Geomorphic Mapping of Garner Run, Susquehanna Shale Hills Critical Zone Observatory (SSHCZO), Central, PA

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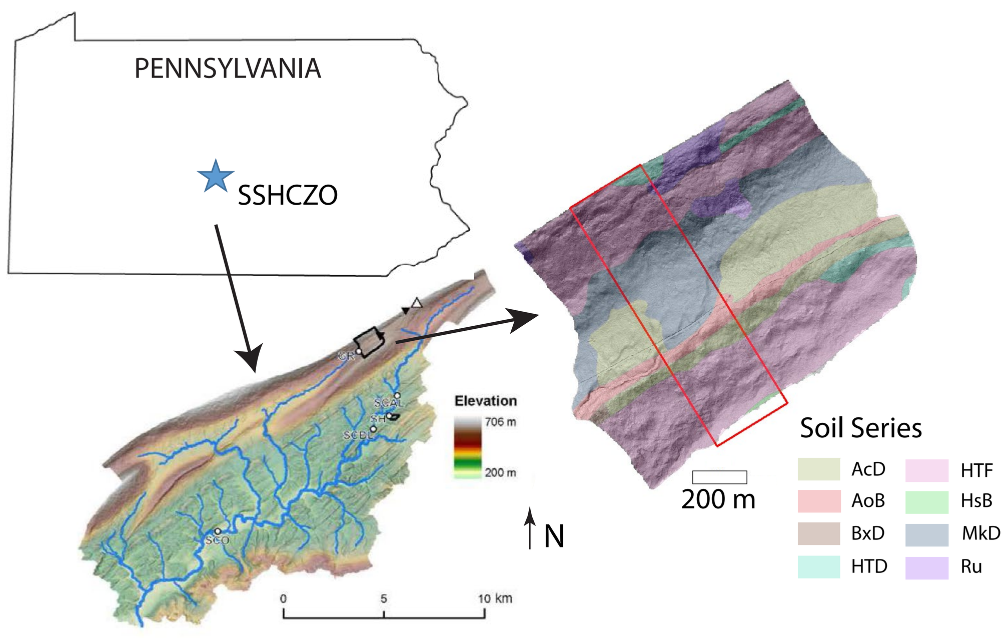
1. Motivation

Investigating the physical properties of the soil mantle and surface morphology is necessary to model the processes linked to mass fluxes--water, energy, gas, sediment, and solutes (WEGSS)--in the landscape. Existing data on these properties are inadequate for the purpose of model building because the resolution does not account for the complex surface heterogeneities present in Garner Run. Previous work is also inadequate for geomorphic interpretations of past processes and climate of the landscape because it fails to capture details like spatial variability of lobate features, as well as surface roughness. This study aims to produce high resolution surficial mapping for future model building and studies of past processes.

2. Garner Run Study Area



Digital elevation model of Shavers Creek Watershed (Brantley et al. 2015)

Garner Run subcatchment showing distribution of soil series (SSURGO database)

Figure 1: Characteristic photo of each mapping class with degree of rockiness specified.

