FEMC

Forest Ecosystem Monitoring Cooperative

Recreational Impact on Dimensions of Forest Health

Technical Overview of Data Analysis Methods and Products

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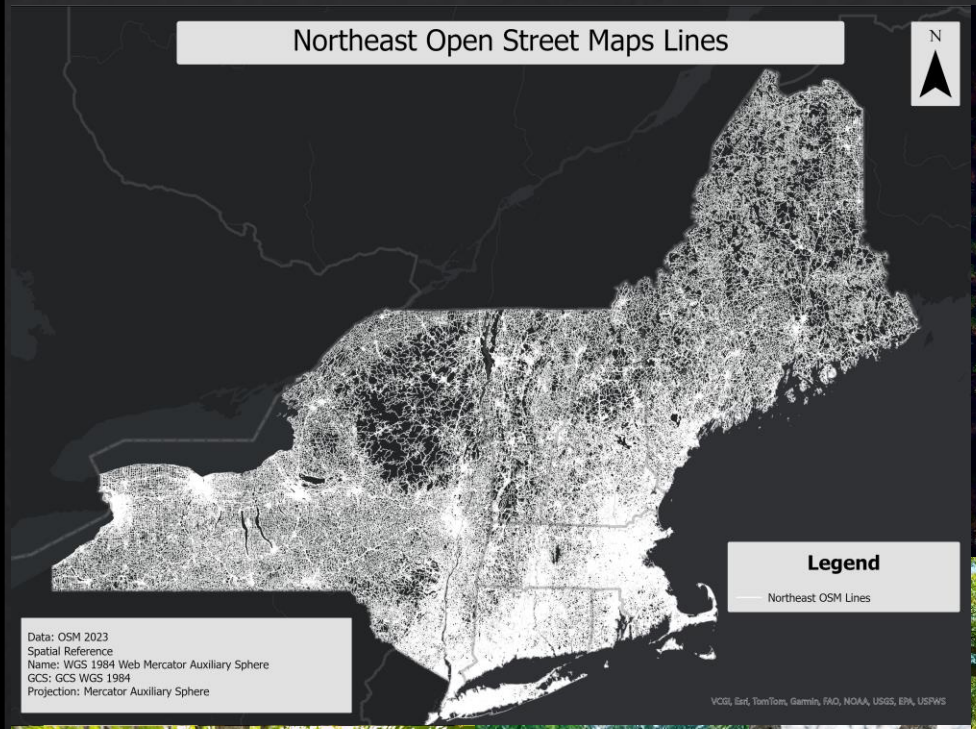
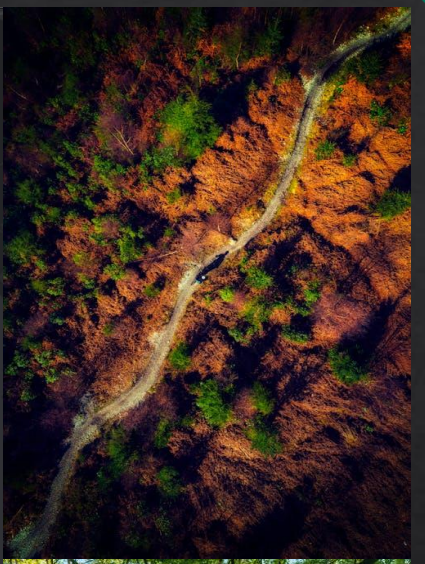
STRAVA

NRCS

Project Overview

- Objective: Create geospatial products and report on hiking and biking impact on:
  - Forest health (Canopy health)
  - Soil suitability
  - Wildlife
- Approach:
  - 2022 – Formed Committees and determined methodology
  - 2022-23 leveraged FEMC network to get access to user data
  - 2023-24 Integration of geospatial data and remote sensing tools
    - Strava (2022 data)
    - iNaturalist - Location of observations to nearest OSM segment
- Goal:
  - Provide tools for managers and researchers to make regionally informed discissions regarding recreation and forest health
  - Provide opensource data for further work





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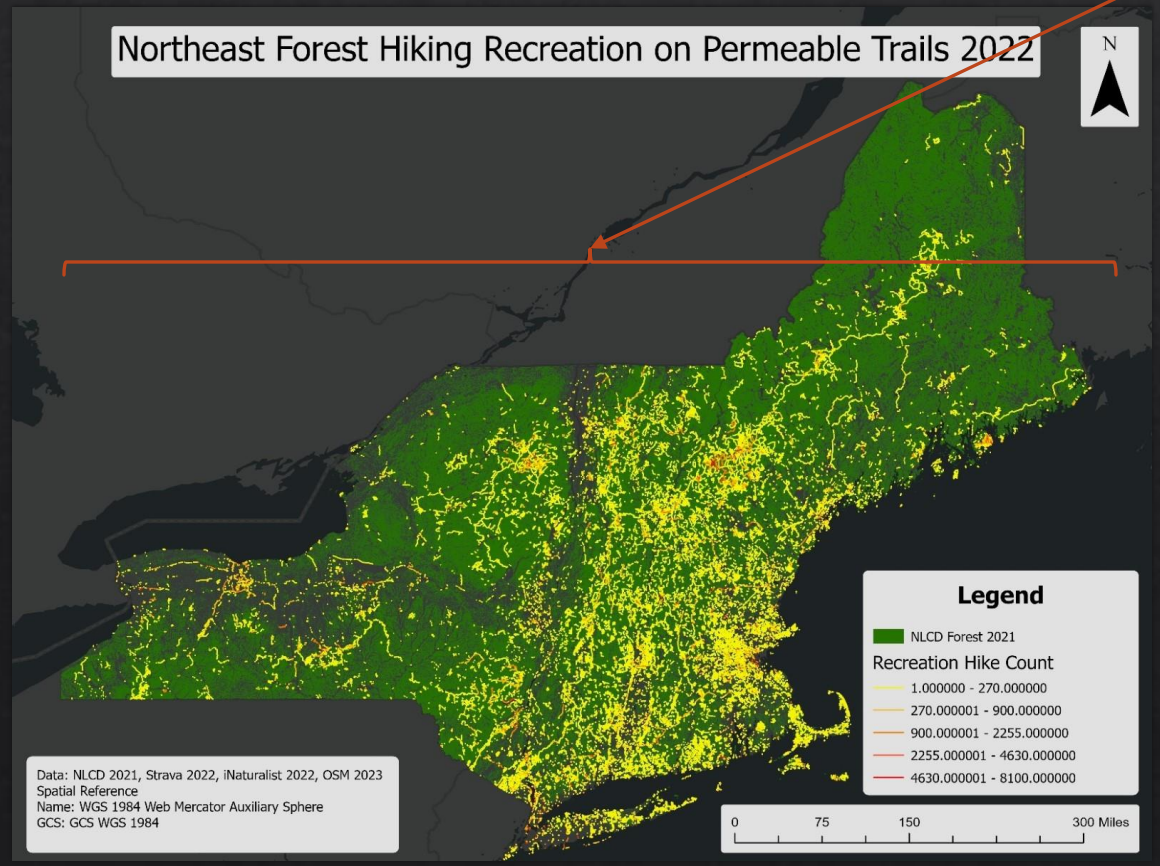
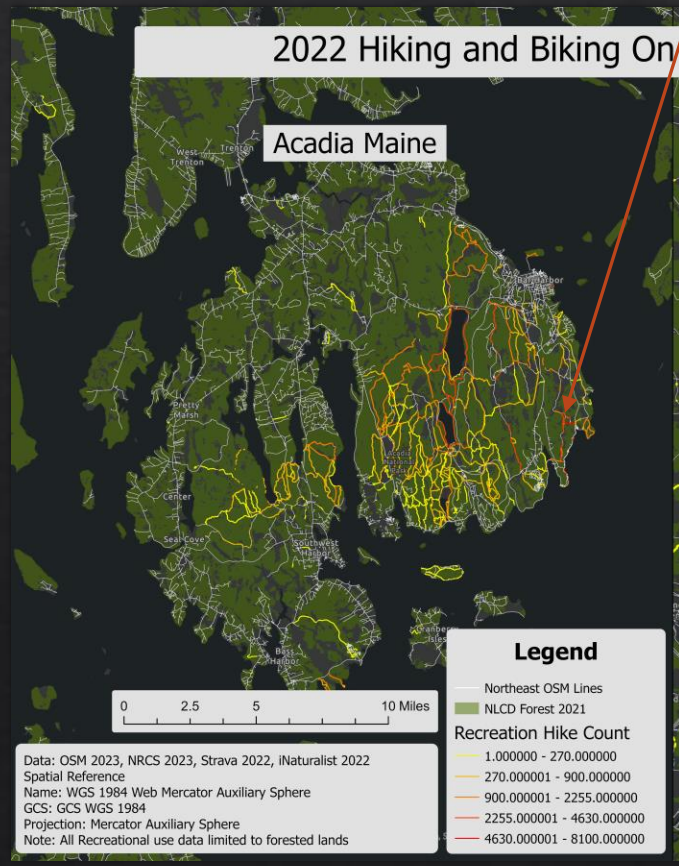
Regional Hot Spots And Local Trail Use

