Forests on the Move: Tracking Climate Related Changes of Treelines in Montane Systems of the Northeast

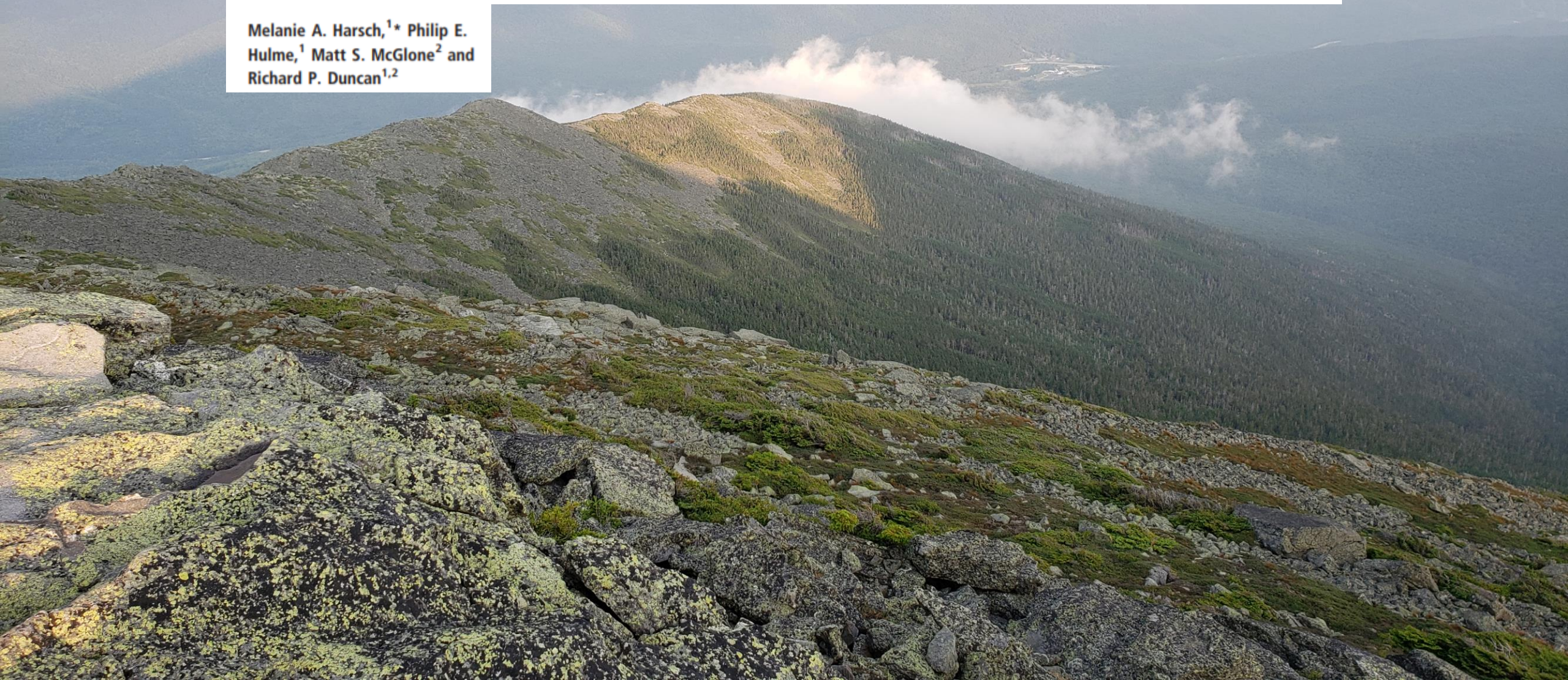
Jordon Tourville (SUNY-ESF – jtourvil@syr.edu)
Martin Dovciak (SUNY-ESF)
David Publicover (AMC)
Sarah Nelson (AMC)

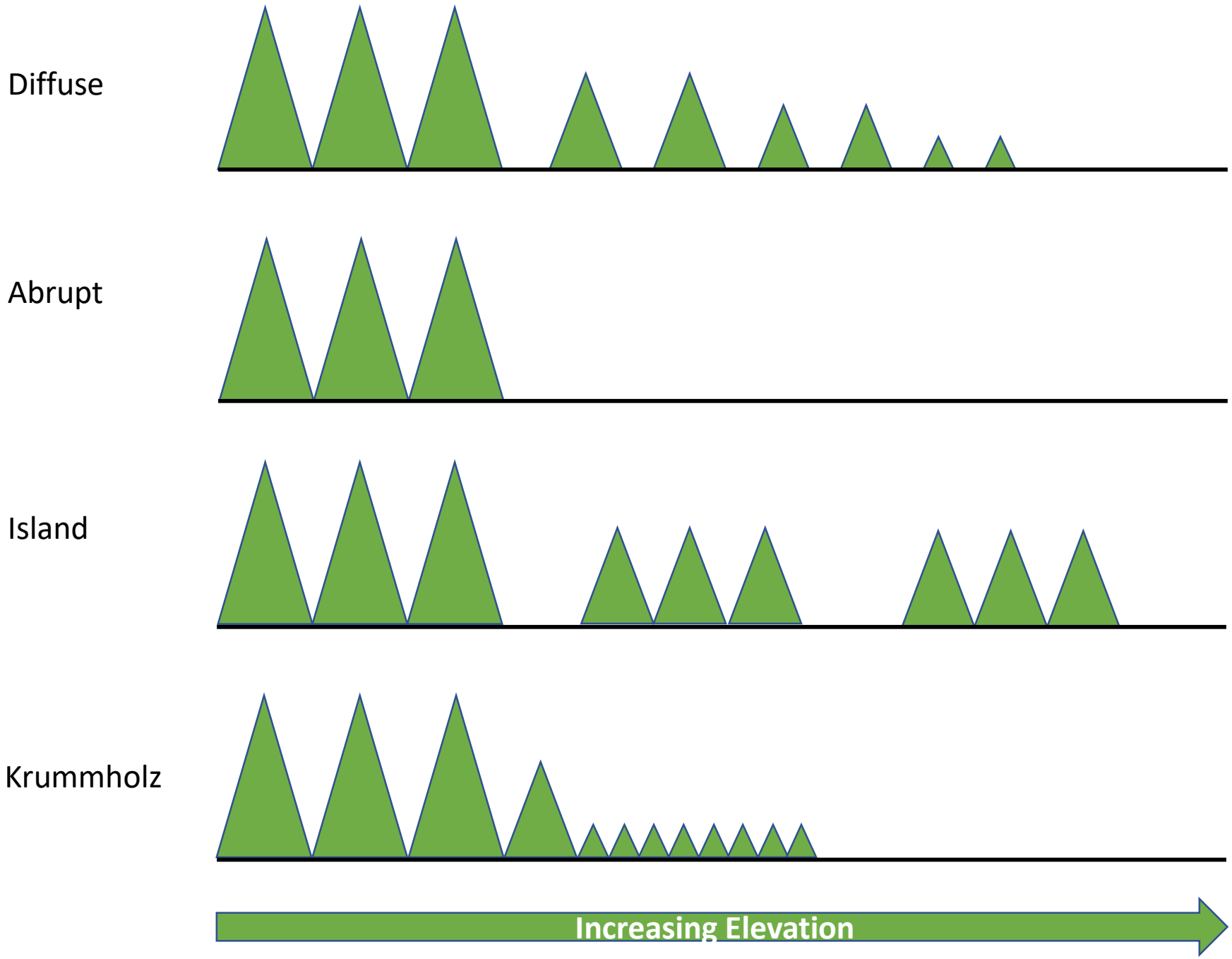
Ecology Letters, (2009) **12**: 1040–1049 doi: 10.1111/j.1461-0248.2009.01355.x

