HIGH ARCTIC SUCCESSION & THE INFLUENCE OF TOPOGRAPHIC HETEROGENEITY

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INTRODUCTION

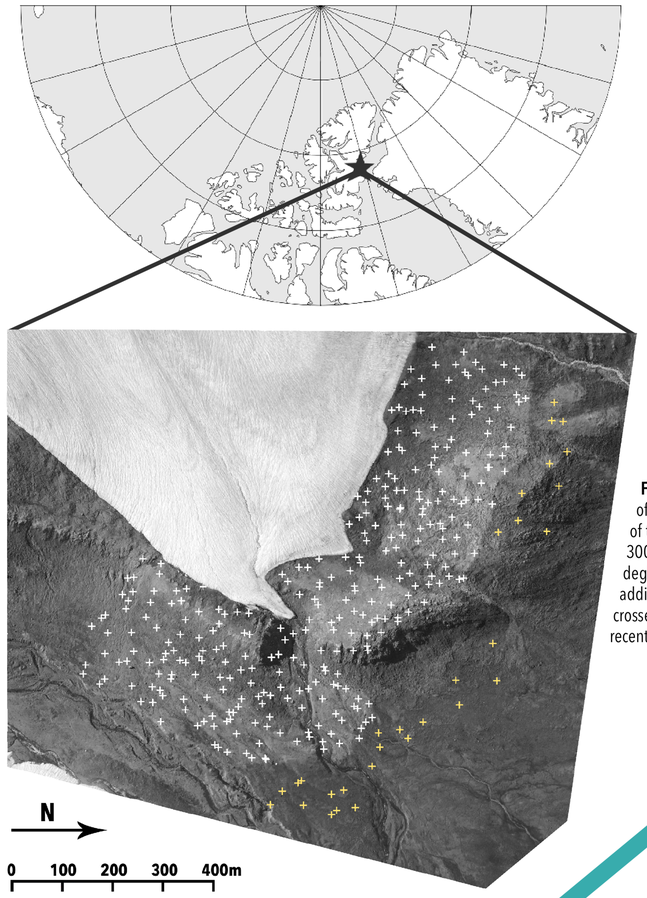

FIGURE 1. Twin Glacier is located on the eastern central coast of Ellesmere Island (top). On the heterogenous foreland of the western lobe of Twin Glacier (bottom), 300 points were sampled in the recently deglaciated area (white crosses), and an additional 30 control points (yellow crosses) were sampled beyond the recently deglaciated area.

The dominant vector of change in successional landscapes is often thought to be time since disturbance. However, as with mature ecosystems, various other factors can influence the presence and abundance of plant species. Factors such as substrate, soil moisture, and available solar radiation all have a direct physiological influence on plant growth. As a result, variations in these factors across a landscape could also influence the patterns of plant succession.

In this study we investigate the influence of 24 environmental variables on the patterns of presence and abundance of vascular plant species across the topographically heterogeneous Twin Glacier foreland, on Ellesmere Island, Nunavut (78°53'N, 75°55'W).

METHODS

Vegetation

> 300 points sampled across the recently deglaciated area on the foreland (Figure 1, white)
> 30 control points sampled beyond the maximum Little Ice Age extent of the glacier (Figure 1, yellow)
> At each point: 2x2m quadrat, divided into 100 smaller squares inside of which presence/absence of species noted

Environmental

> At each point in each square, presence/absence of Moss, Relict, Boulder, LRock, SRock, SandyFS, DarkF
> Temperature recorded at 49 locations and soil nutrient probes placed at 34 locations from mid-June to end of July. Soil samples collected at the same 34 locations to determine soil moisture.
> Aerial photographs taken of the forland

Analysis

> Digital Elevation Model (DEM) created from the aerial photographs
> DEM, temperature, and soil data used to determine and model Elev, Aspect, Slope, GlacDist, PlanCurv, ProfCurv, TWI, SolarRad, Temp, OM, Moisutre, NH4, NO3 and P
> SeedDist calculated using distance to nearest point containing large enough abundance of the species to be considered a seed source (minimum abundance varied depending on species)
> Species located at more than 15 points correlated with all measured & modeled environmental variables