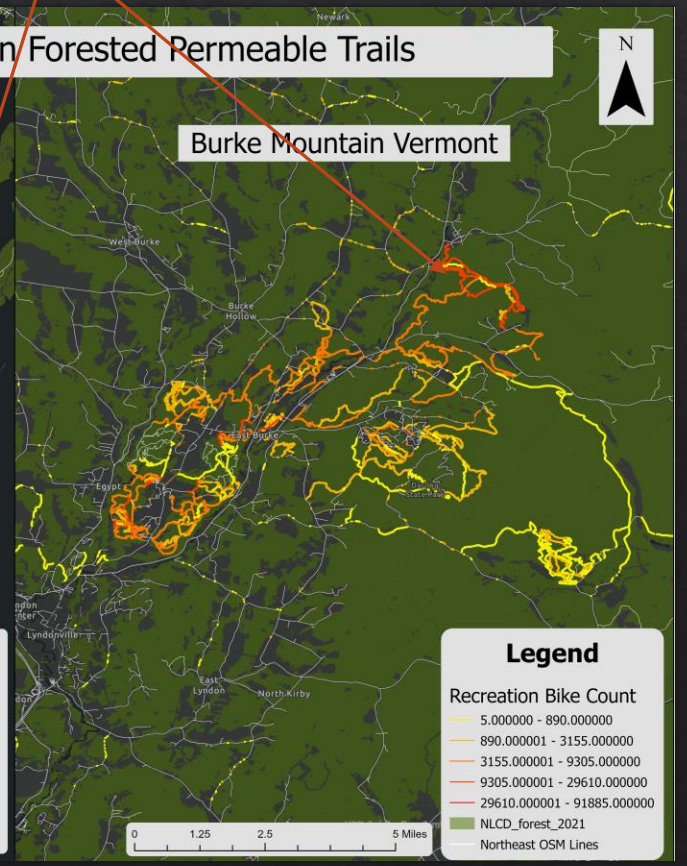
- FEMC State Coordinator data access with Strava
- Forest Trails Only
- Permeable and likely permeable surfaces only