LETTER

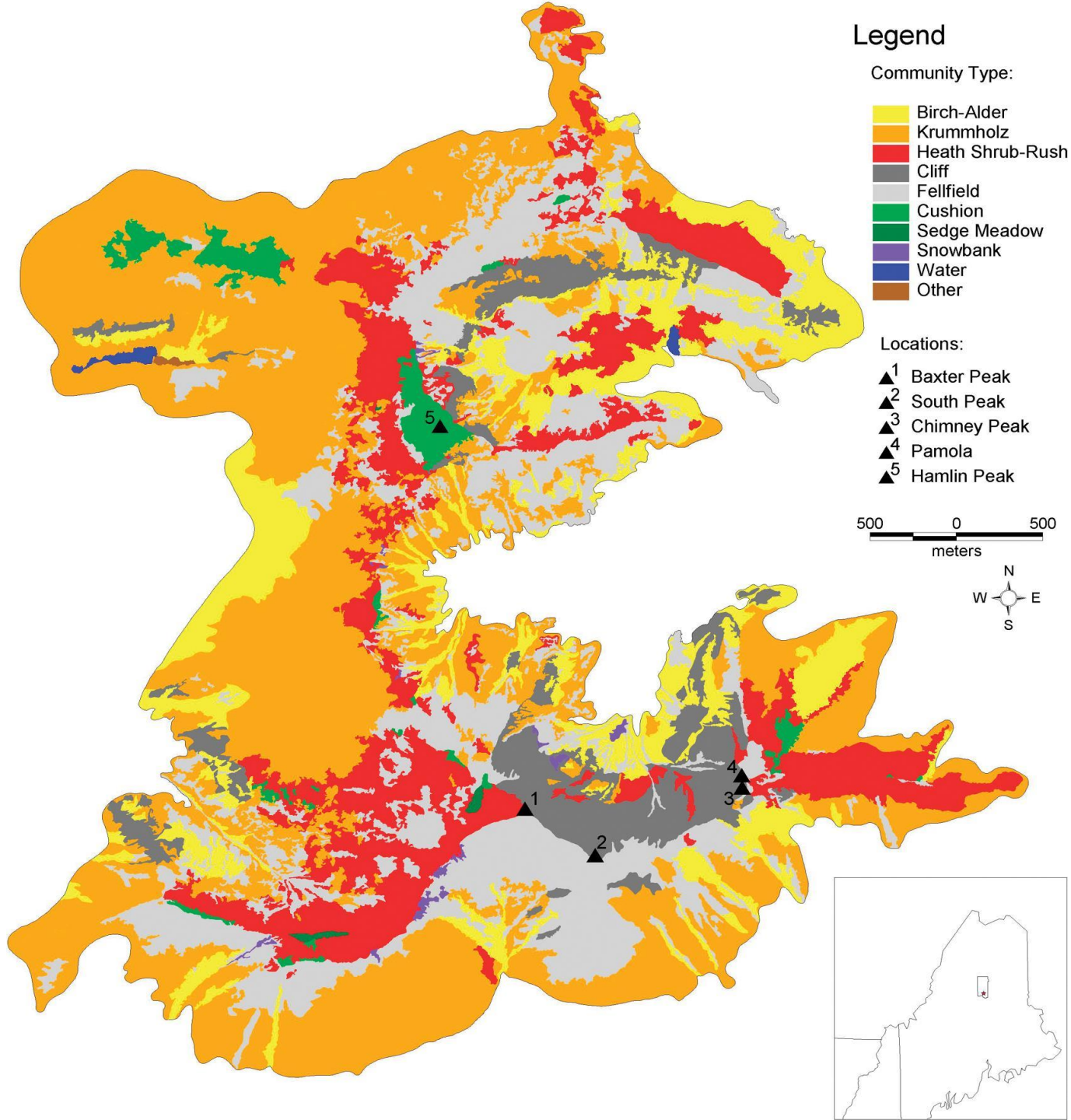
Are treelines advancing? A global meta-analysis of treeline response to climate warming

Melanie A. Harsch,[1]* Philip E. Hulme,[1] Matt S. McGlone[2] and Richard P. Duncan[1,2]




Diffuse
Abrupt
Island
Krummholz
Increasing Elevation

BE OUTDOORS
APPALACHIAN MTN CLUB



Current (well educated) Assumptions

- Treeline locations are sensitive to changes in climate
- Changes in climate can be modulated by topography

Goals

G1 - Quantify changes in treeline position on alpine peaks of the northeast over the last several decades

G2 - Assess demographic structure of tree species at treeline

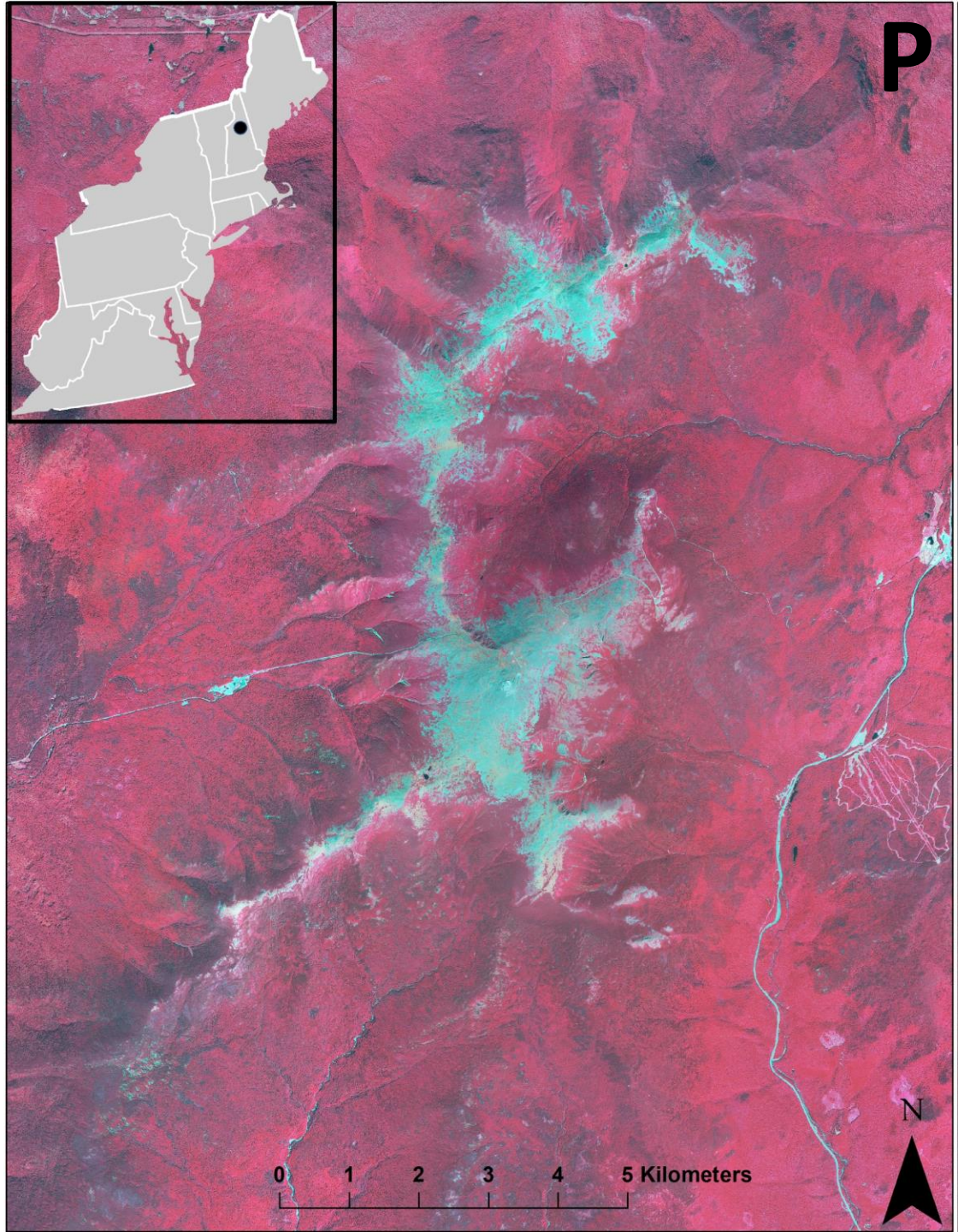
G3 - Determine variables that can explain potential changes in treeline position

