Uncovering the Past Landscape of Central New Hampshire: Accuracy Assessment for Identifying Stonewalls Using LiDAR-derived Products

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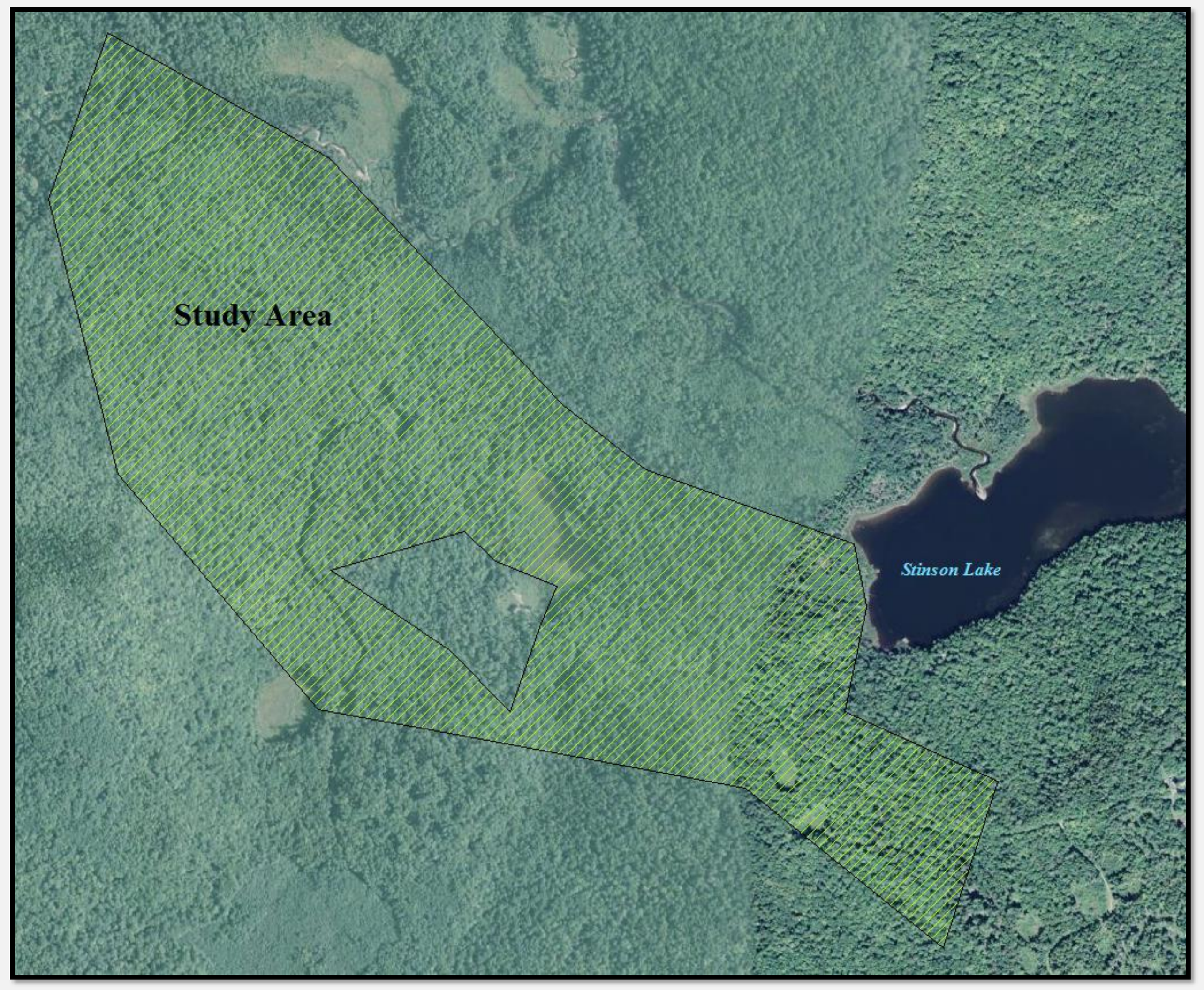
Research Questions

How many line-transects are needed to assess the accuracy of digitized stonewalls from LiDAR-derived terrain products in the White Mountain National Forest, NH?