- Regional coverage of user data

- Fine scale individual trail use data

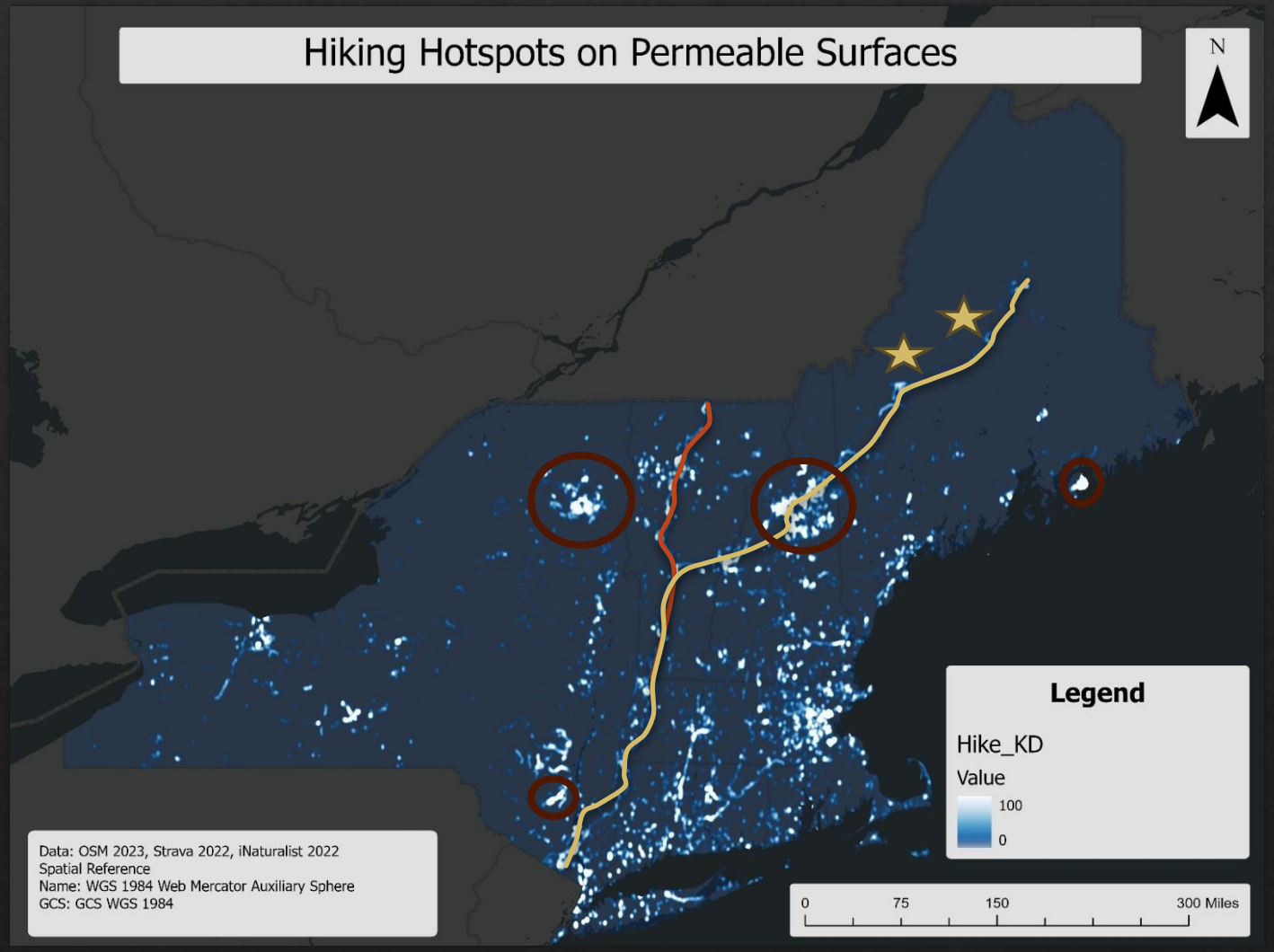




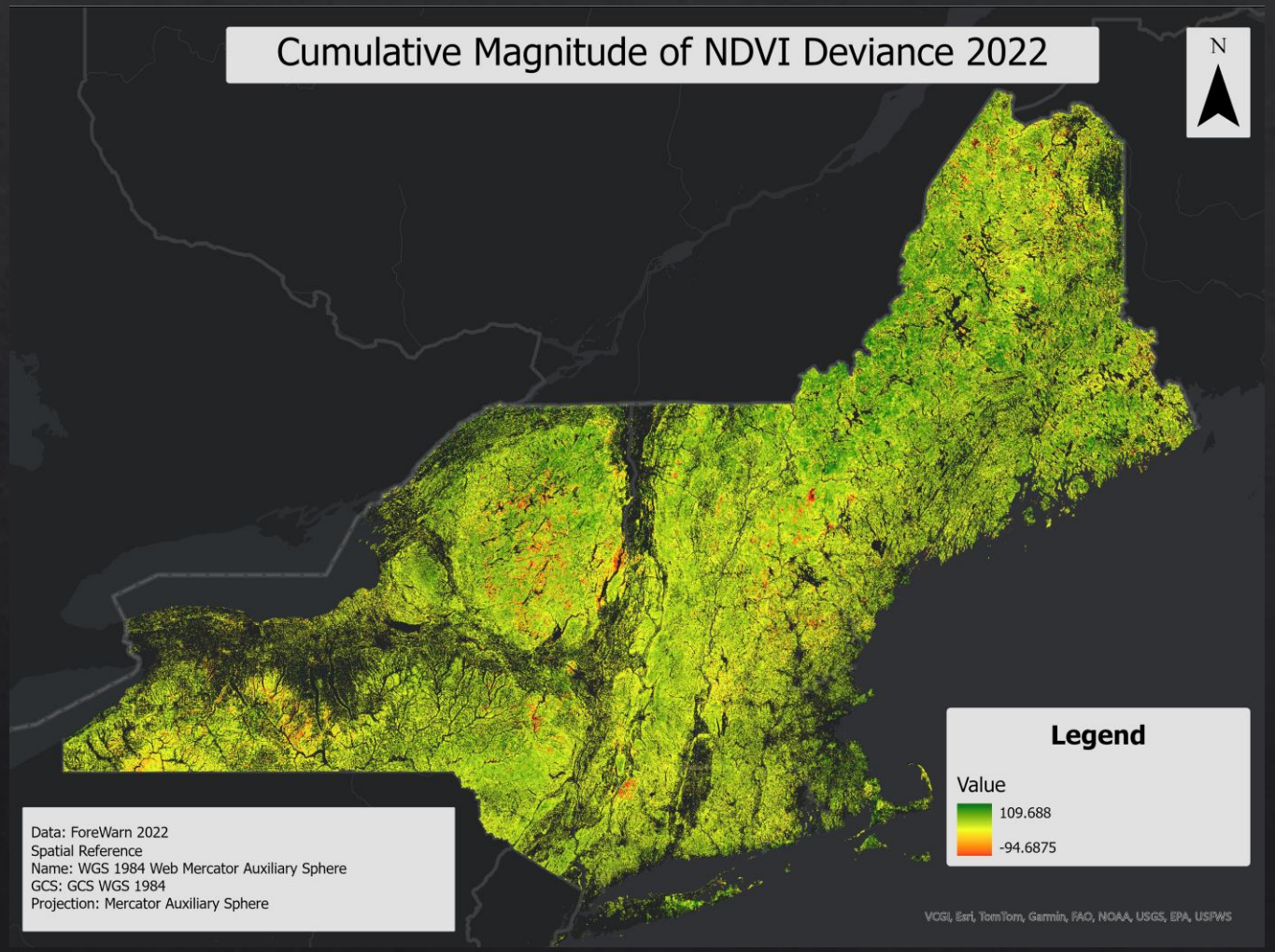


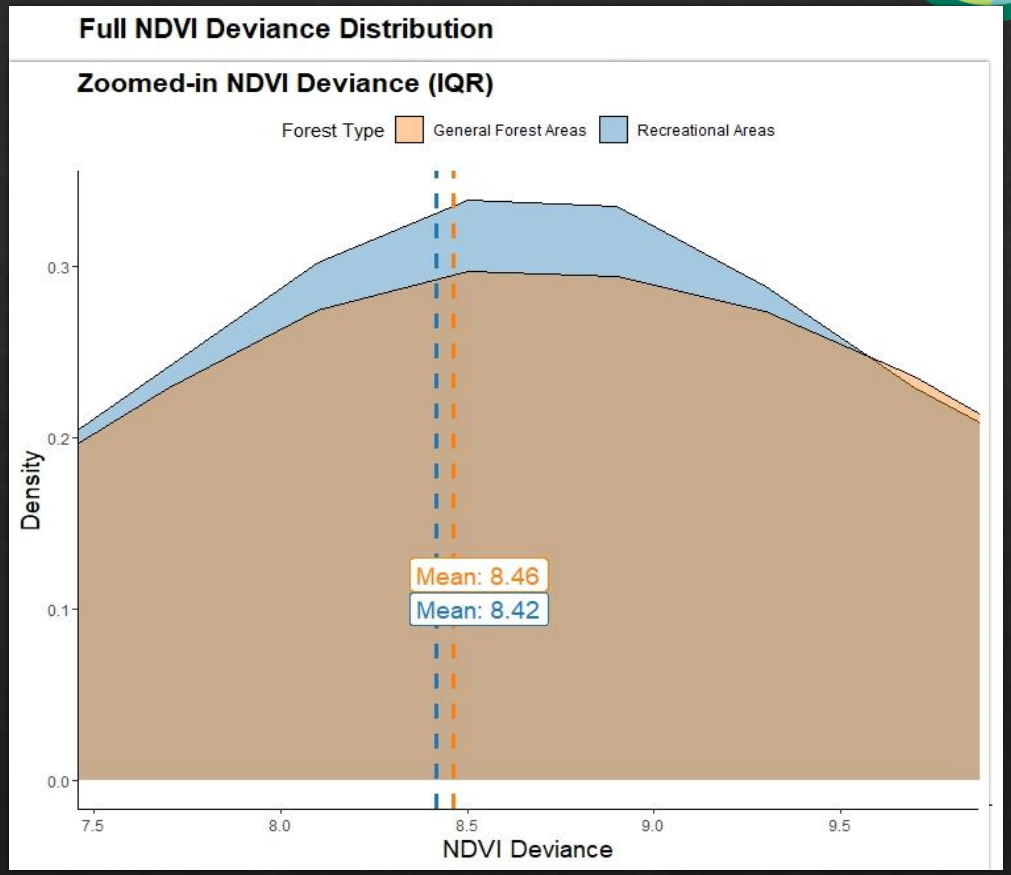
Regional Hotspots

- **What Are Hotspots?**
  - Recreation hotspots identify regions with **intense hiking and biking activity** based on Strava and iNaturalist data.
  - Combined with NRCS soil suitability, hotspots highlight areas with **high recreational use on vulnerable soils**.
- Key Findings:
  - High-Use Hotspots: Regions like Kingdom Trails (VT) and Glacier Ridge (NY) experience intense recreation.
  - Soil Vulnerability: Trails on unsuitable soils increase risks of erosion and degradation.
  - Management Implications: Targeted conservation needed in high-use, high-risk zones.
- Applications:
  - Prioritize trail maintenance and restoration.
  - Develop sustainable recreational plans for high-risk areas.
  - Data driven regional allocation of resources



Health Proxy Relationships





ForWarn