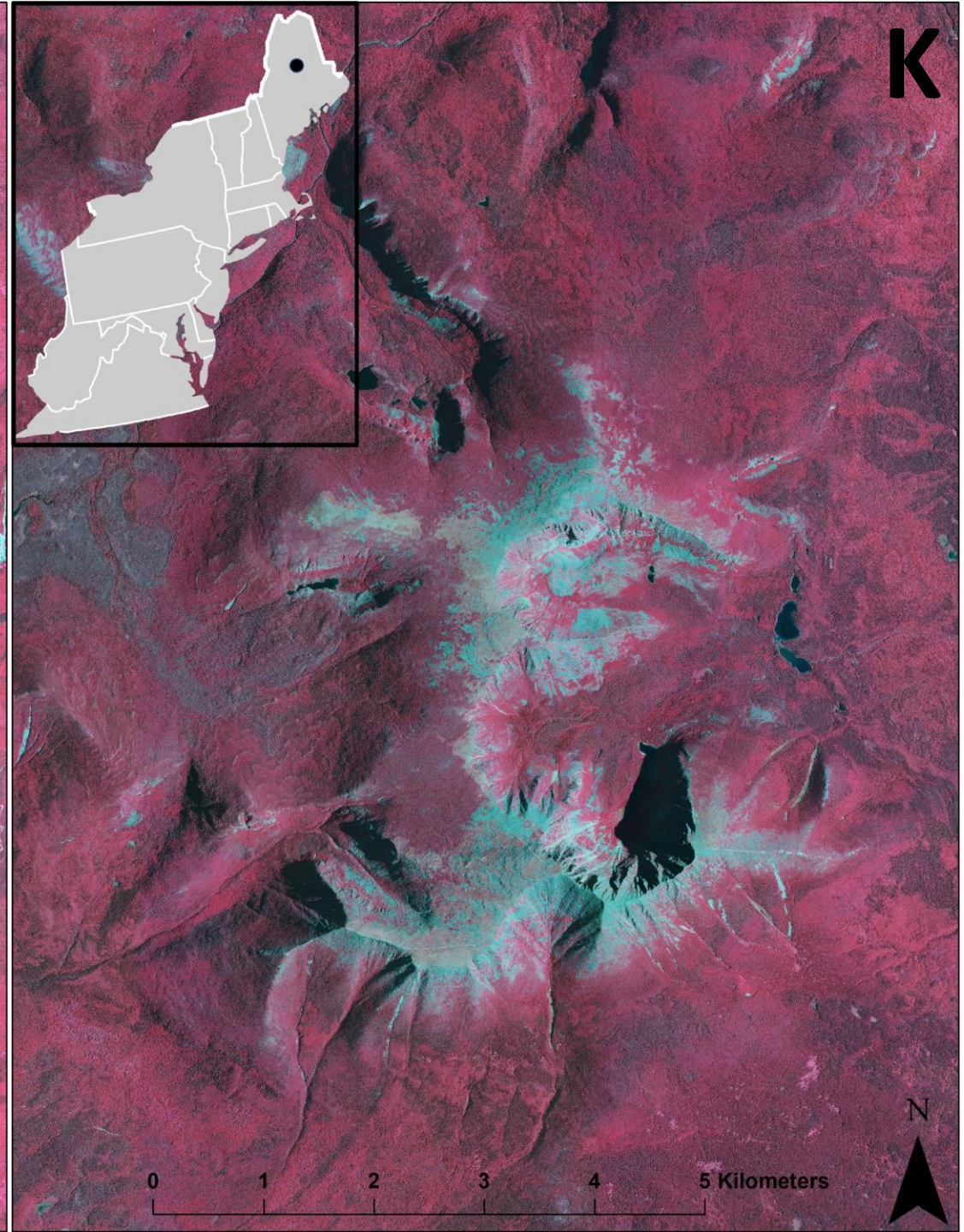
Hypotheses

H1 - Treelines in the Presidentials and Katahdin have shifted upslope over recent decades

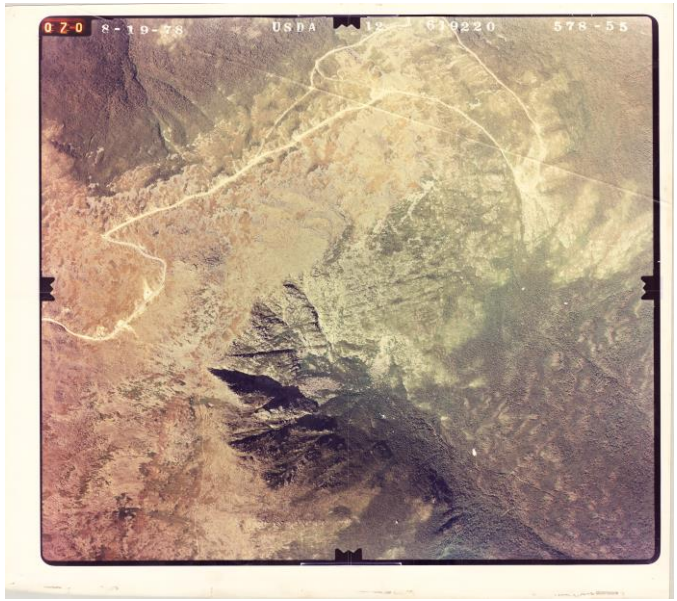
H2 - Diffuse treeline form is more sensitive to change (greater altitudinal shifts)

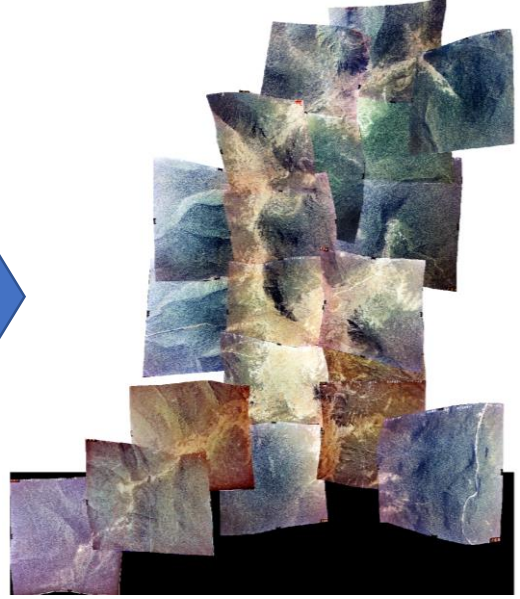
H3 - Significant variation in treeline change can be explained by measured climatic and topographical variables (temperature, slope, aspect, etc.)

