Effects of elevation and heat load on the landscape-scale distribution of male and female trees in aspen (Populus tremuloides)

- Robert Bidner
Quaking Aspen (*Populus tremuloides*) – Flowers, Twig, and Seeds
Aspen on the Landscape

- Vegetative reproduction from root suckers\textsuperscript{1,2}
- Stand replacing disturbance\textsuperscript{3,4}
Aspen Decline and Future Range

- Grazing/browsing pressure$^{5,6}$
- Fire suppression$^7$
- Climate change related drought$^{8,9}$

Photo Credit – Rocky Mountain Research Station (Ft. Collins, CO)
Aspen Distribution Literature

- Described at local scale$^{10,11,12}$
- Genetic and geographic history$^{13,14}$
- Focus on large mortality events$^{15,16}$

Photo Credit – Rick Wicker
Aspen Sex Distribution – Grant/Mitton (1979)

- Male/Female spatial segregation by elevation
- Individual sex recorded in the field

<table>
<thead>
<tr>
<th>Elevation Range</th>
<th>Percent Female, Number of Sample Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,700 – 2,450m</td>
<td>56%, (52)</td>
</tr>
<tr>
<td>2,450 – 2,900m</td>
<td>46%, (94)</td>
</tr>
<tr>
<td>2,900 – 3,100m</td>
<td>36%, (52)</td>
</tr>
</tbody>
</table>

Data Credit – Grant and Mitton 1979
Research Question:

Do aspen sex ratios change with elevation and heat load index?
Hypothesis:

The overall sex ratio of aspen genets on the landscape will be male-biased, both at higher elevations and at sites with a greater heat load index.
Site Location and Field Collection

- 32 total sites
- 21-50 samples per site (1452 total)
- Broad elevation gradient
- Wet/dry moisture categories
Lab Portion – Determining Sex

- Using genetic markers
- Clear and easily interpreted results
## Data + Methods

### Sample Name | Score_M1_F0 | Aspect | Slope | Latitude (°) | Longitude (°) | Elevation (m) |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>COM1601</td>
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<td>COM1605</td>
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<td>271.7466</td>
<td>21.68808</td>
<td>39.37843</td>
<td>-106.785</td>
<td>2508</td>
</tr>
</tbody>
</table>

- Aspect and slope extracted with **ArcMap 10.6.1**
- Heat load index calculated from radian aspect, slope, and latitude$^{18}$
Bayesian Model

• Binomial (Bernoulli) GLM

• Elevation, heatload, site, latitude, interaction term

• Uninformative priors
Model Analysis

- Iterations = 10000
- # Chains = 2
- Thin = 4
- Gelman Diagnostic
- Effective Size
• Nearly 2:1 Male ratio overall (923 M to 529 F)
• Model = No effect of elevation
Plotted Data and Analysis

- 1 Site with very low heat load values (ORS)
- Model = No interaction
Plotted Data and Analysis
Discussion

- Effect of elevation ×
- Effect of heat load ×
- Effect of Latitude ×
- Site Effect
- Interaction between elevation and heat load ×
Future Work

• Create a hierarchical model by site
• Analyze different interaction terms
• Look into heat load outlier site
Literature