$$\text{Magnitude of Seasonal Deviance } (x,y) = \frac{\sum_{i=1}^{n} \text{pctNDVIc}_i(x,y)}{\text{Cumulative Deviance}_{\text{avg}}(x,y)}$$

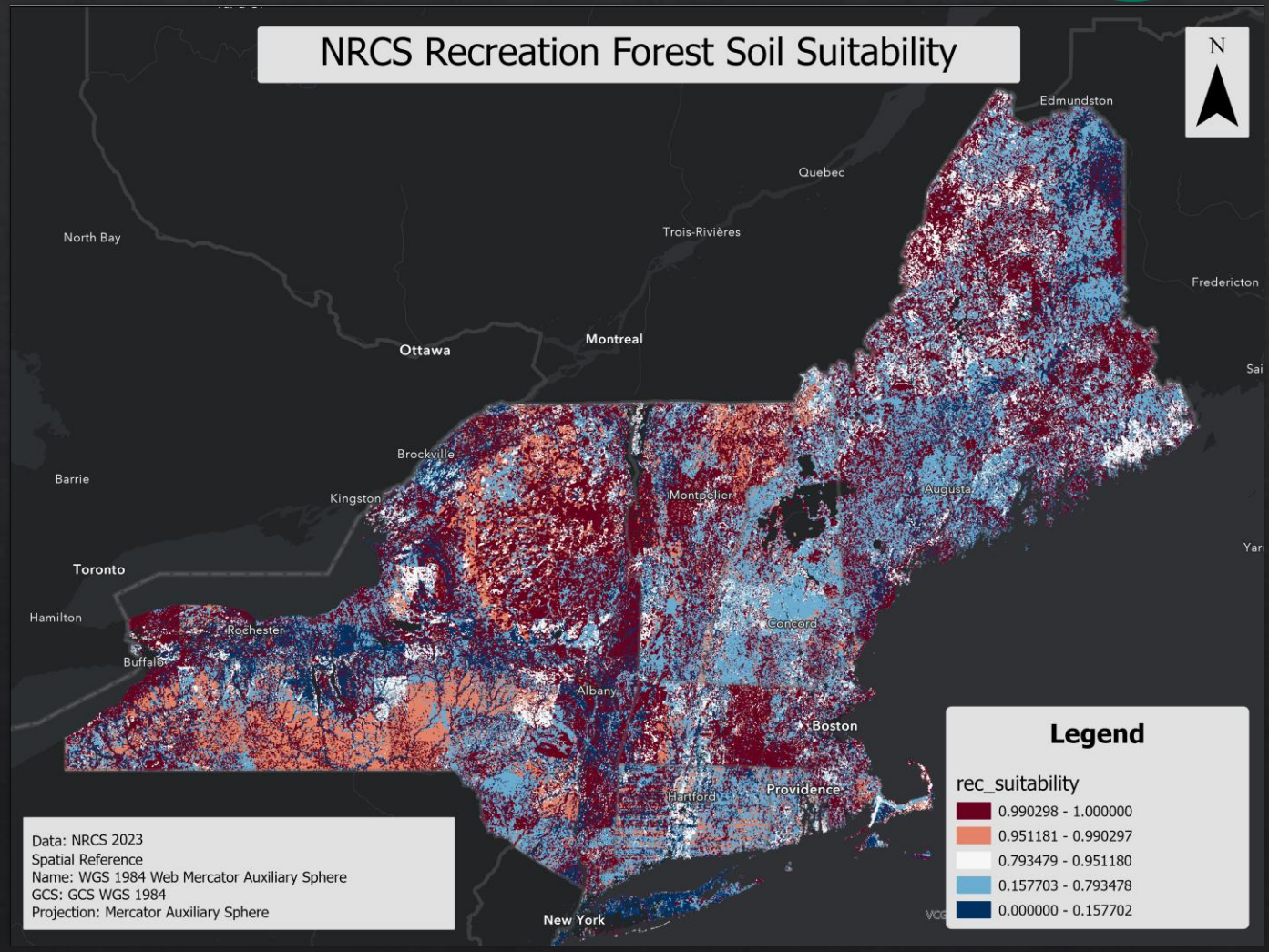
- p = 0.01644 significant but very weak relationship
- Where recreation occurs is different than other parts of forest

Recreation and Canopy Health Summary

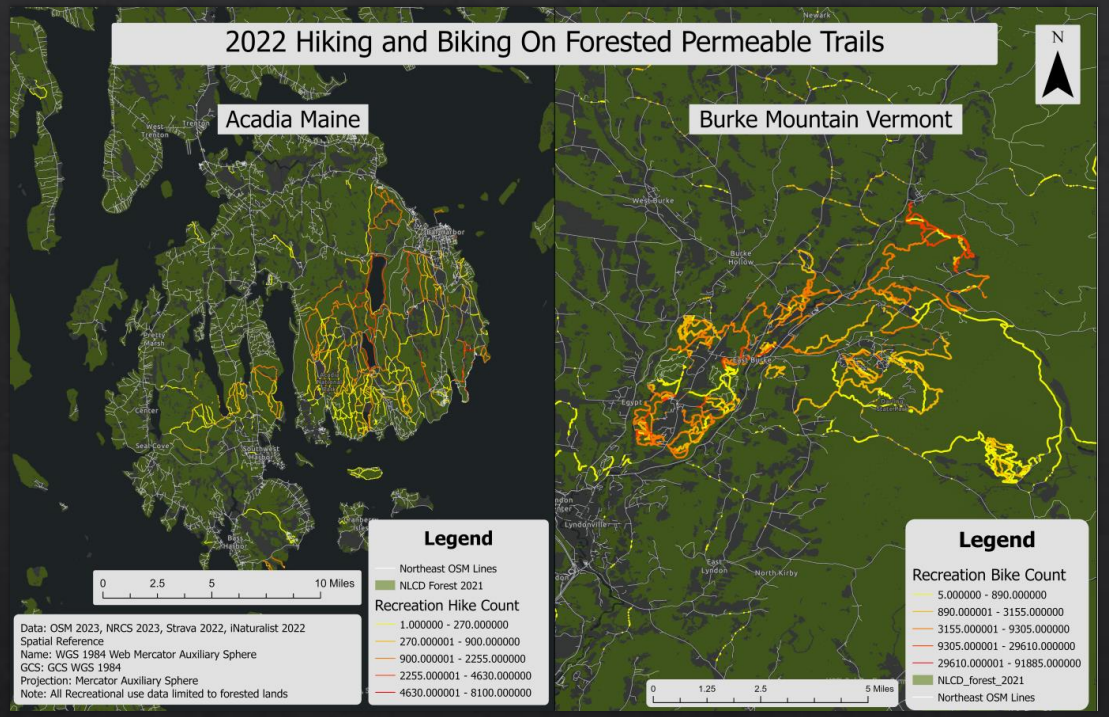
- Recreation and Canopy Health:
  - Recreational areas show slightly **worse NDVI deviance** compared to non-recreational areas.
  - **Minimal Impact:** Recreation plays a minor role in forest health relative to other environmental factors.
  - Some significant p-values and R^2, but very **small relative impact**.
- Key Drivers:
  - Forest health is more influenced by climate variability, natural disturbances, and management practices than recreation.
- Limitations:
  - Coarse spatial resolution of NDVI data (30m) may obscure small-scale effects.
  - NDVI deviance may not capture subtle interactions between recreation and vegetation health.
  - Ground points to assess forest health and higher resolution imagery needed