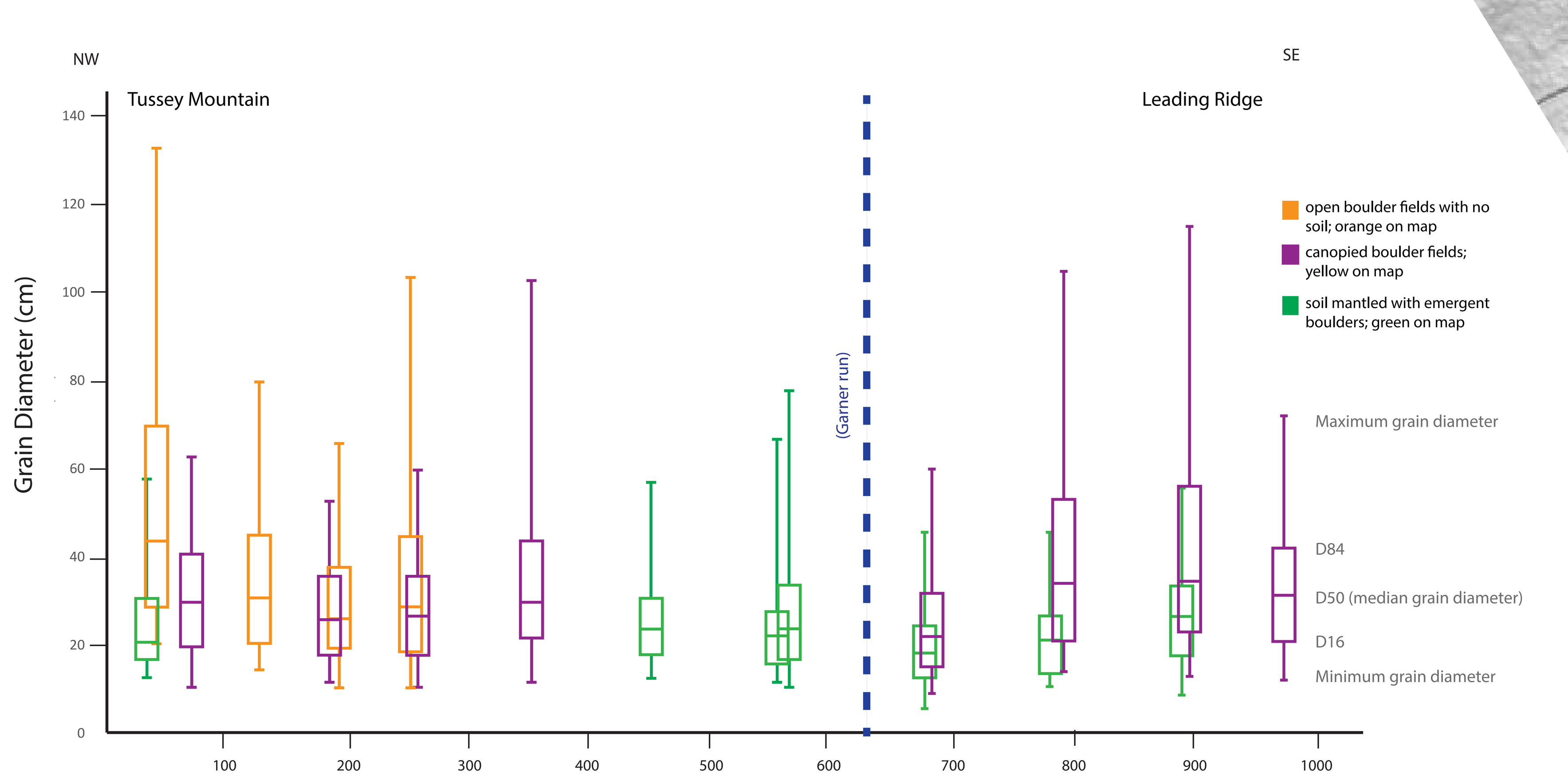


Figure 2: Plot of grain sizes of boulders as a function of distance from the Tussey Mountain ridgeline, color coded by surface unit. The dashed blue line shows location of Garner Run stream channel relative to boulder point count locations.