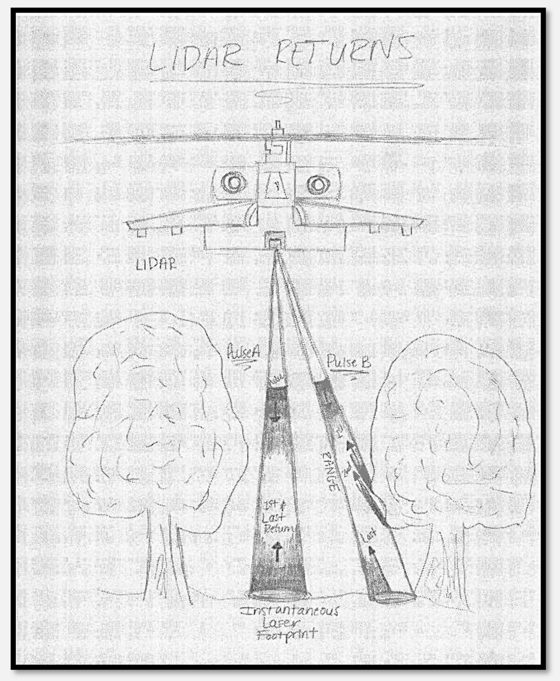
How can an efficient field assessment be developed from transect sampling to standardize digitizing methods for statewide initiatives?



Background & Importance

What is LiDAR?

LiDAR stands for Light Detection and Ranging. It offers an alternative to in situ field surveying and photogrammetric mapping techniques for the collection of elevation data. A 3-D point cloud is generated from the elevation data recorded, and most common ground-return visualization products can be produce a digital elevation model (DEM). Newly released LiDAR data from the NH GRANIT website was essential for this research.



Pictured Above: A sketch of how multiple returns are generated from a single pulse of laser light.

Background & Importance of Mapping Stonewalls