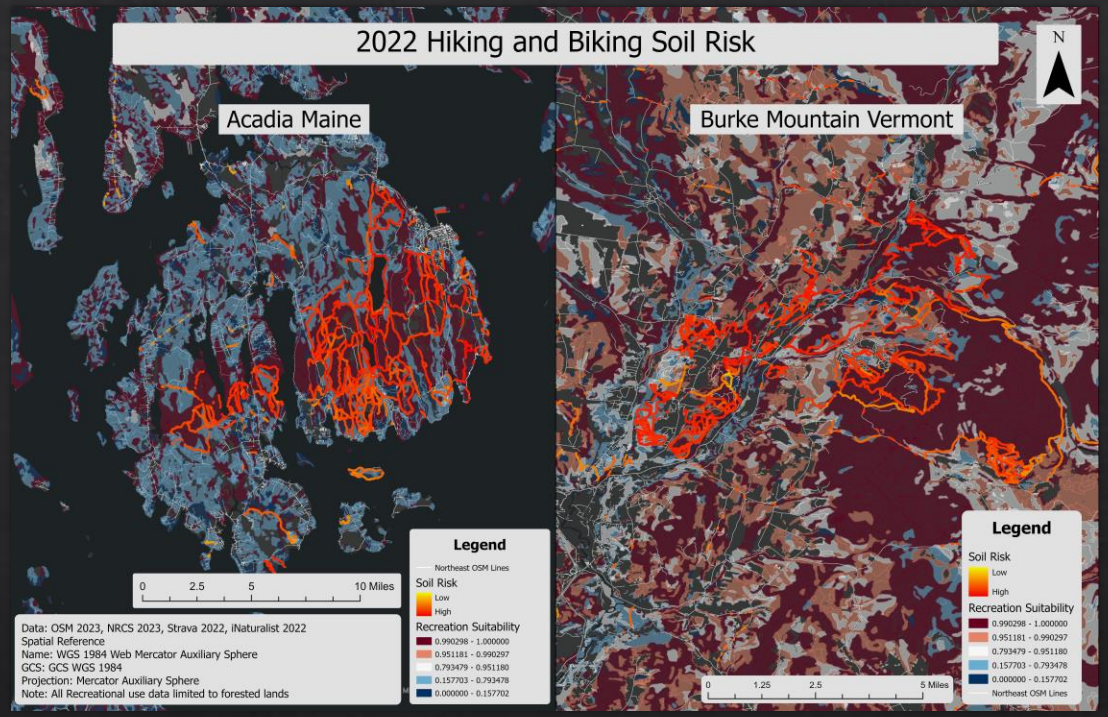
Modeled Soil Recreation Vulnerability

- Overview:
  - NRCS Web Soil Survey provides soil suitability data for recreational development.
  - Soil properties assessed for vulnerability include erosion risk, compaction, organic matter, and stoniness.
- Key Metrics:
  - Soils classified as Not Limited, Somewhat Limited, or Limited based on their ability to sustain recreation.
  - Vulnerable soils are concentrated in areas with steep slopes, poor drainage, and high erosion potential.