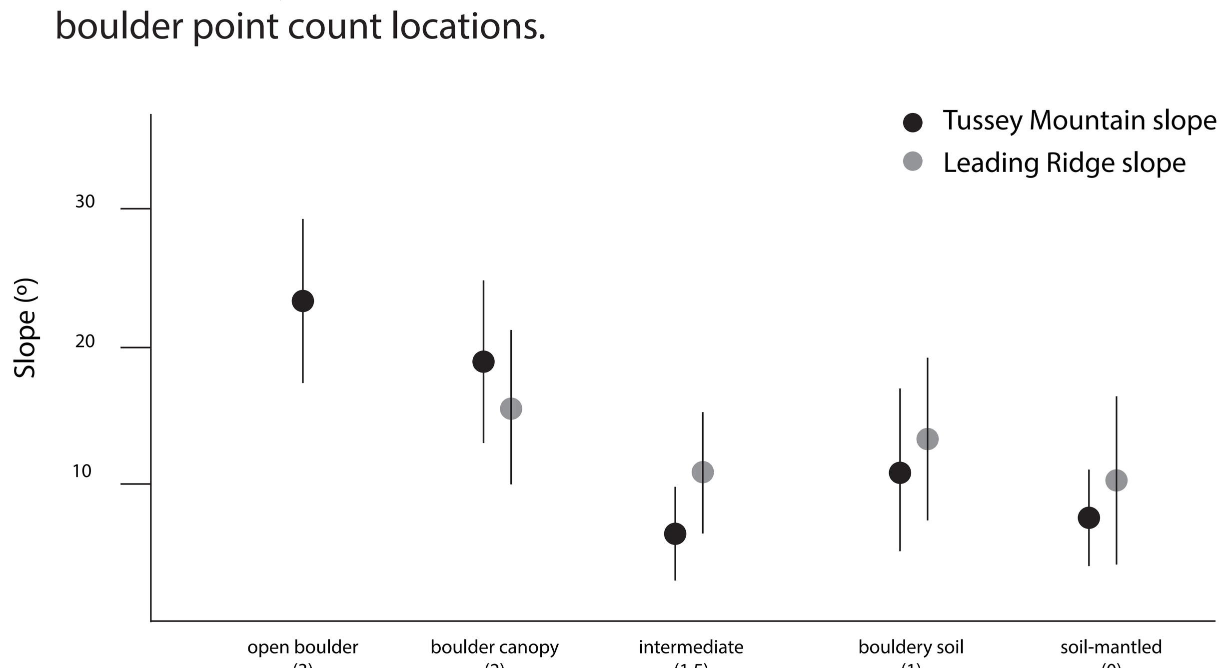
