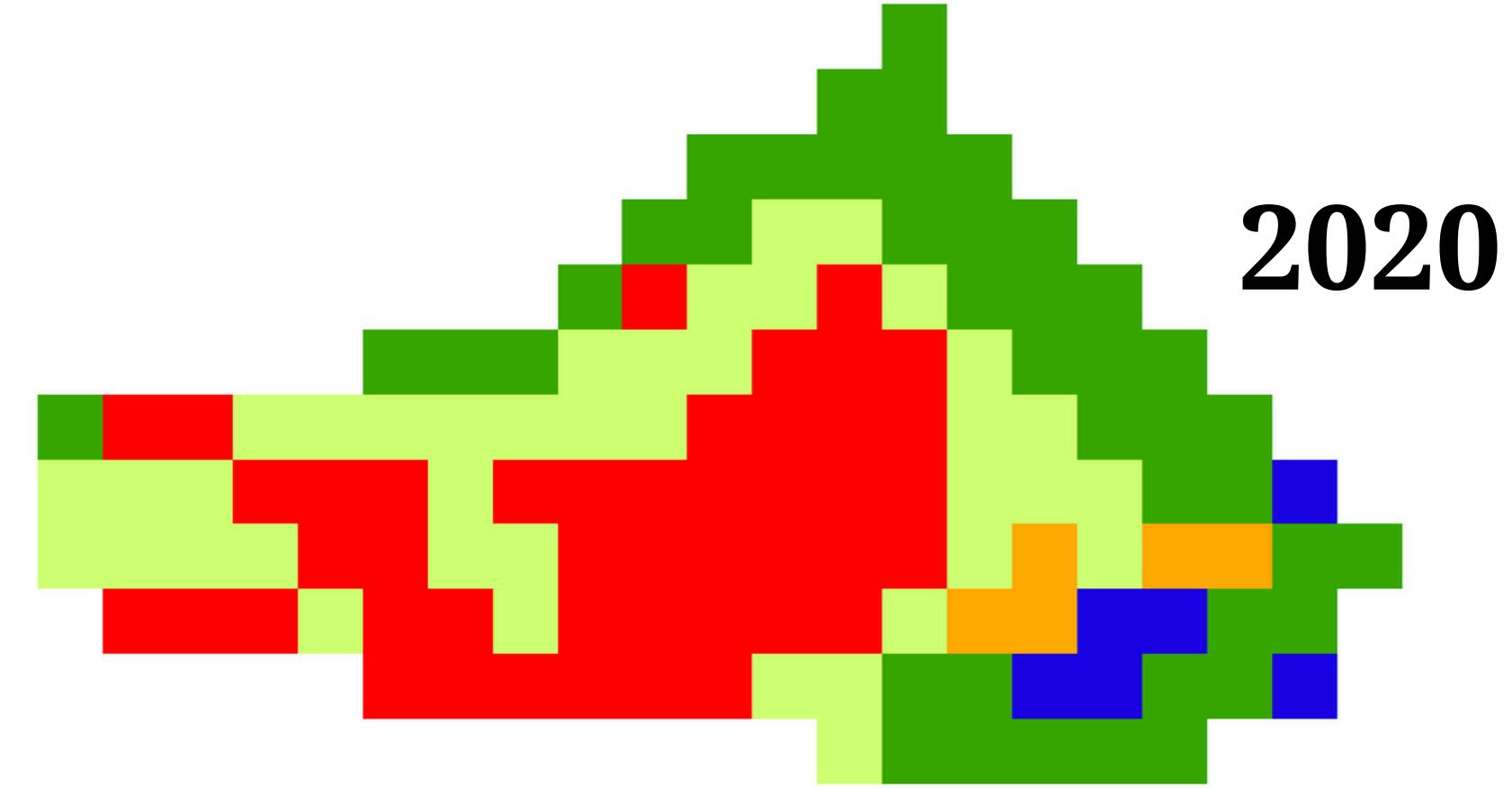


# CHANGE IN LAND COVER VISUALIZED



1992

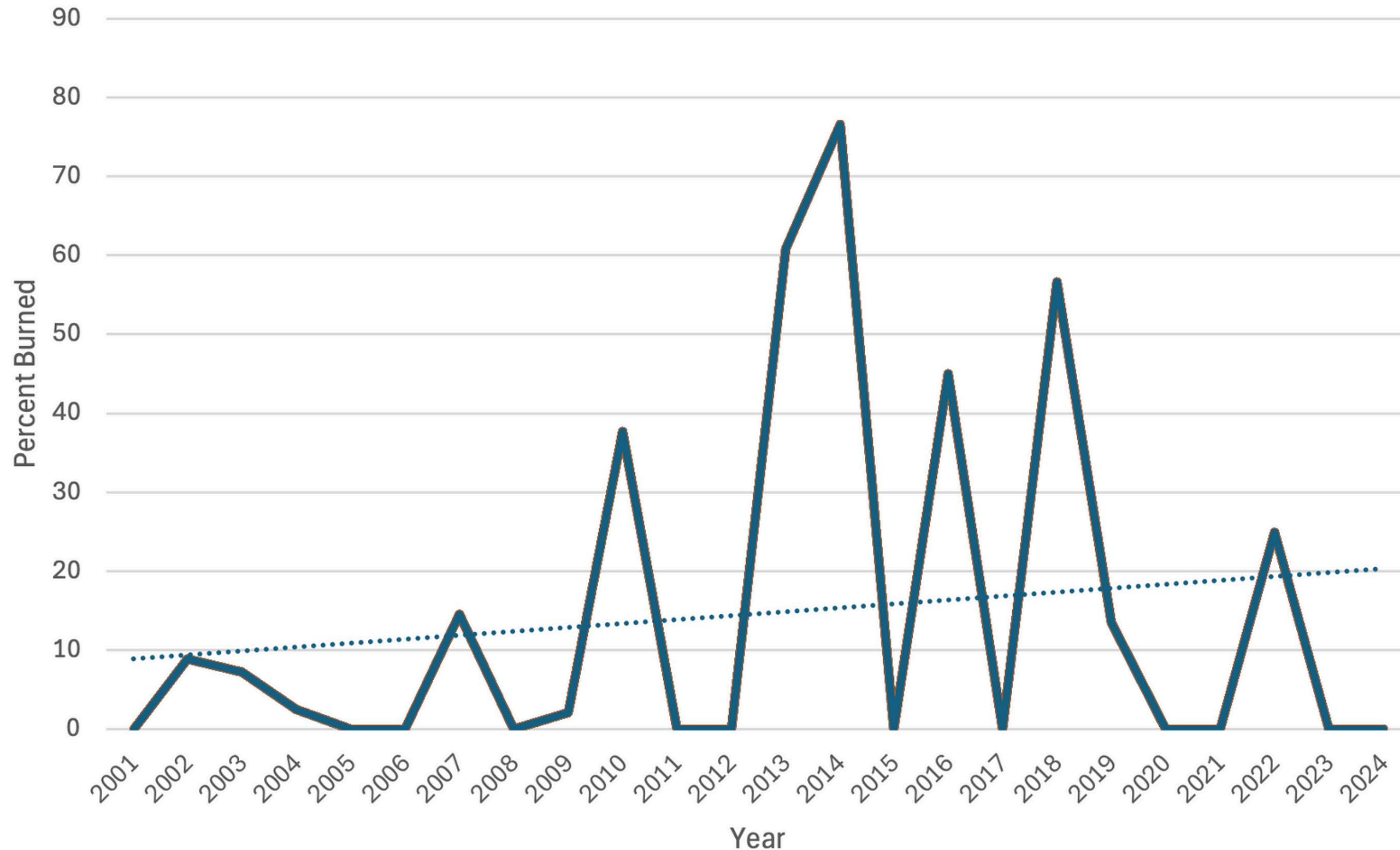
- █ Mosaic
- █ Forest
- █ Shrubland
- █ Grassland
- █ Water



2020



# RNSC LOS CLAVELLINOS FIRE, 2001-2024



# CONCLUSIONS

- Larger management units experience less degradation.
  - Particular attention needs to be paid towards smaller MUs.
- Over 90% of land cover does not experience change.
  - Change occurs mostly within mosaic, forest, and shrubland classes.
  - The Gran Chaco management unit and areas in Guatemala experience the most forest loss.