To better understand the relationship and impact that humans have had on the natural landscape we must begin to record where such features are found. This is especially true for the preservation of such historical artifacts within the White Mountain National Forest (WMNF), NH. The mapping of stonewalls is possible using LiDAR-derived terrain derivatives (Johnson & Ouimet 2014), but a sampling design is needed to assess the accuracy of both presence *and* absence of digitized stonewalls.

References and Resources

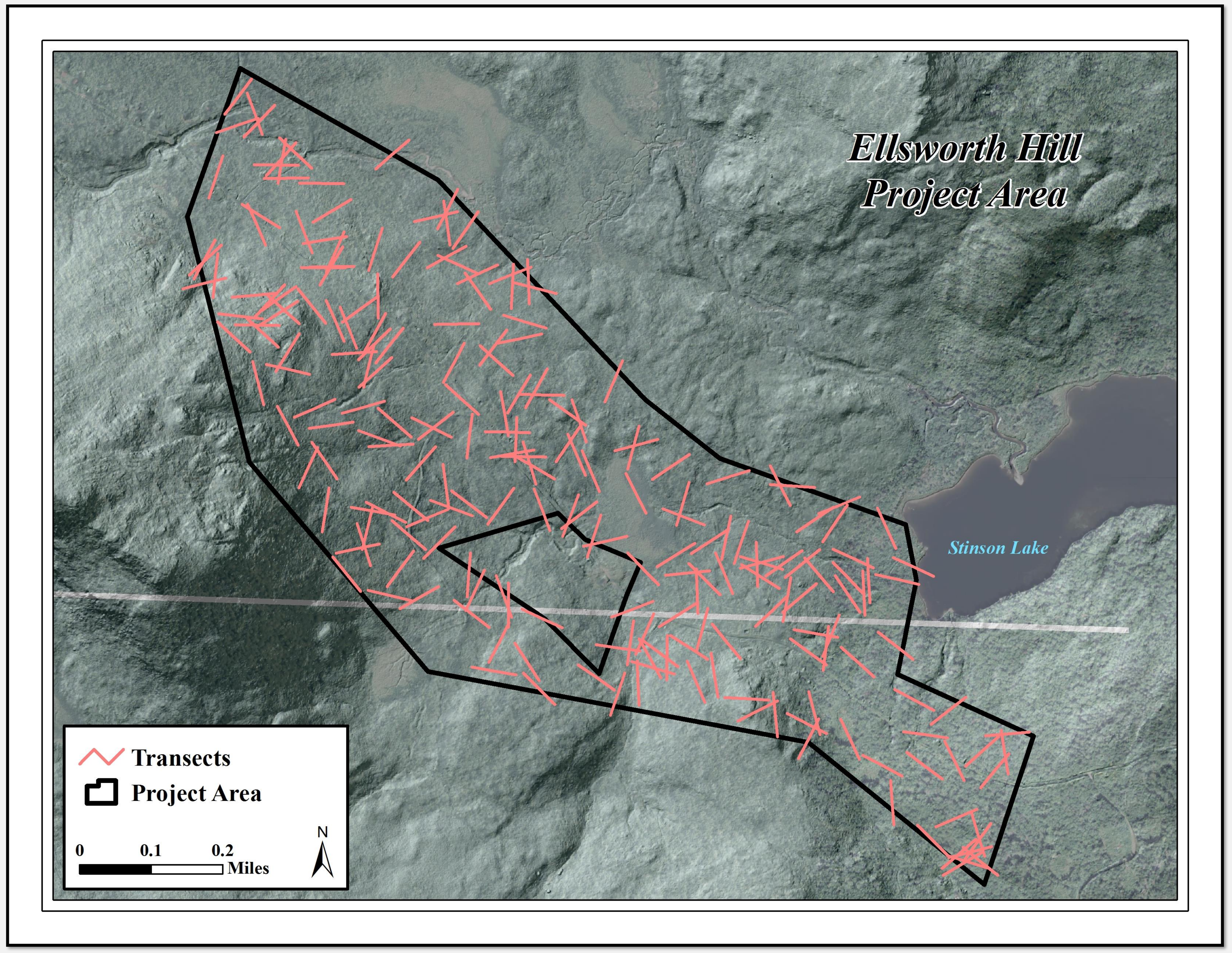
Johnson, K. M., & Ouimet, W. B. (2014). Rediscovering the lost archaeological landscape of southern New England using airborne light detection and ranging (LiDAR). *Journal of Archaeological Science*, *43*, 9-20.