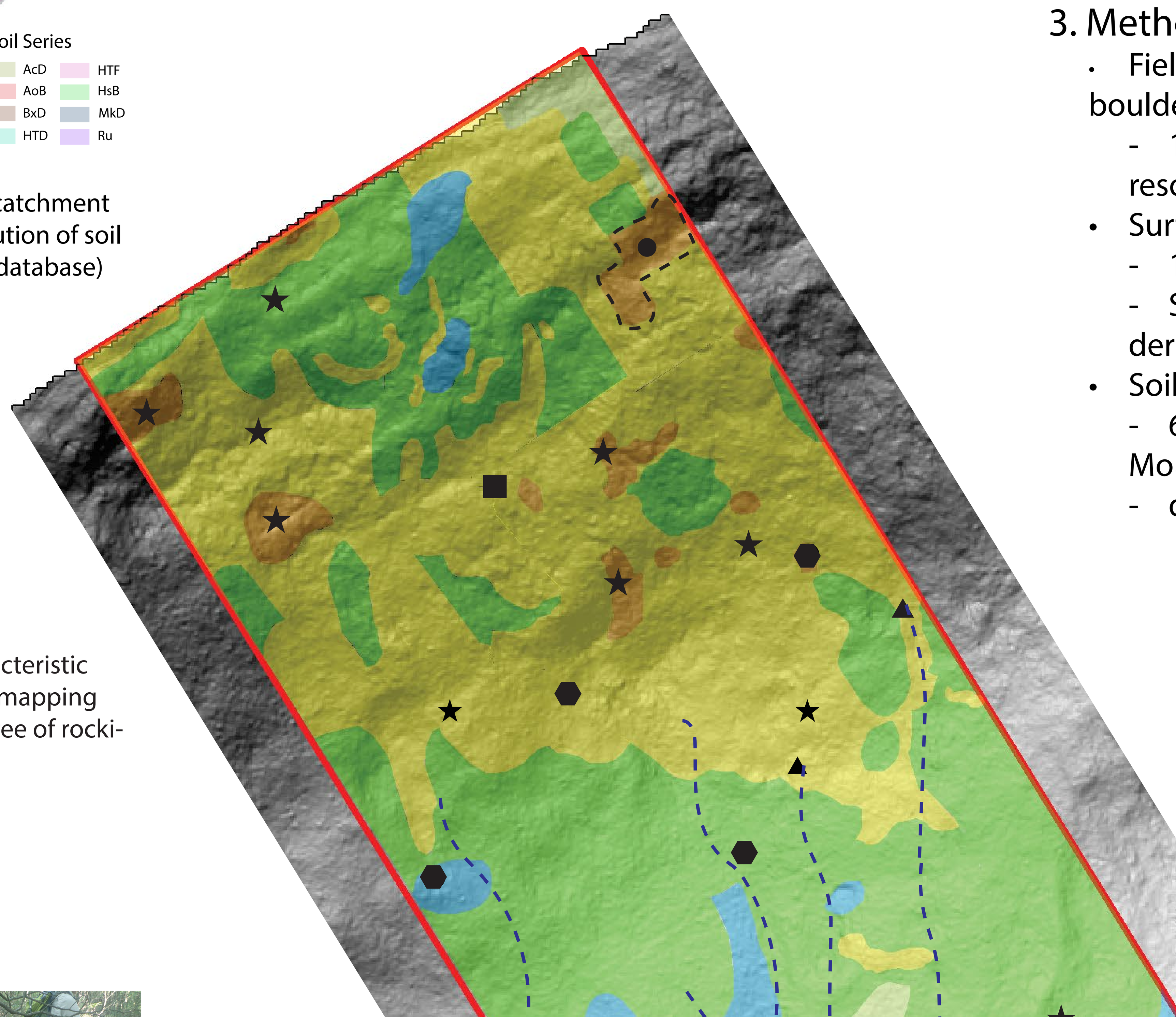
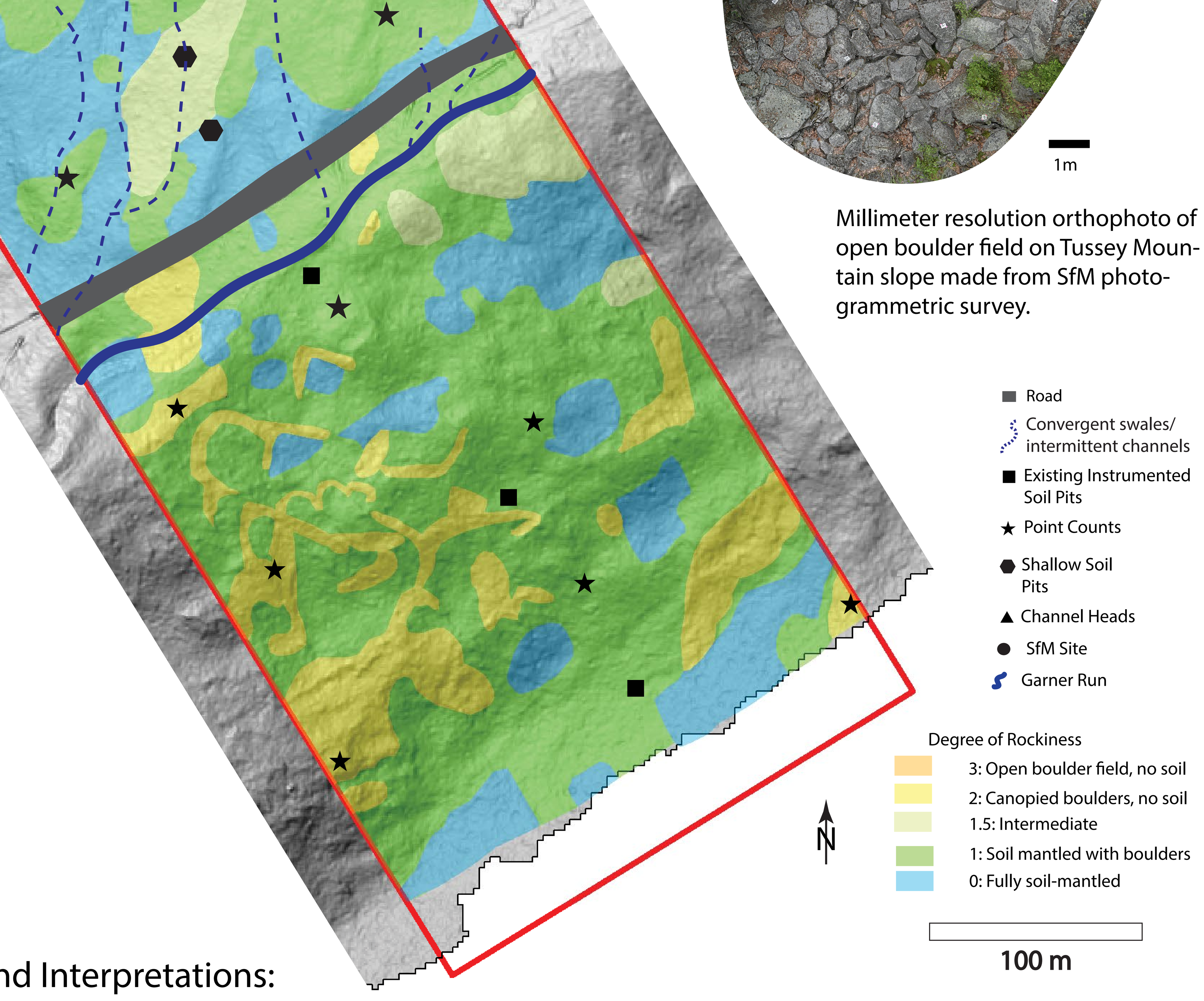