  - There is a gain in forest in both Panama and Costa Rica.
- Fewer than 50% of management units experience fire.
- Temperatures are increasing across the whole study area.
- Precipitation is stable, except for increases in Colombia.
- Dashboard will be available to WCS and maintained by Clark Consulting Group.



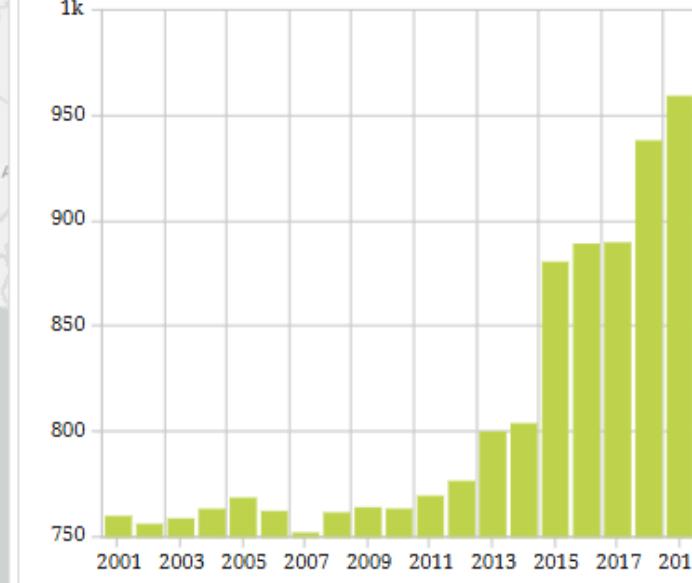
# ARCGIS ONLINE DASHBOARD DEMONSTRATION

 Trends in Terrestrial WCS Management Units: Central and South America  
Wildlife Conservation Society | Clark Consulting Group