Soil Suitability Impact On Regional Hotspots

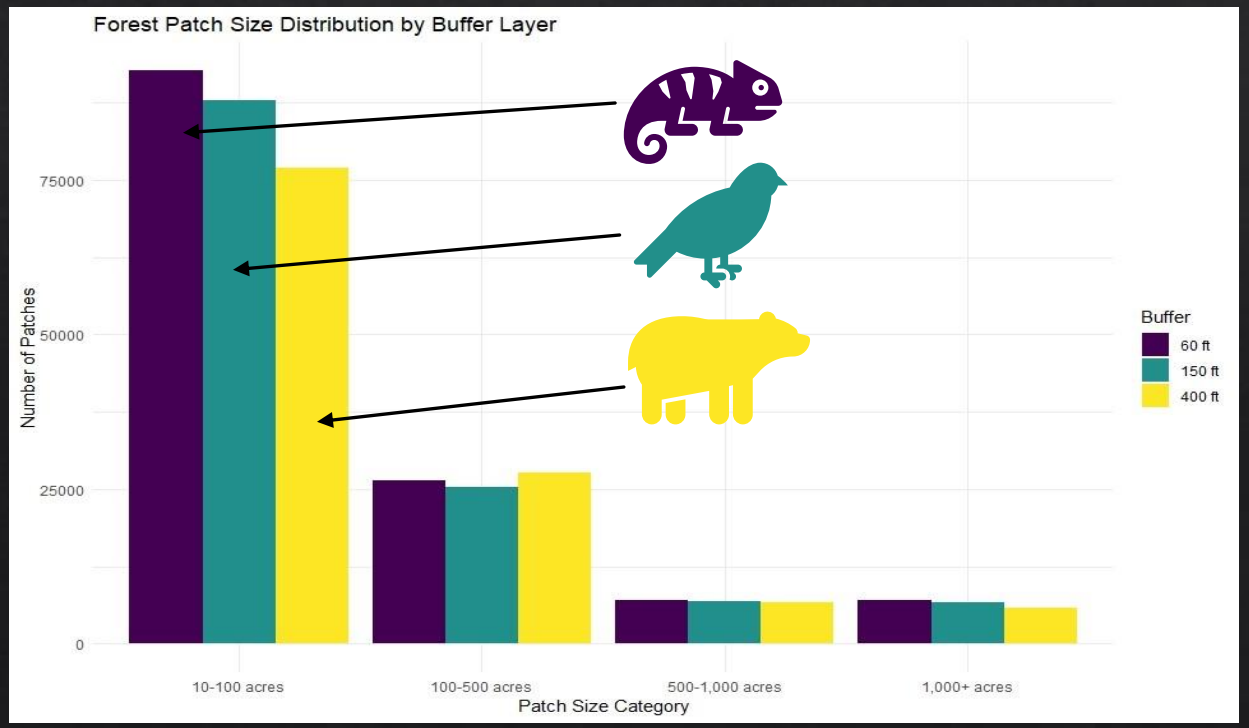


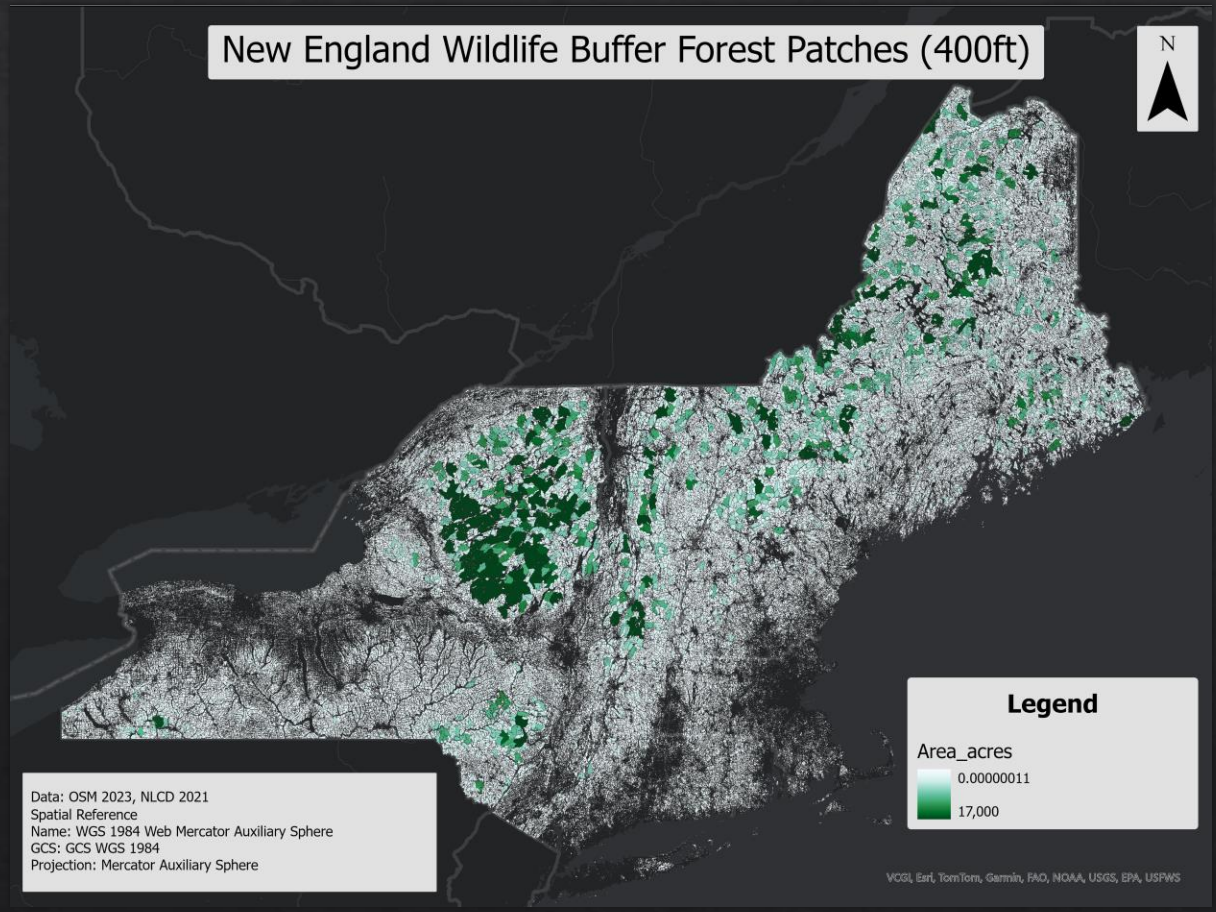


- Trail use counts alone are valuable tracking of where recreationist are recreating
- Adding in soils gives greater context to the erosion and impact from this use
    - High (very red) on a regional scale indicates these locations likely need proactive management