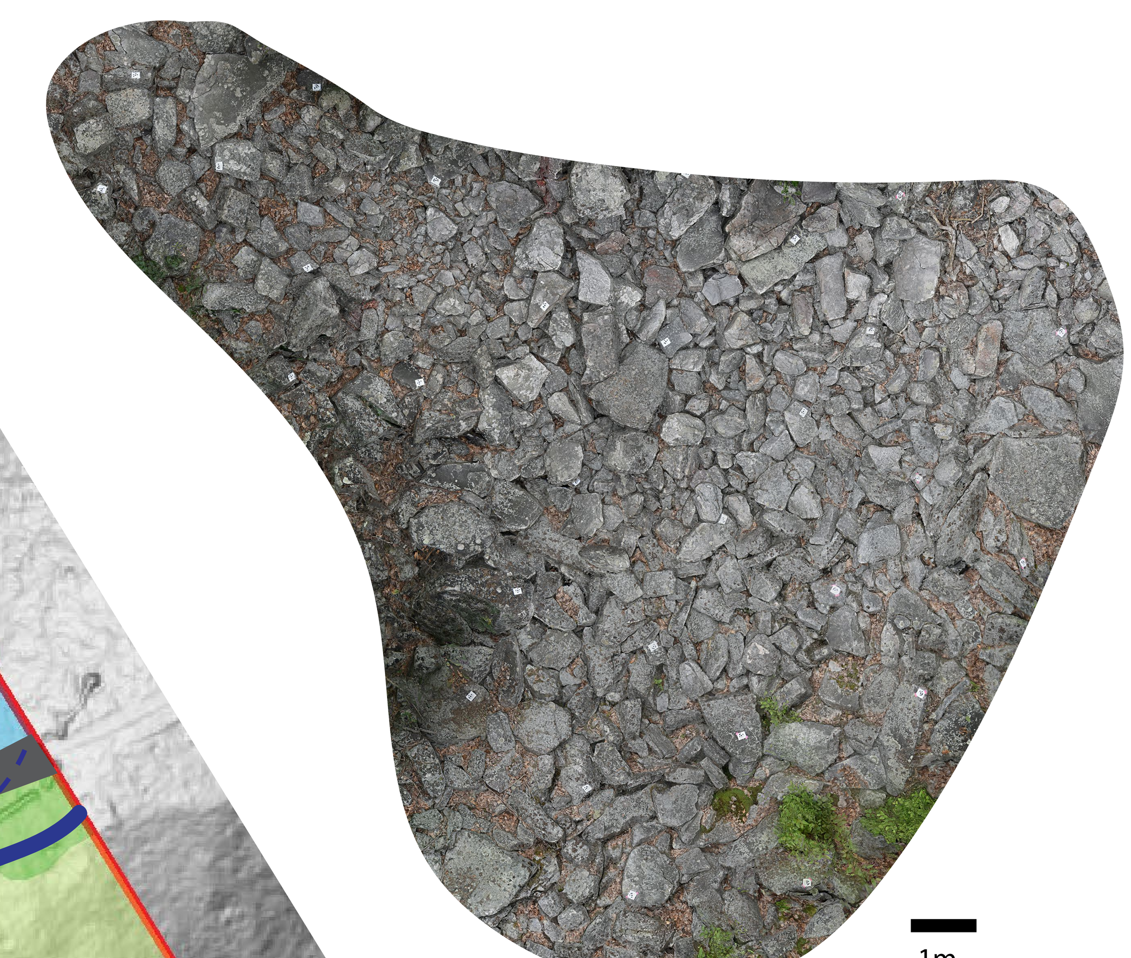