Click on a Management Unit to View Trends



Human Impact Index (2001-2020)



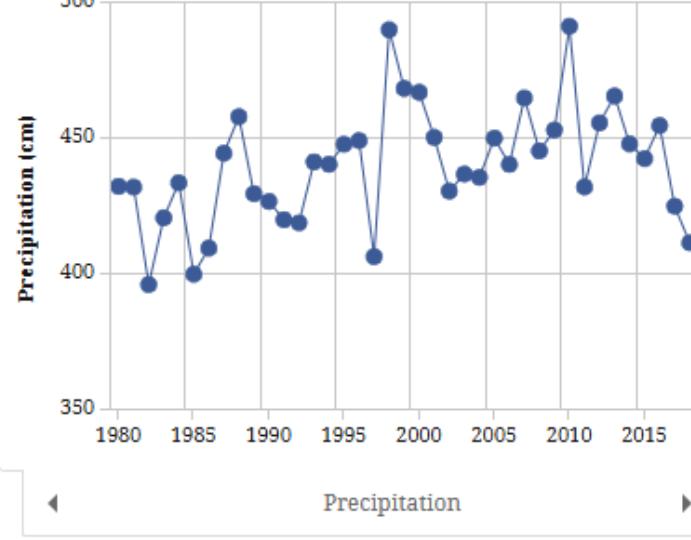
Precipitation  
**0.5986 cm**  
Average Annual Change

Temperature  
**0.0297°C**  
Average Annual Change

Landscape Characteristics

Management Unit Area  
**583.2k Sq Km**

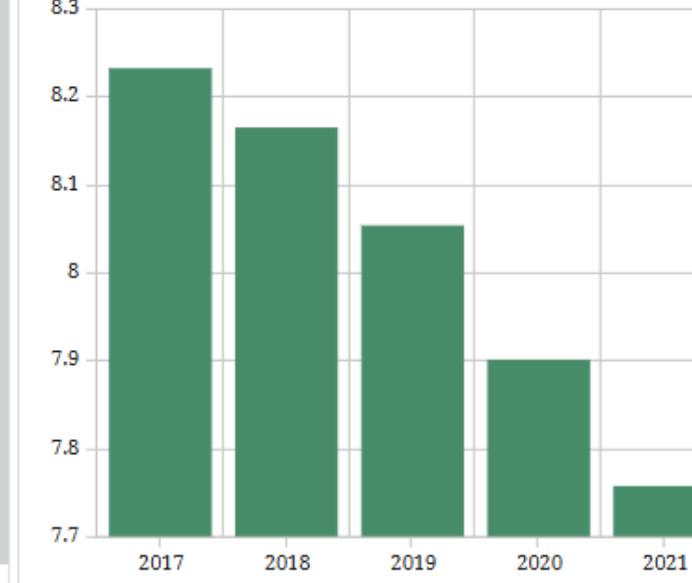
Precipitation (1980-2019)



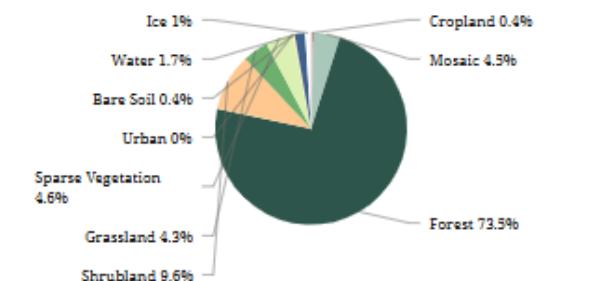
Burned Area  
**0.0025%**  
Average Annual Change

Nighttime Lights  
**0.0045 nW/sr/cm²**  
Average Annual Change

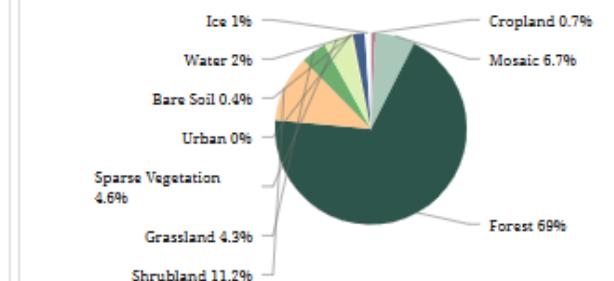
Forest Integrity Index (2017-2021)