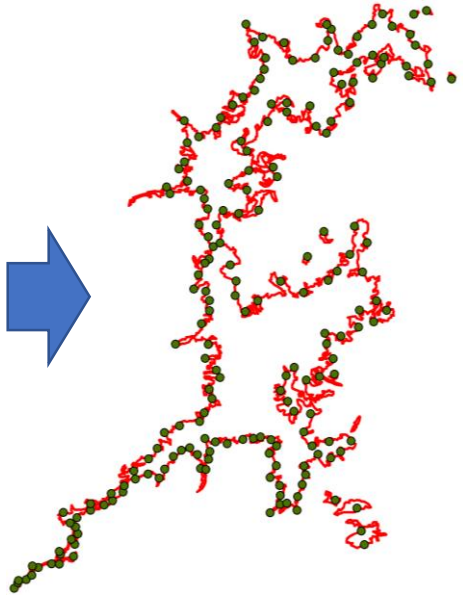

P
0 1 2 3 4 5 Kilometers
N

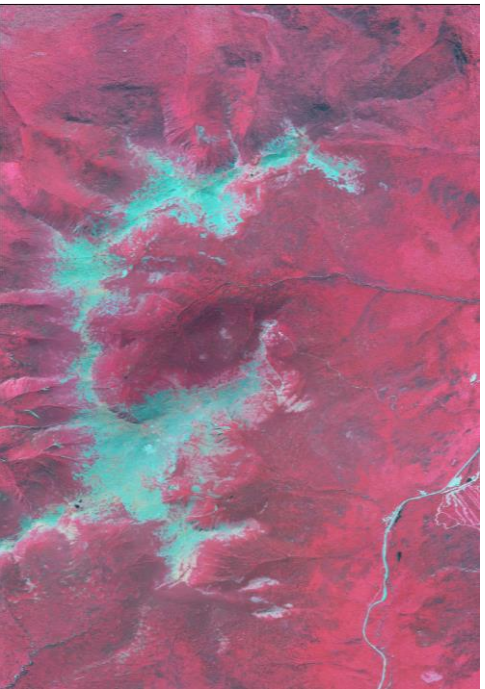

K
0 1 2 3 4 5 Kilometers
N

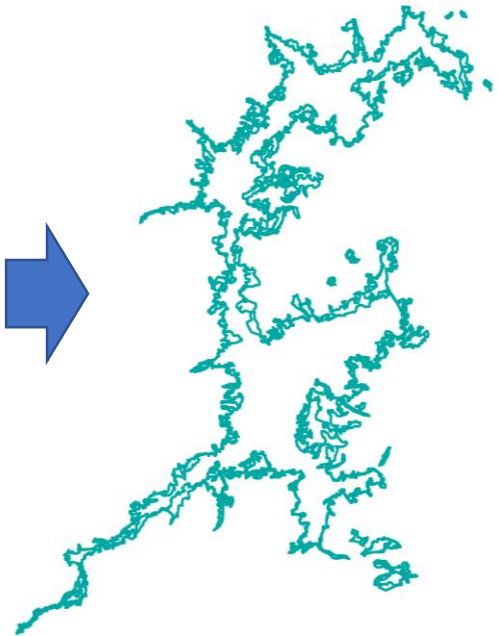
H1 – Treeline Advance

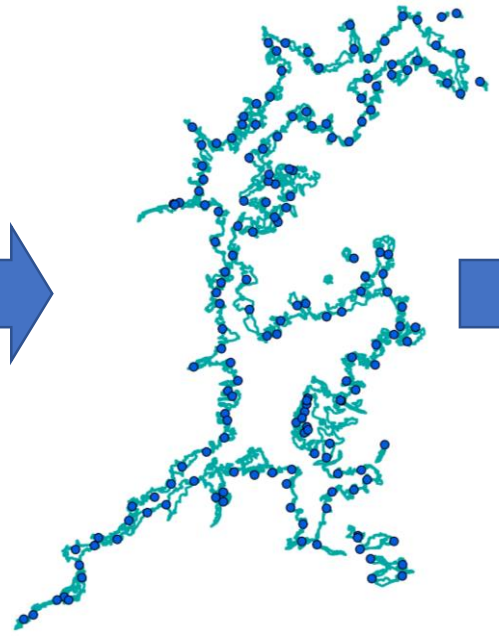


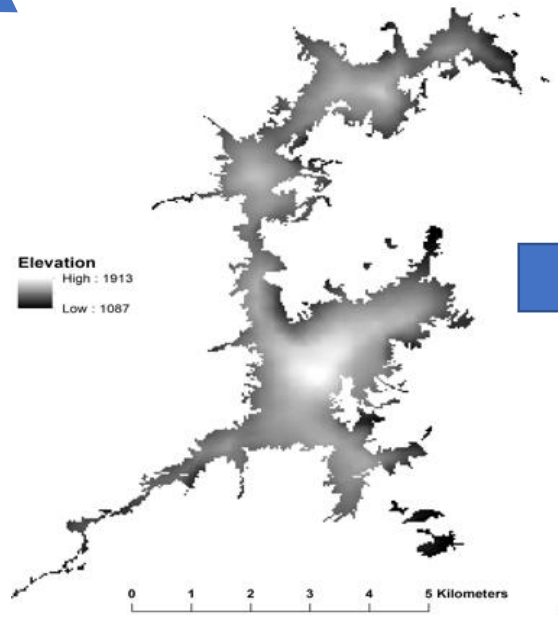












Δ Treeline Position

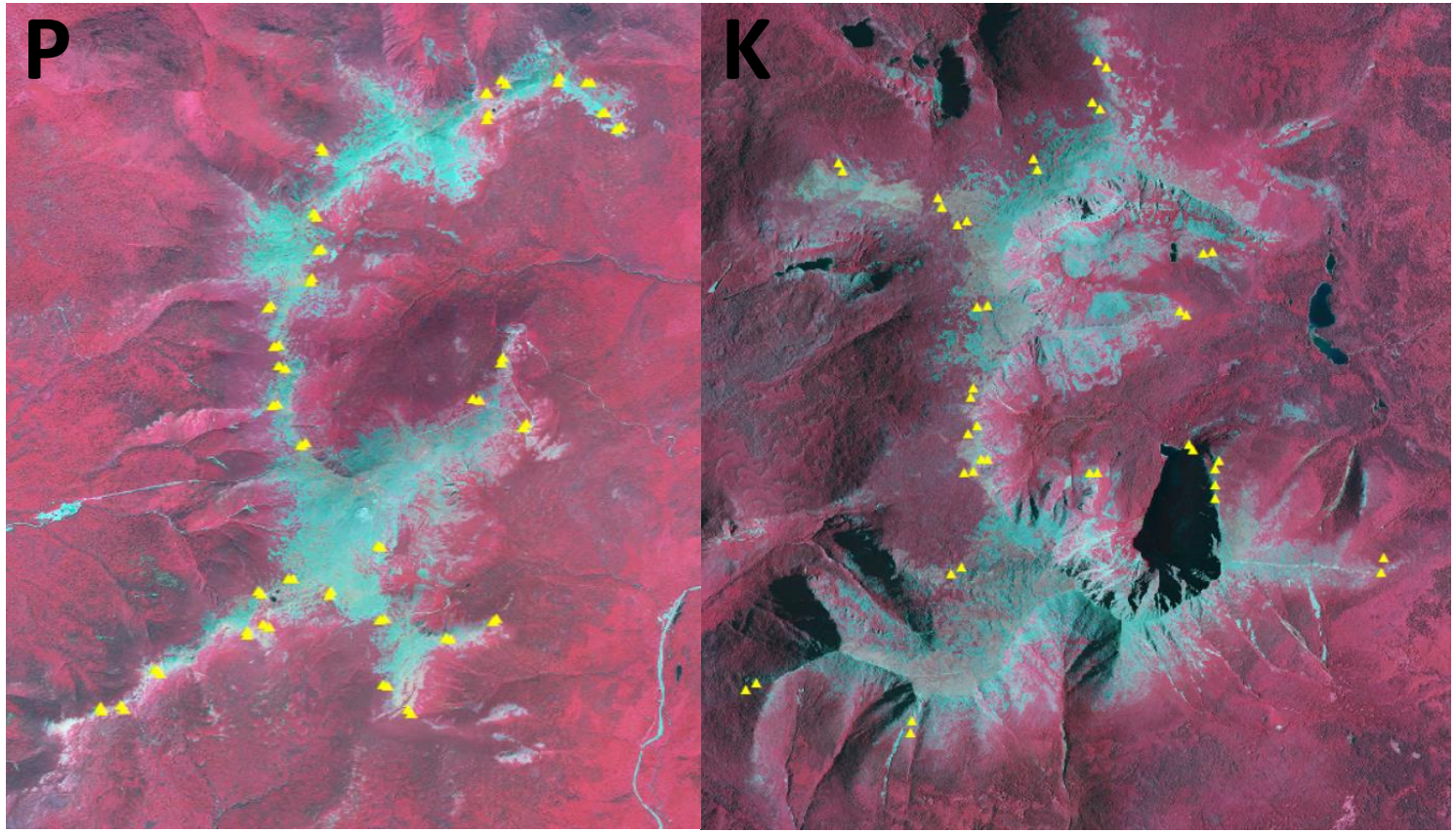
H2 – Treeline Form

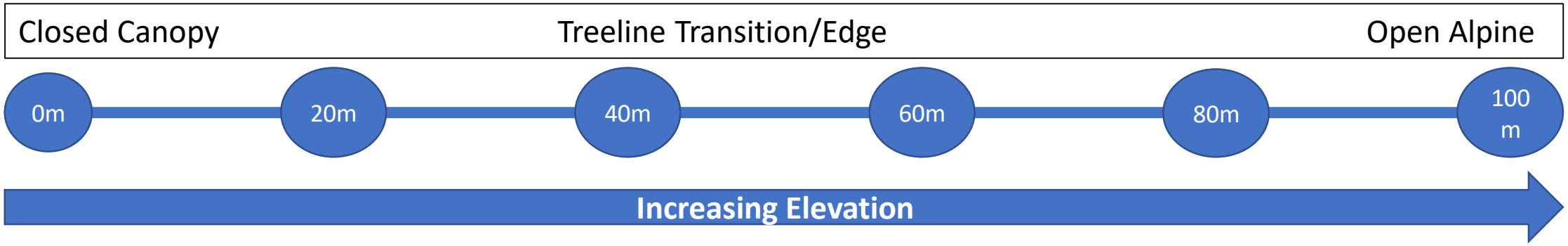
Full belt transect – all intersecting trees

- **Species ID**
- **Basal diameter (3 classes)**
- **Height (3 classes)**
- **Treeline form**

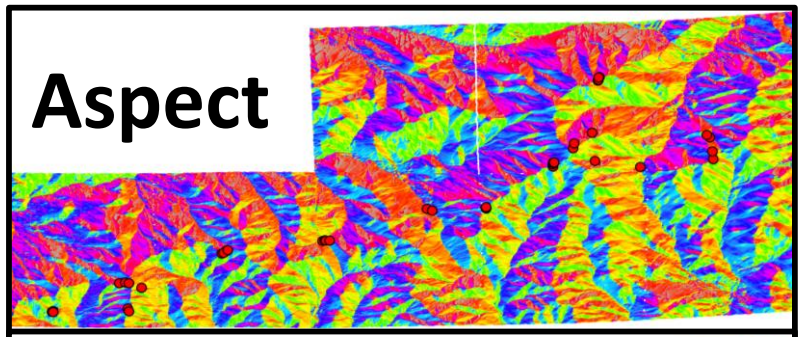
At 20m intervals

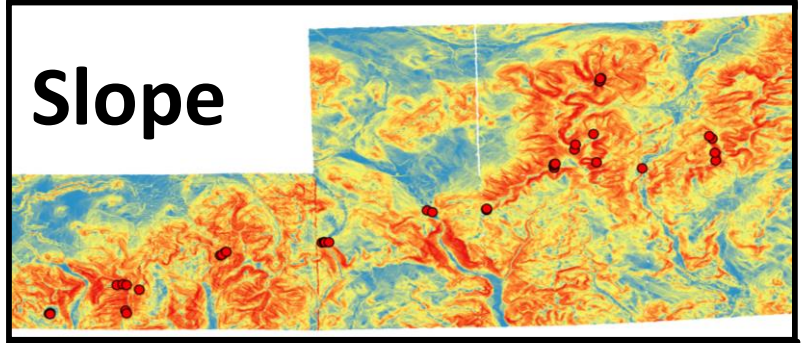
- **GPS point**
- **Slope**
- **Aspect**
- **Elevation**
- **Soil depth to bedrock**