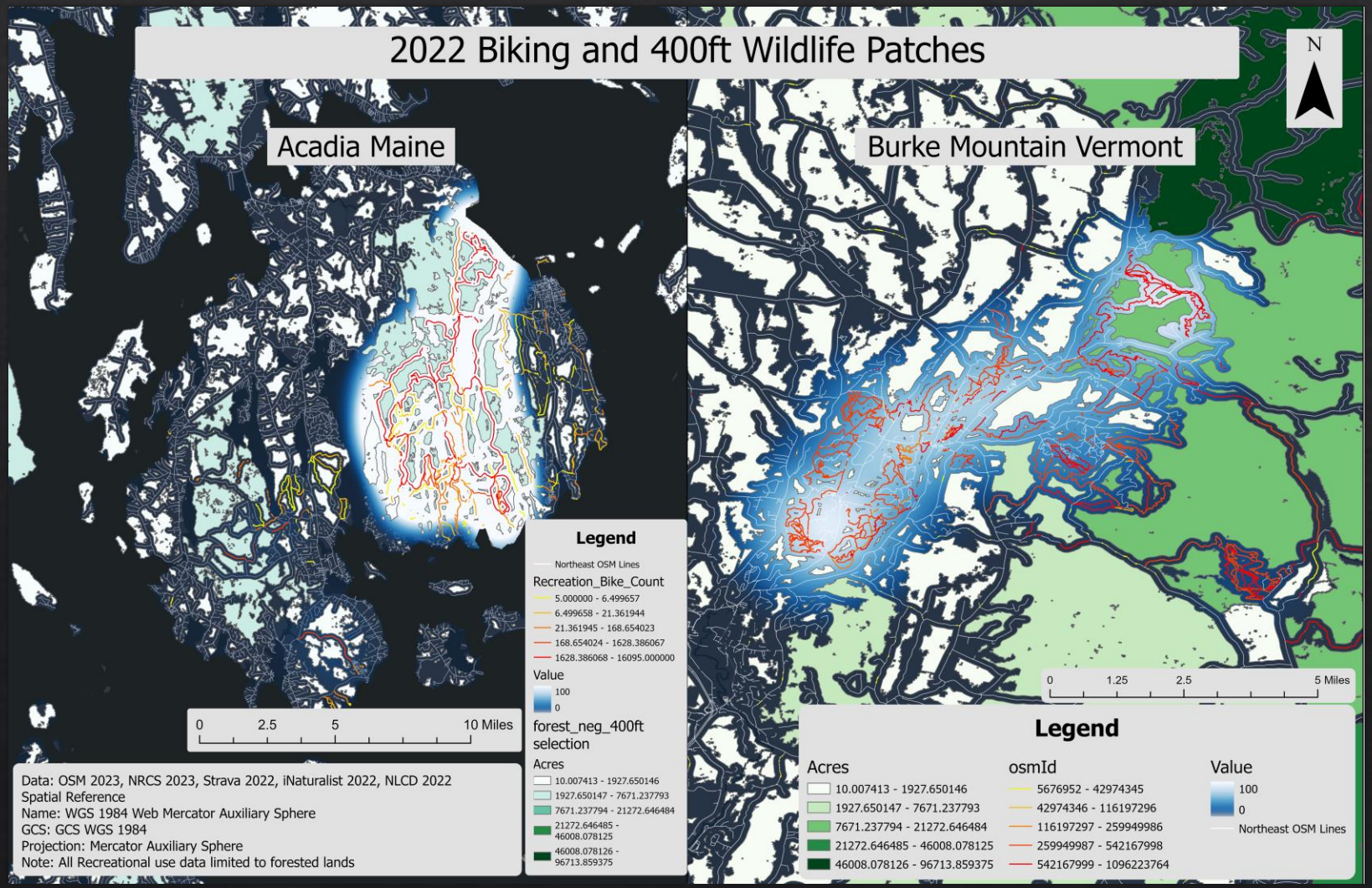
Wildlife Disturbance and Patch Size

- Key Results:
  - Larger trail buffers result in fewer but larger patches.
  - Connectivity critical for species like wood thrush and black bears.





Using Multi-Layer Analysis For Wildlife

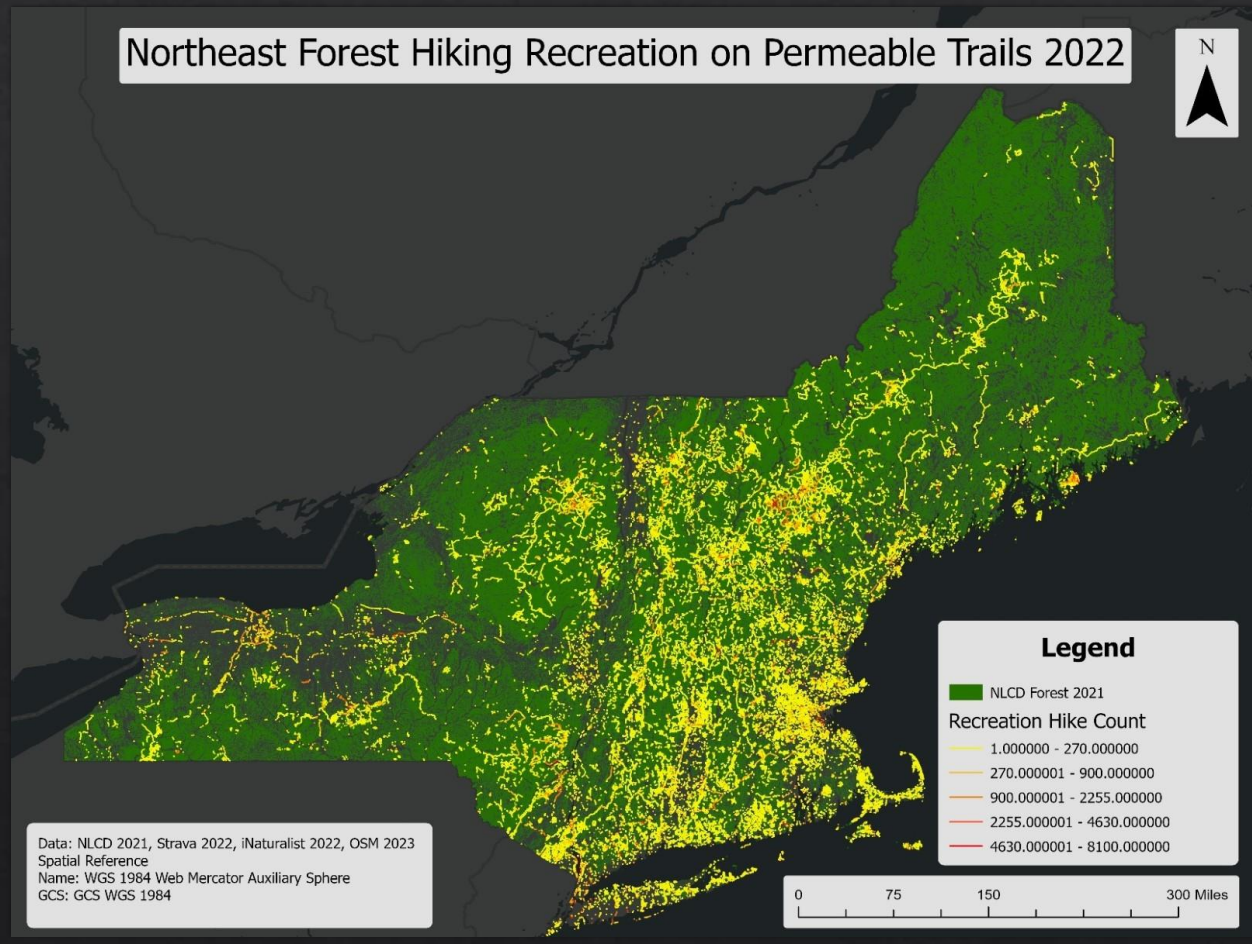


- **Example Applications:**
  - **Trail Management:** Adjust or reroute high-use trails (e.g., red-hotspot zones) away from critical wildlife habitat.
  - **Conservation Planning:** Prioritize protection of large forest patches heavily impacted by recreational use.
  - **Recreation Impact Assessment:** Quantify overlap between biking hotspots and wildlife zones to guide policy or zoning efforts.
- **Decision-Making Potential:** Balance recreation needs with habitat conservation by:
  1. Identifying high-impact zones.
  2. Prioritizing areas for mitigation or trail adjustments.
  3. Supporting data-driven discussions for land use planning.

Summary

Key Insights:

1. **Forest Canopy Health:**
    1. Minimal impact of hiking and biking on NDVI deviance at the regional scale.
    2. Other drivers, such as climate and land management, dominate forest health changes.
    3. Further work with higher resolution data
2. **Soil Suitability:**
    1. Recreational hotspots on unsuitable soils present risks for erosion and degradation.
    2. Areas like **Kingdom Trails (VT), Glacier Ridge (NY), Acadia NP (ME)** require targeted management.
3. **Wildlife and Connectivity:**
    1. Trail buffers reduce undisturbed forest patch size, impacting wildlife habitats.
4. **Population and Recreation Patterns:**
    1. Proximity to urban centers influences recreational use.
    2. High-use areas far from population centers may require unique conservation strategies.



Open Data and Other Uses

- Please Use These Data!
  - Go to our website
  - Download though AGOL
  - Or use the Rest Service directly

https://www.uvm.edu/femc/CI4/cooperative/projects/recreation#products

Citations and Credits

Thank you to all our contributors and committee members!