Kershaw, J. A., Ducey, M.J., Beers, T.W., Husch, B. (2017). Forest Mensuration. Wiley Publications. Chapter 12.

GRANIT :: LIDAR Project. (2015, October 24). Retrieved November 20, 2016, from http://lidar.unh.edu/map

New Hampshire Topographic Maps - Perry-Castañeda Map Collection - UT Library Online. (n.d.). Retrieved November 20, 2016, from http://www.lib.utexas.edu/maps/topo/new_hampshire

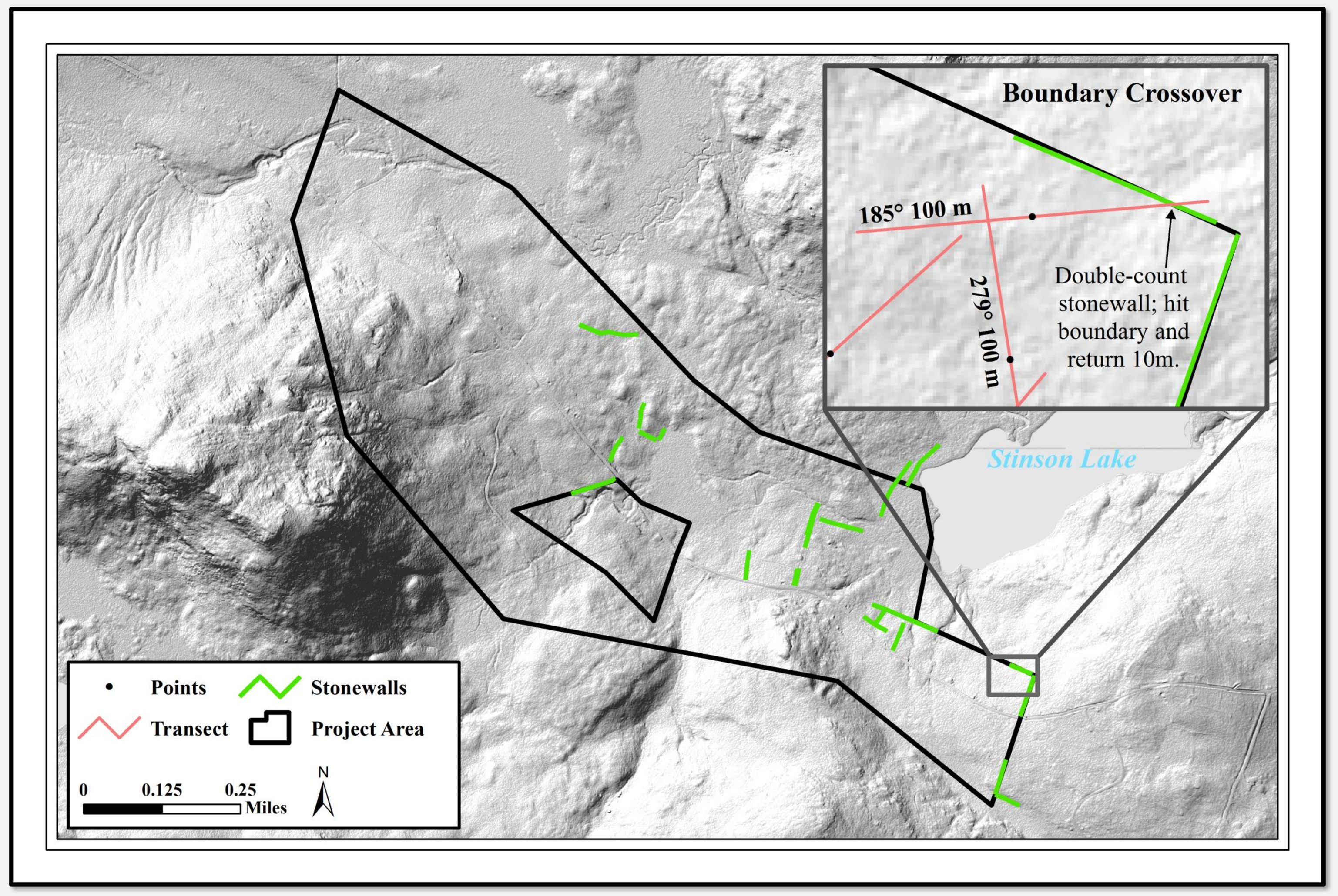
Field Approach Methodology



We calculated the total length of stonewalls using digitized locations as the sample population. The inclusion zone, a_i, is

$$a_i = wL = \frac{2l}{\pi}L$$

where *w* is the projection of the stonewall to the sample line and *L* is the length of the sample line (Kershaw et al. 2017). We determined 21,980 m (~220 100 m) of transect are necessary to estimate the total length of stonewalls in the project area. Transects were created from randomly generated points directions for each 100 m transect (figure above). The field protocol includes documenting each stonewall crossed along a transect with a GPS waypoint, a photograph, and record height and width of stonewall.