Figure 3: Plot of average slopes for each surface class. Circles are plotted at the average value and whiskers extend to +/- 1 standard deviation.

3. Methods and Approach:

- Field mapping of surface features: spatial distribution of boulder fields, variations in ground cover
  - 11 days total (300 m x 1000 m area, mapped at 10 m resolution)
- Surface clast grain size measurement
  - 19 point counts (n = 100 for each) across mapping area
  - Structure from motion photogrammetry survey of boulder field to characterize surface roughness
- Soil descriptions
  - 6 shallow pits dug (average depth of 30 cm) in Tussey Mountain slope
  - described depth, color, and texture of horizons



Millimeter resolution orthophoto of open boulder field on Tussey Mountain slope made from SfM photogrammetric survey.

4. Results and Interpretations:

- Surface rockiness and grain size decrease downslope which could be a function of downslope being less steep and therefore unable to facilitate the transport of largeer clasts. Statistical breakdowns suggest a decrease in rockiness coinciding with a decrease in slope on both hillslopes.
- Strong asymmetry in degree of rockiness between Tussey Mountain and Leading Ridge suggests an aspect related relationship in landscape development. Aspect differences would cause Tussey to experience greater freeze-thaw cycles and enable more extensive solifluction to occur as compared to Leading Ridge.
- Clay content is higher in the low-sloping bench at the foot of Tussey Mountain possibly suggesting a difference in underlying parent material (sandstone vs shale). Further investigation into clay contents via deeper pits and hydrometer work would be beneficial in getting more precise clay content percentages.

References:

Brantley, S. L., DiBiase, R., Russo, T., Shi, Y., Lin, H., Davis, K. J., Kaye, M., Hill, L., Kaye, J., Neal, A. L., Eissenstat, D., Hoagland, B., Dere, A., (2015): Designing a suite of measurements to understand the critical zone. Earth Surface Dynamics (submitted).

Acknowledgements::

This project would not have been possible without financial support from NSF EAR 1263212. This project also was aided tremendously with the help of Brandon Forsythe and Dave Pederson in soil pit digging. Thank you.