Photos

[1] New Hampshire Division of Travel & Tourism

[2] Carl D. Walsh

[3] Sleepy Hollow

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Questions and Discussion

Slide #

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7. Modeled Soil Vulnerability
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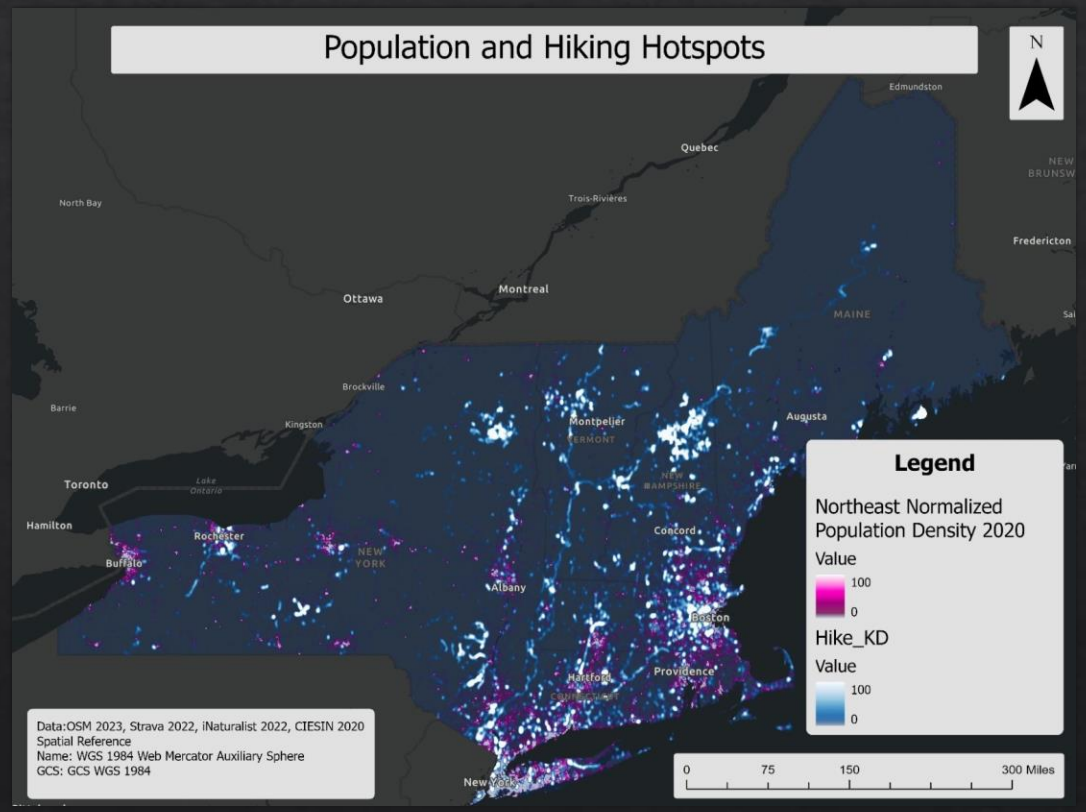
EXTRAS:

1. Considering Population
2. Magnitude of Use Shows Weak or No Relationships
3. Considering Soils and Magnitude Shows Weak or No Relationships

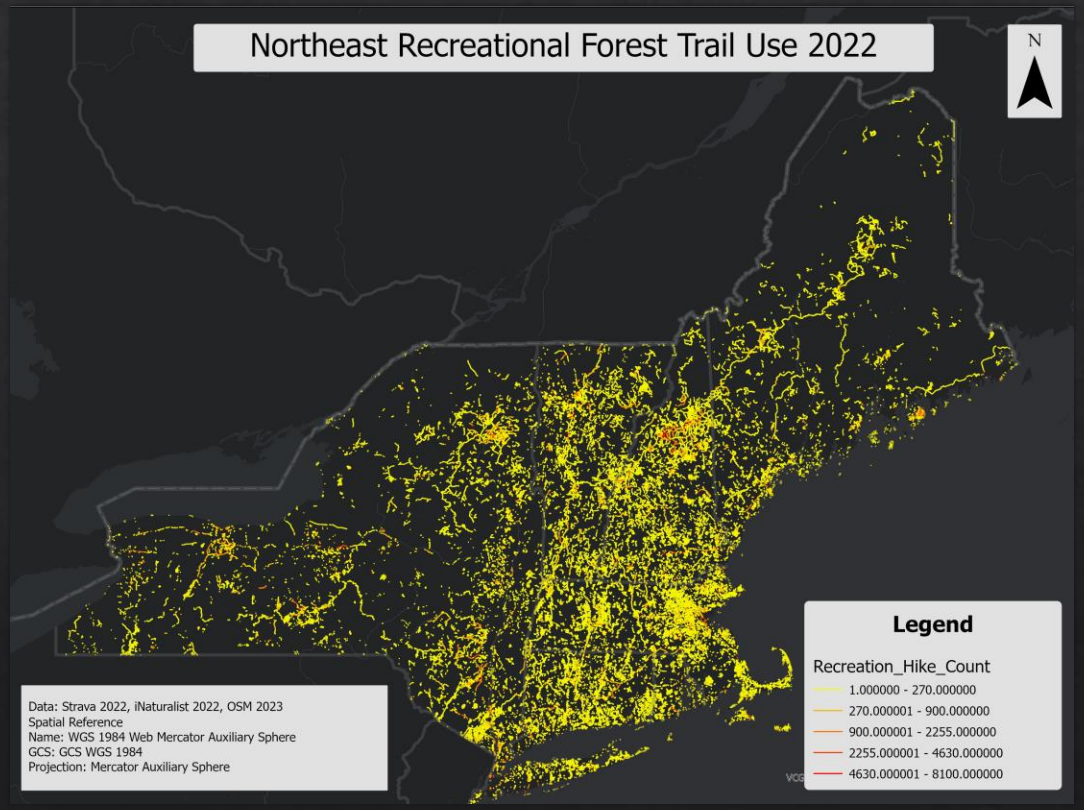
Considering Population

- Recreation Patterns:
  - Recreation often occurs closer to population centers, reflecting accessibility and ease of use.
  - Hotspots farther from urban areas may cater to destination recreation rather than casual use.
- Management Implications:
  - Close to Population: Frequent use may require trail maintenance, crowd management, and erosion control.
  - Far from Population: Higher use relative to population density may indicate unique ecological or recreational value, necessitating special management strategies (e.g., wilderness protection, infrastructure development).
- Key Examples:
  - High-use regions like Adirondacks, White Mountains, and Northern Maine show significant activity away from dense populations.
  - Urban hubs like Boston and New York influence nearby recreation hotspots.



Magnitude of Use Shows Weak or No Relationships

- Hiking Recreation and NDVI Deviance:
  - Finding: Statistically significant negative relationship (Estimate = -0.00003498, p = 3.09e-05).R^2 = 0.0002497:
  - Hiking explains only a tiny fraction of NDVI deviance variation.
  - Conclusion: Hiking has a minor impact on canopy health relative to other drivers.
- Biking Recreation and NDVI Deviance:
  - Finding: No significant relationship (Estimate = -0.000009975, p = 0.594).R^2 = 0.000004099:
  - Biking activity does not significantly affect forest canopy health.



Considering Soils and Magnitude Shows Weak or No Relationships

- Soil Suitability and NDVI Deviance (Hiking):
  - Finding: No significant relationship (Estimate = -0.000008811, p = 0.763).
  - Conclusion: Hiking on unsuitable soils does not meaningfully affect canopy health.
- Soil Suitability and NDVI Deviance (Biking):
  - Finding: Statistically significant relationship (Estimate = 0.00007221, p = 0.00759).R^2 = 0.0001025:
  - Weak explanatory power; other factors likely more influential.