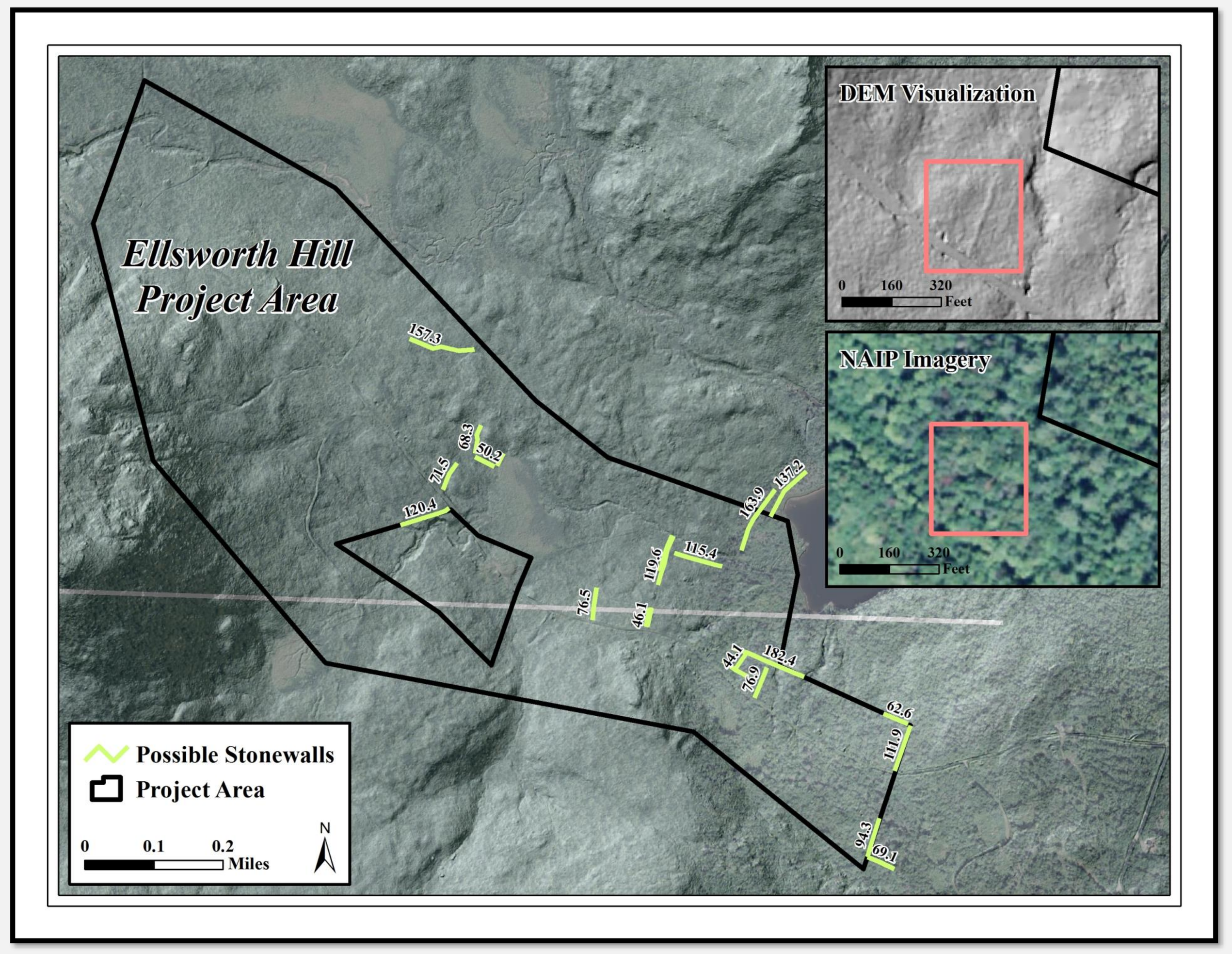
Preliminary Methodology

Pre-Processing →

- **Downloading Data:** We utilized the recently published GRANIT : LIDAR Project to download LiDAR data for our area of interest within the White Mountain National Forest, NH. Once here, a custom selection was made and tiles of the Bare Earth LiDAR derived DEM were then downloaded for use in ArcGIS 10.4.
- **Mosaic to New Raster:** This data management tool was utilized to merge multiple raster datasets into a new raster dataset, essentially "stitching together" the downloaded tiles using a mean operator.
- **Hillshade Tool:** This spatial analyst tool was used to tease out textures and minute changes along the landscape using a 315˚ hillshade layer.

Digitizing →

- **Digitizing Historical Features:** A shapefile, *Possible_Stone_Walls*, was edited to digitize features found in the hillshade layer. We manually interpreted the hillshade layer for linear features along the landscape. Keeping in mind that roads and stonewalls may look similar at times, we noted that roads seemed to look more concave or depressed, while stonewalls looked the opposite. Historical topography maps and aerial imagery can be used to provide context when analyzing the DEM at specific locations of uncertainty. In many cases stonewalls will delineate property boundaries for settlements, either seen on historical topography maps or are still used for boundaries of existing homes in this area. It is important to note that digitizing was conducted at a scale of 1:2,000 – 5,000.



- **Geo-referencing:** Historical images and topographic maps can assist in digitizing stonewall locations. The historical property maps would include documentation of known settlement locations during the given time period. Thus taking these existing structures into consideration, we could assume that there would be an increased likelihood of the presence of stonewalls at that location.

Future Analysis

The research we have presented thus far is still in the preliminary stage. We plan to further assess the accuracy of the presence *and* absence of stonewalls throughout our study area by implementing the field protocol using line-transect sampling. We designed this project and the field accuracy assessment to be reproducible in other parts of the state. Standardizing such practices are essential for cohesive statewide and regional efforts. This will hopefully enable other organizations within the state and region to accurately document historical features common to New Hampshire's unique landscape.