1992 Land Cover in Management Units



2020 Land Cover in Management Units



Powered by Esri

Dashboard Produced by Clark Consulting Group

Management Units Strongholds Countries



CLARK CONSULTING GROUP

[Link to Dashboard](#)

# ACKNOWLEDGEMENTS

## Wildlife Conservation Society

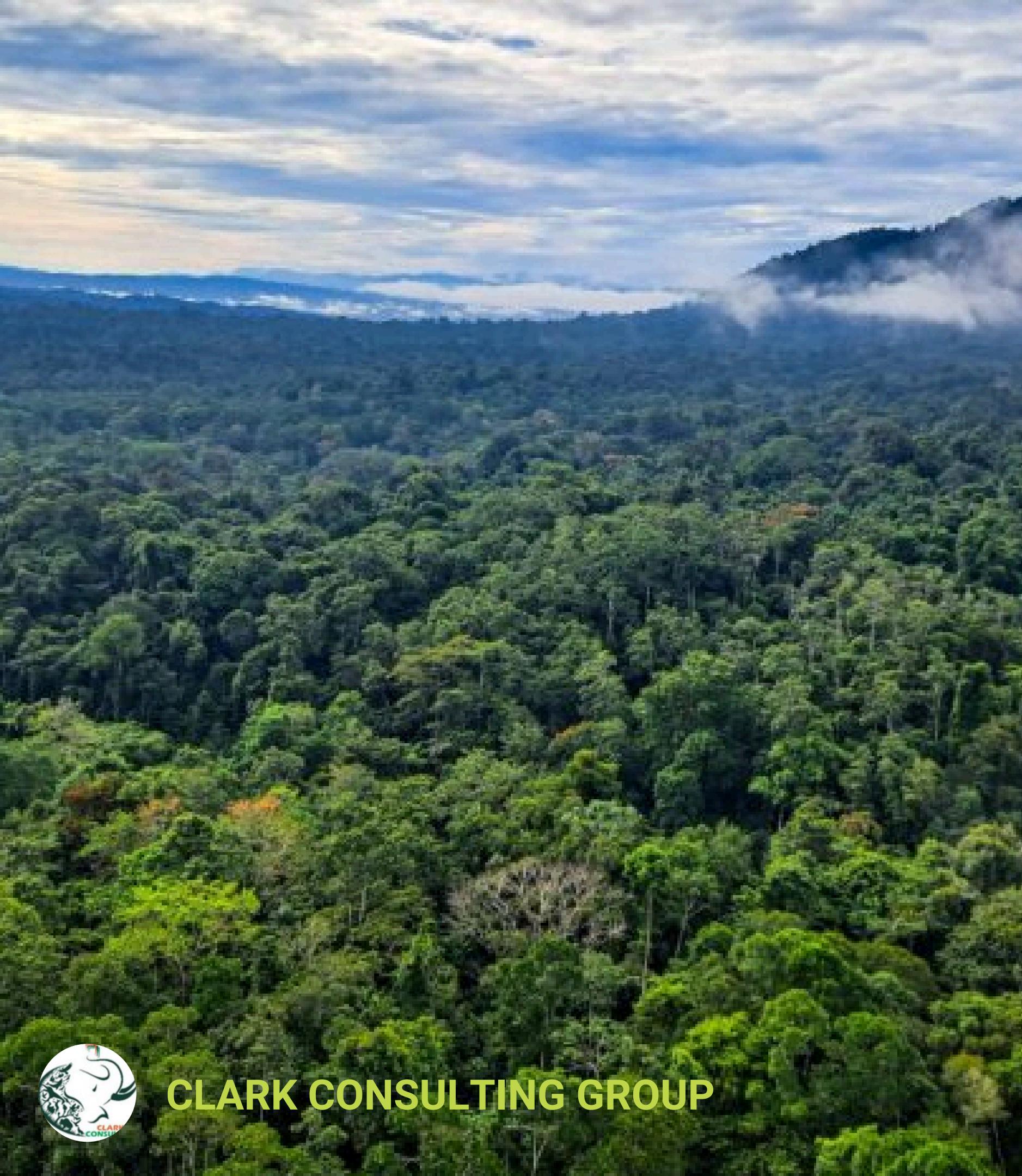
- Wenddy Acahuana
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- Jonathan Palmer

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- Florencia Sangermano
- John Rogan
- Abby Frazier
- Mikayla Schappert
- Antonio Fonseca

## Bagel Time Worcester





**CLARK CONSULTING GROUP**

**THANK  
YOU**