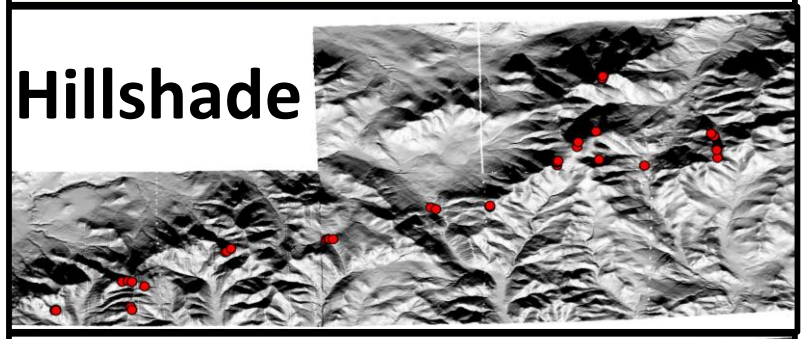


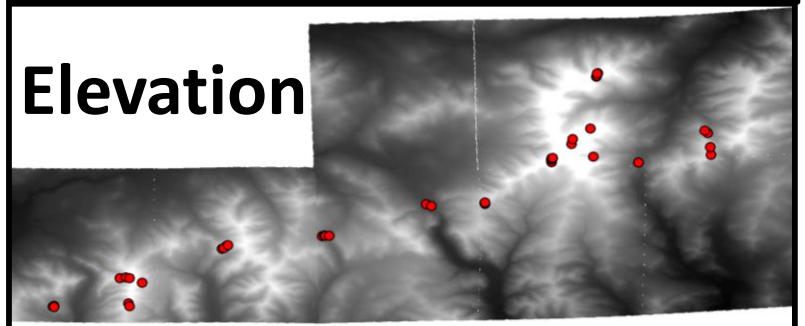


H3 – Treeline Drivers

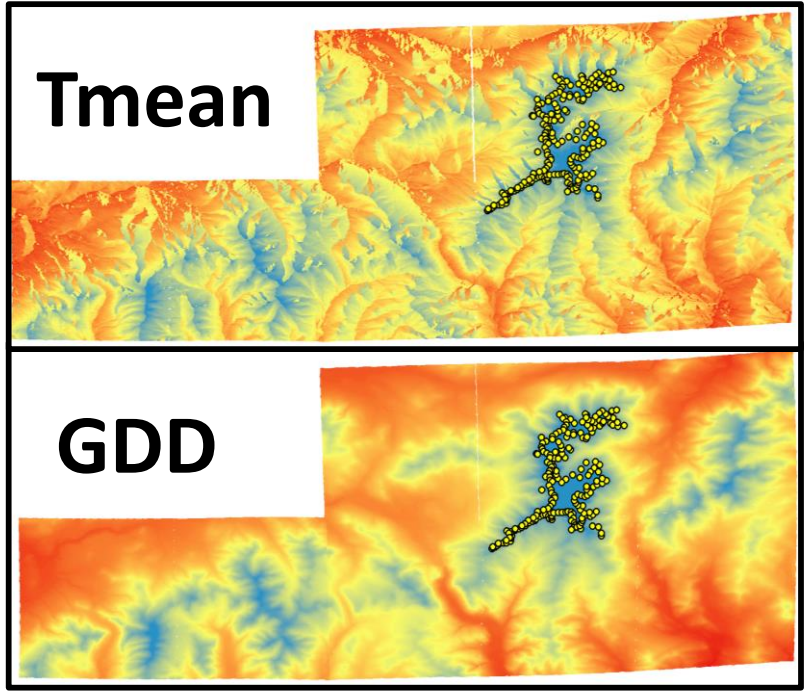




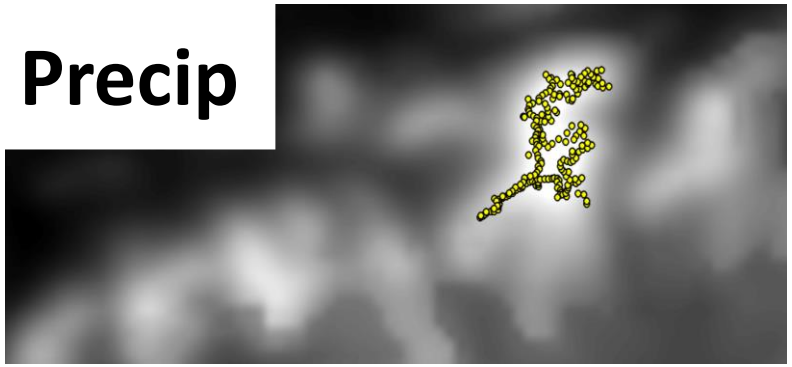




HOBO Values



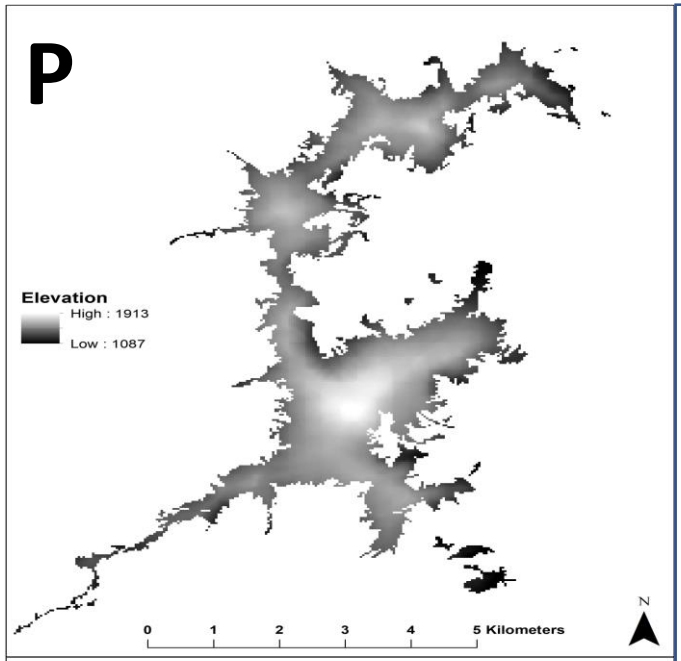
Presidentials Only!

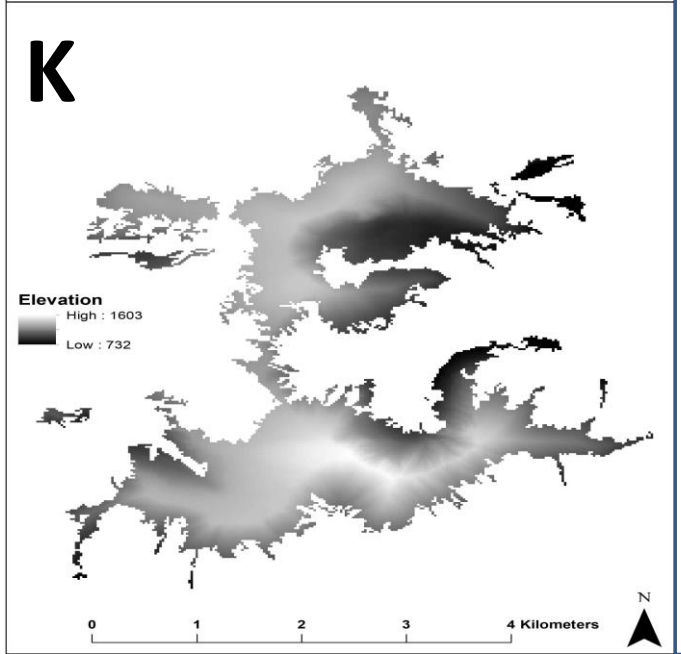


elevation_change ~ Aspect + Slope + Hillshade + GDD + Tmean + Precip

Results

H1 – Treeline Advance

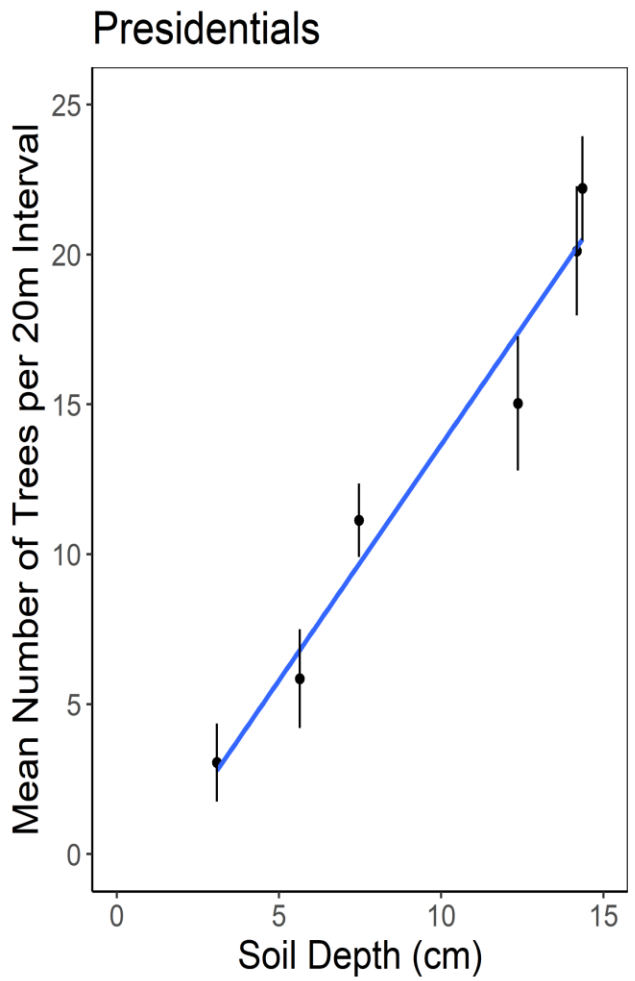


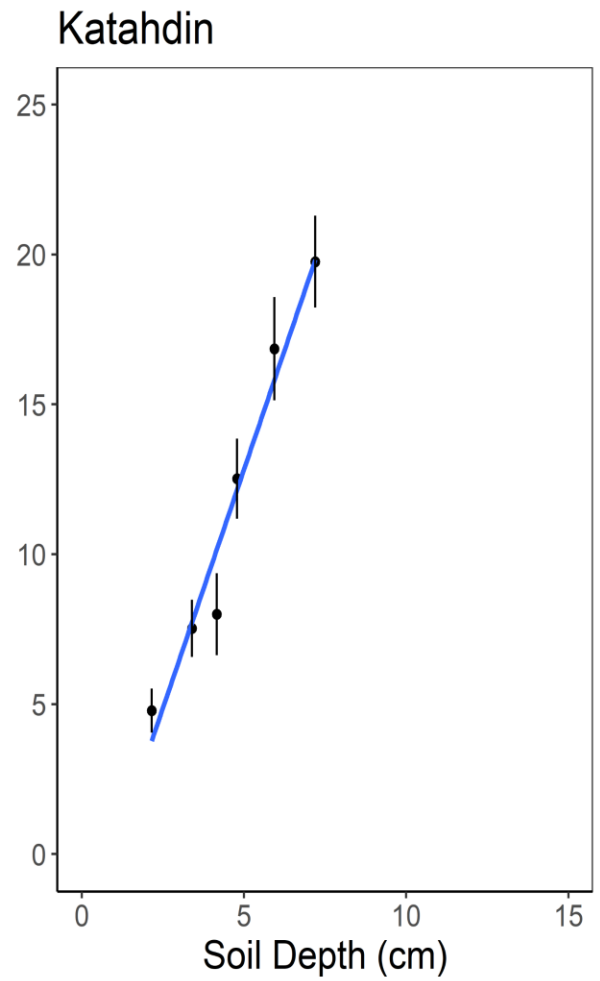


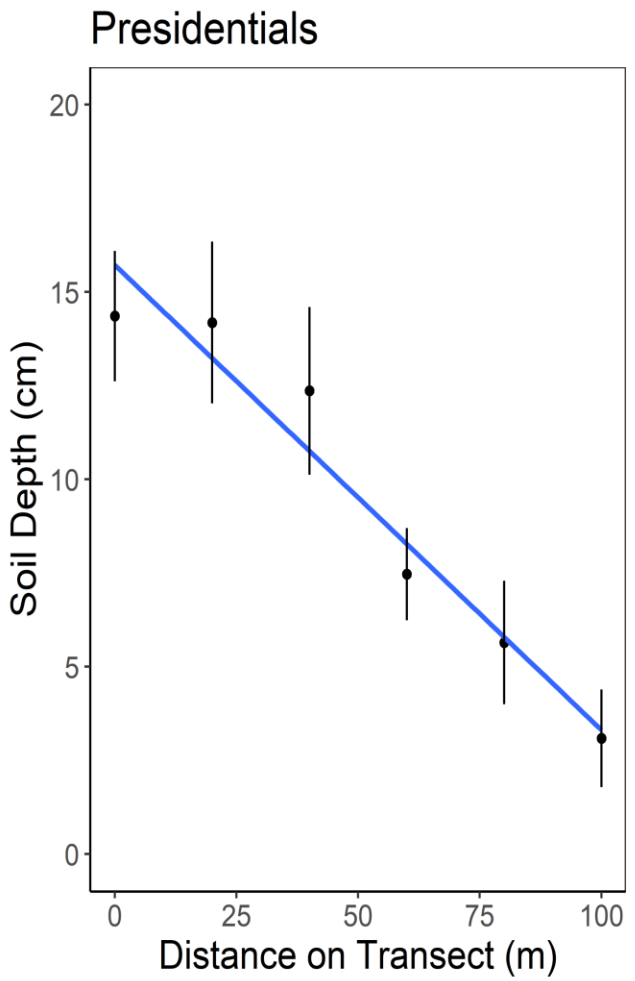
H1 – Treeline Advance

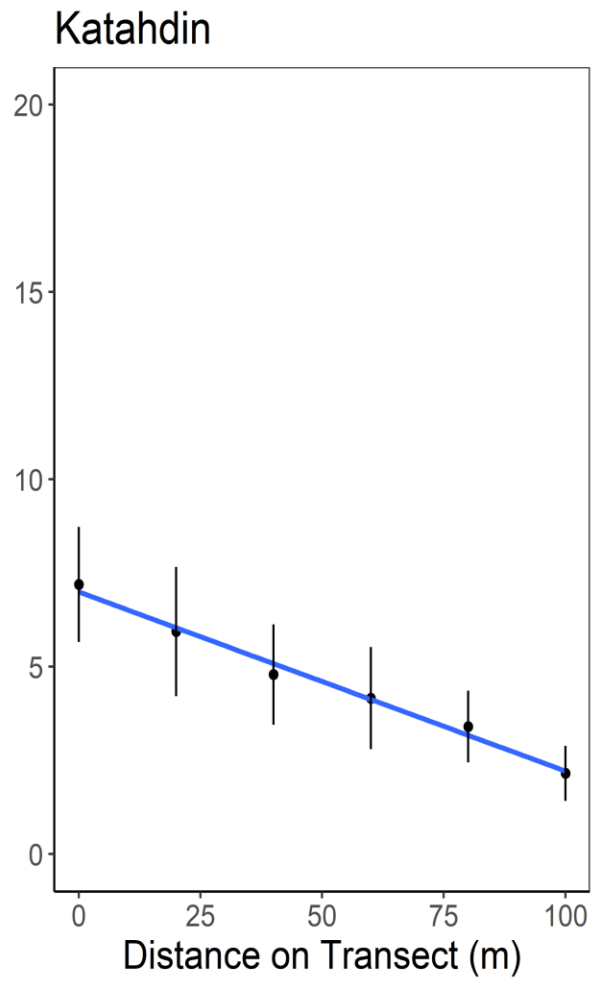
	Presidentials	Katahdin
Mean Treeline Elevation Shift (m)	11.77±1.67	8.39±1.12
Mean Treeline Shift Rate (m/year)	0.29	0.30
Area Above Treeline Change (%)	-4.13	-0.79

H2 – Treeline Form

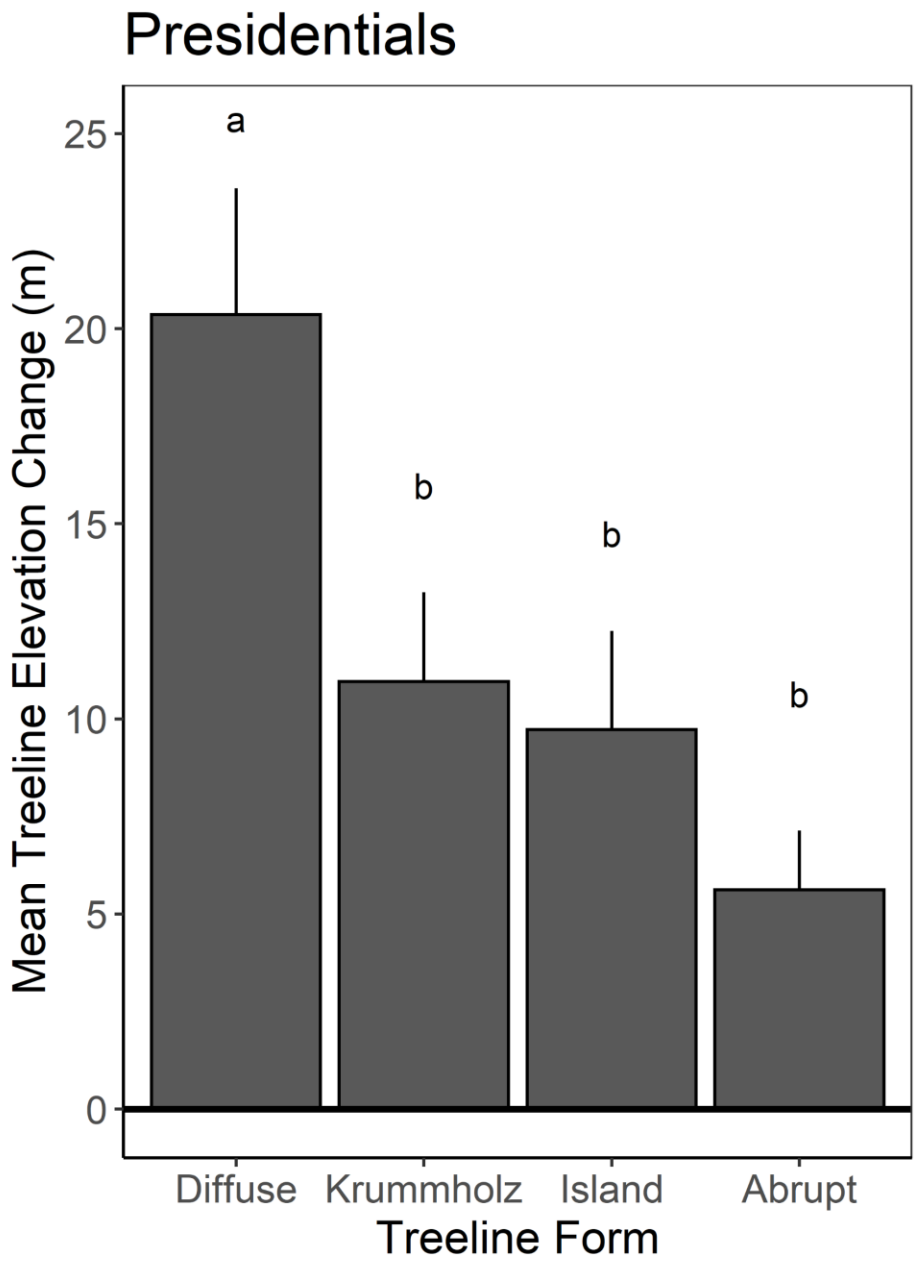


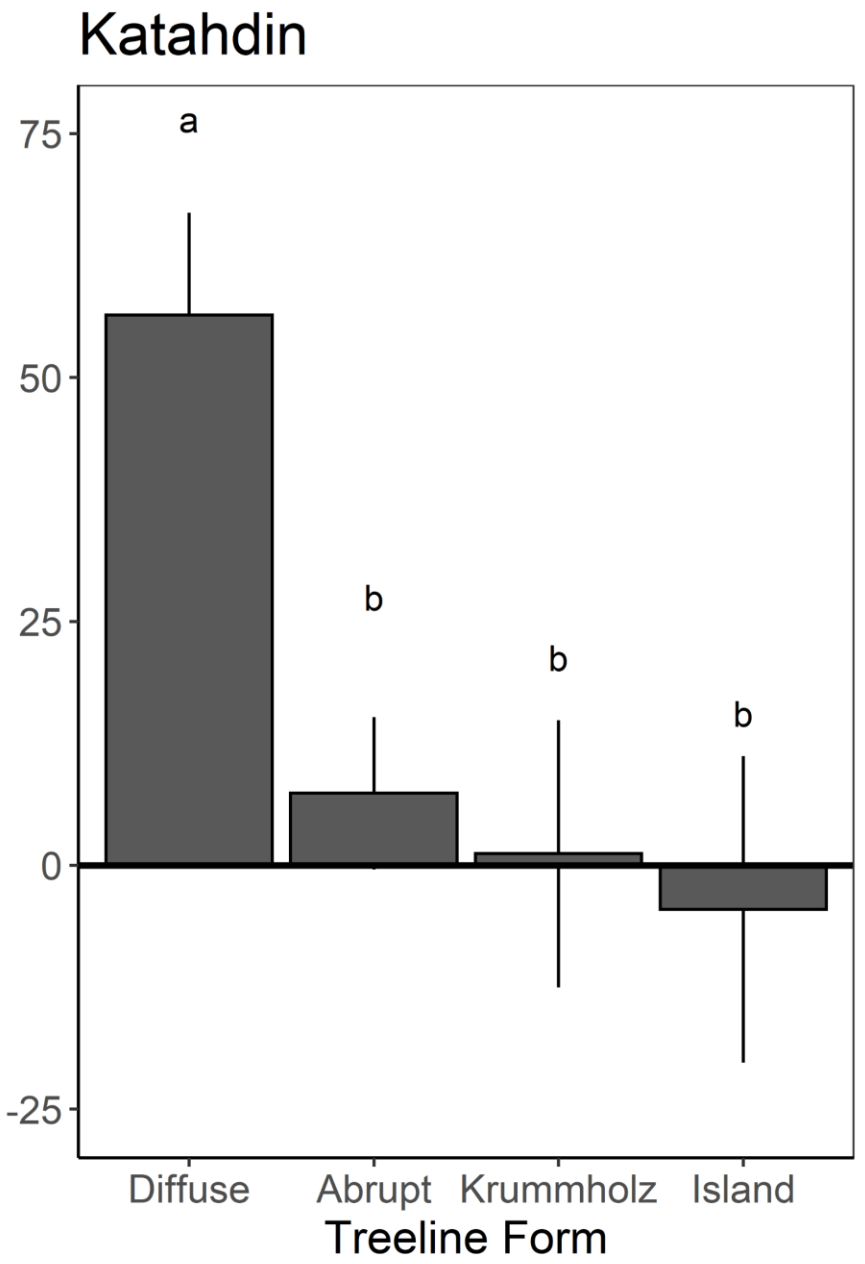




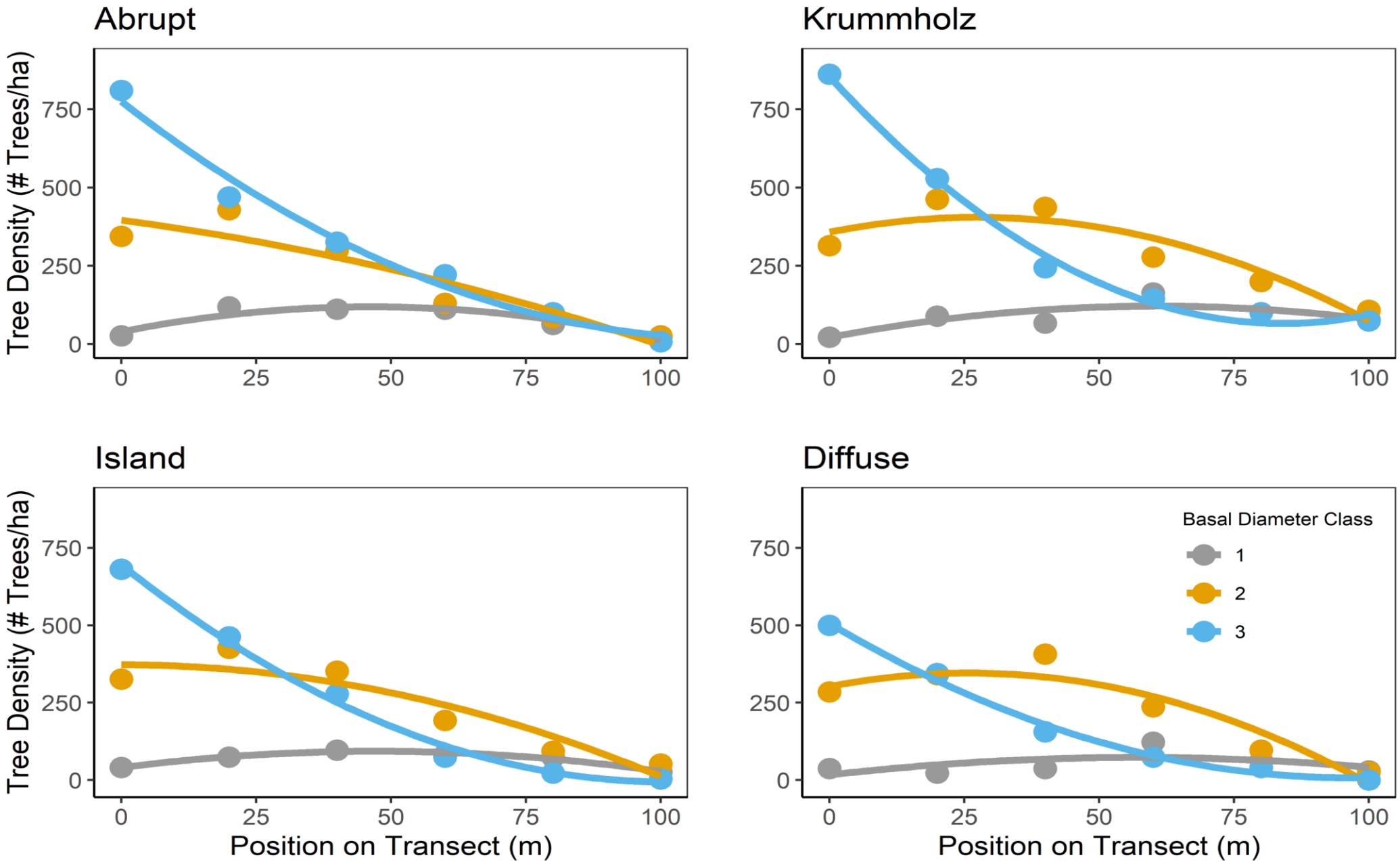


H2 – Treeline Form

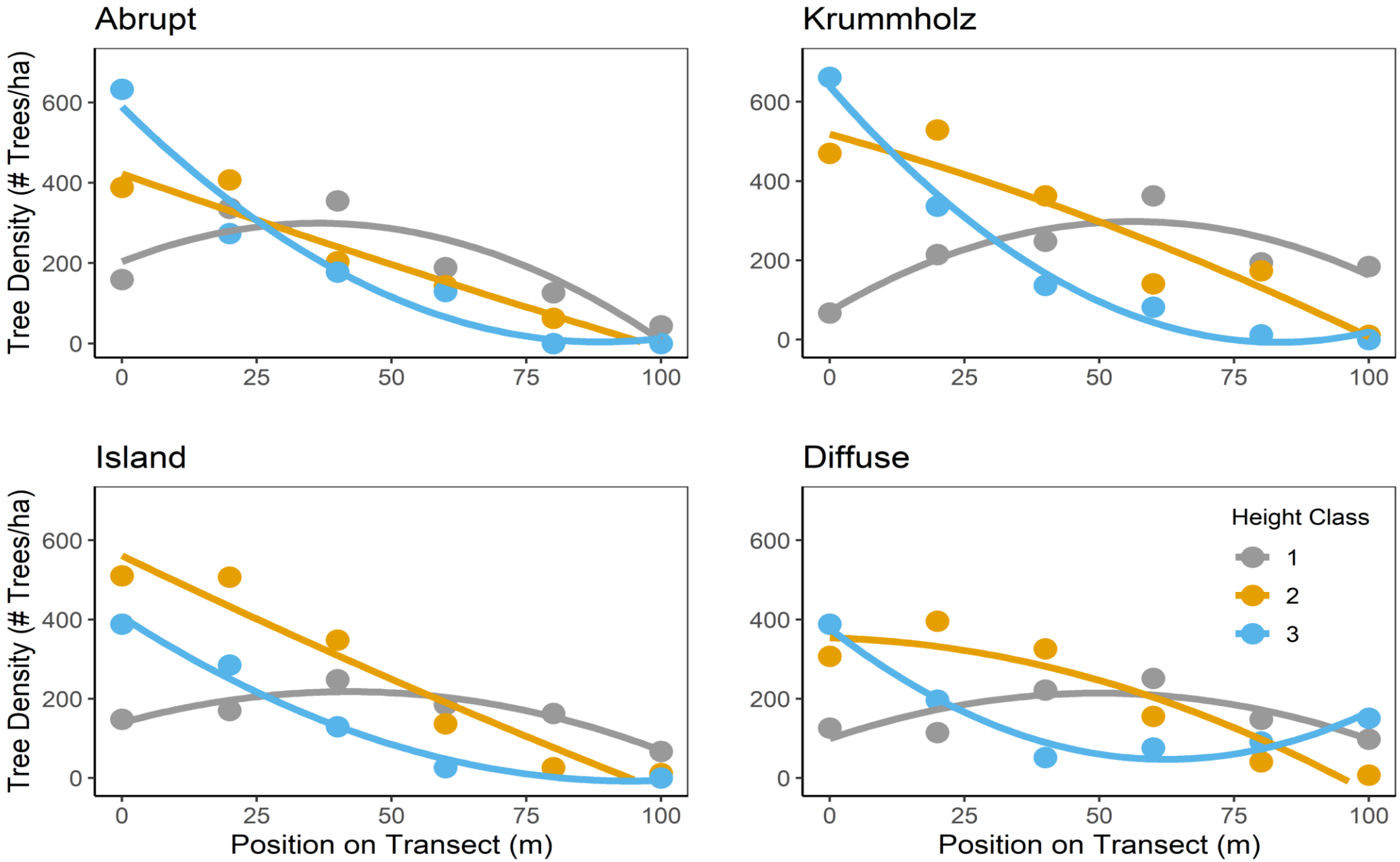




H2 – Treeline Form



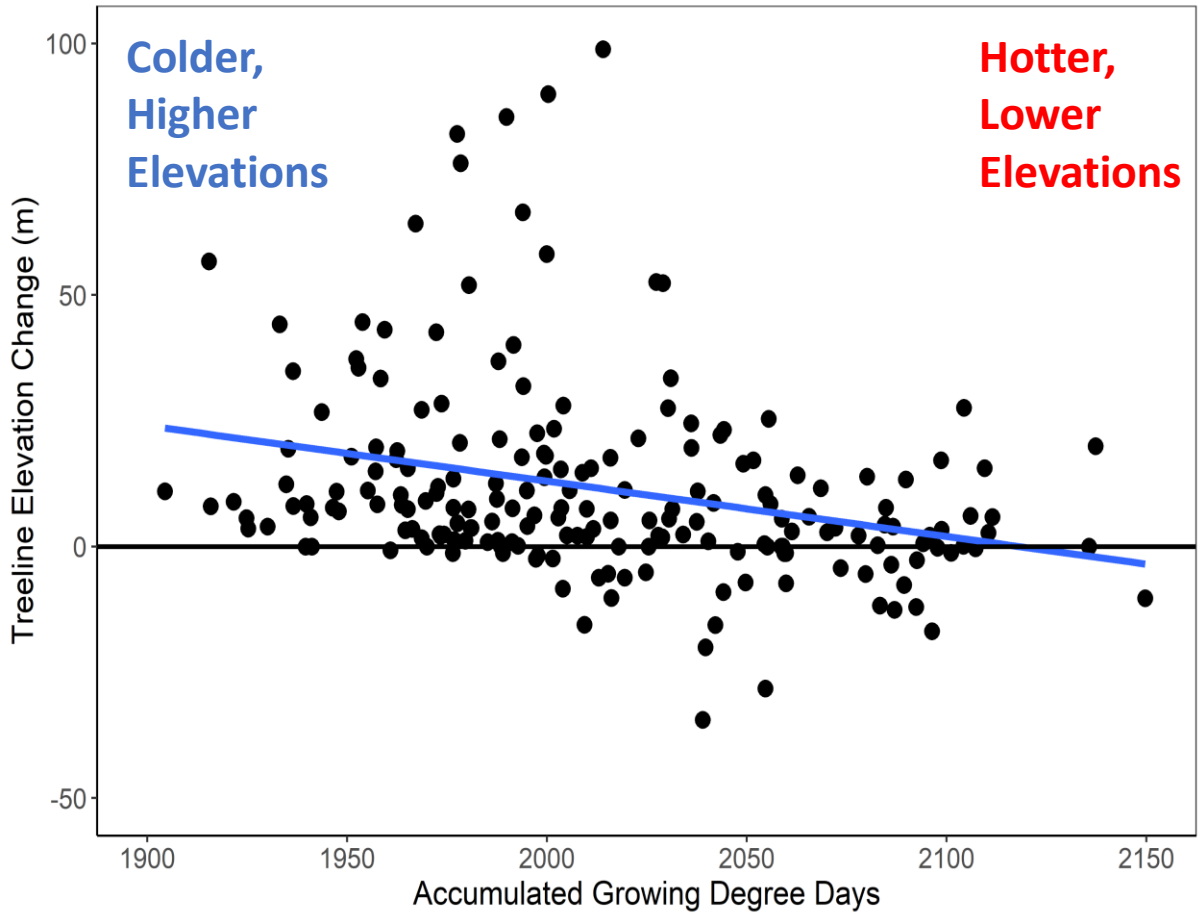
H2 – Treeline Form

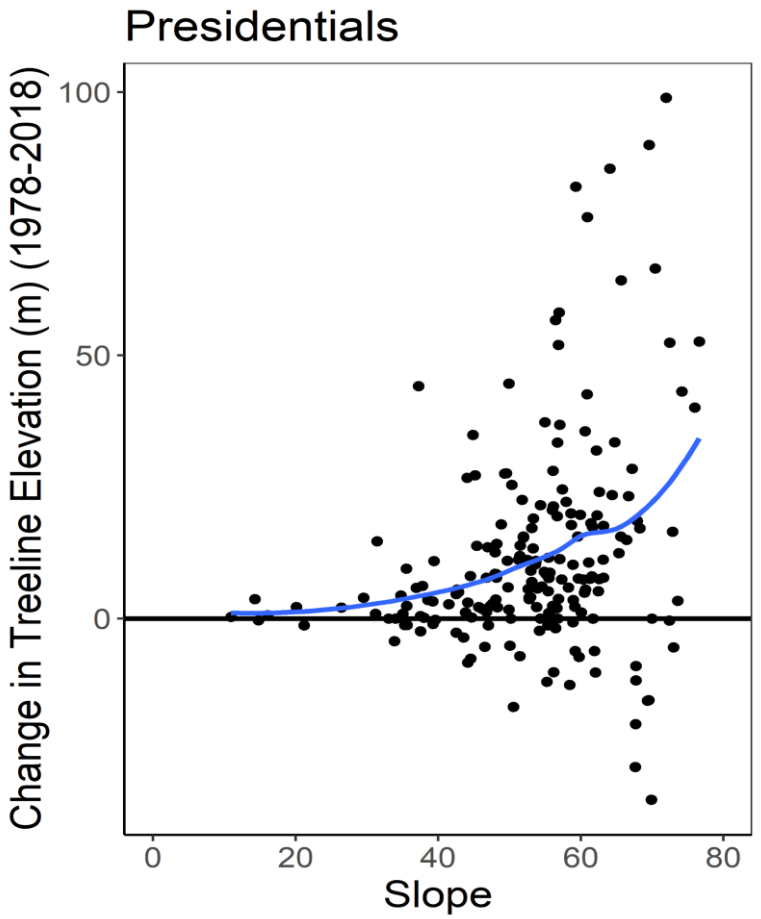


H3 – Treeline Drivers

elevation_change ~ Aspect + Hillshade + Tmean + Precip + Slope + GDD $R^2 = 0.15$

Slope (+)
GDD (-)





Conclusions

- **H1** - Supported, significant upslope advance of treelines
- **H2** - Supported, greater upslope shifts of diffuse treelines
  - Important role of soil depth
  - Demographic structure can predict treeline form
- **H3** - Supported, GDD (climate) and slope (topography) explain significant (although small) amount of variation in treeline change
  - Rate of change of climate variable could refine our ability to detect and quantify treeline advance

Acknowledgements

- People
  - Dr. Martin Dovciak
  - Dr. Jay Wason
  - The Dovciak Lab
  - EB Faculty and Grad Students
  - Eben Sypitkowski
  - Georgia Murray
  - Patrick Lynch
- Agencies
  - Appalachian Mountain Club (AMC)
  - SUNY-ESF
  - USFS
  - Baxter State Park
- Funding
  - Sussman Foundation
  - NSF
  - NY Flora Association
  - Botanical Society of America