ENVIRONMENTAL VARIABLES

Moss - abundance of moss (facilitation)
Relict - preserved relict vegetation from deglaciation
Boulder - rocks larger than 30 cm in diameter
LRock - rocks 10 - 30 cm in diameter
SRock - rocks 0.5 - 10 cm in diameter
SandyFS - light coloured sandy fine sediment
DarkFS - dark coloured organic fine sediment
Substrate - index combining all substrate measures
Elev - elevation, meters above sea level
Aspect - slope aspect
Slope - slope angle
GlacDist - distance to the edge of the glacier (proxy for time since disturbance)
PlanCurv - plan curvature
ProfCurv - profile curvature
TWI - topographic wetness index
SolarRad - June and July solar radiation
Temp - air temperature at a height of 8.5 cm
OM - soil organic matter
SM - soil moisture
NH4 - ammonium
NO3 - nitrate
P - phosphorous
SeedDist - distance to nearest "seed source"
X - geographic coordinate x
Y - geographic coordinate y

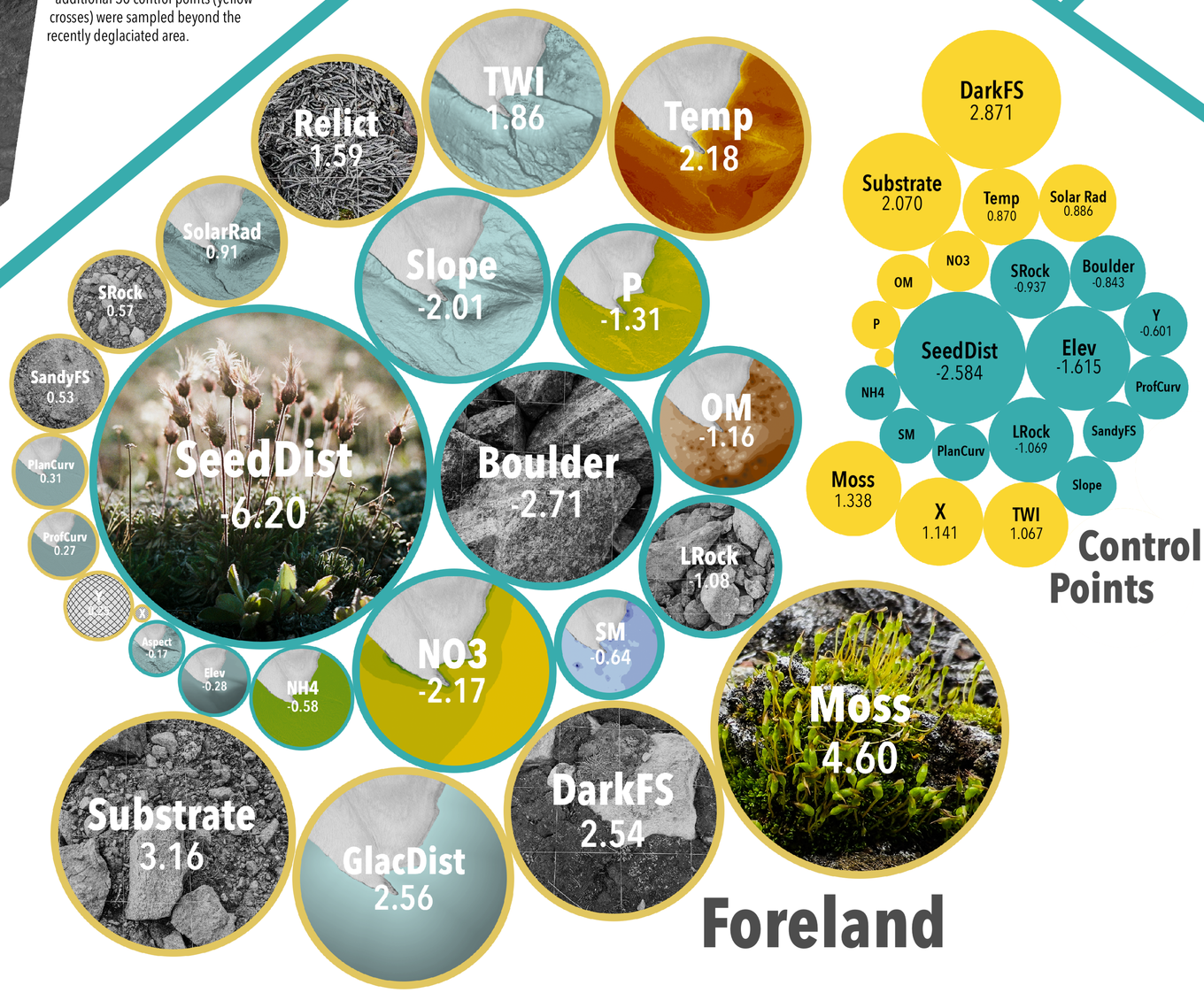

FIGURE 2. The sum of correlations between plant species and environmental variables on the **recently deglaciated foreland (left, with images)**, and at the **undistrubed control points (right, solid colours)**. The size of the circle indicates the strength of the correlation. **Blue** circles/outlines represent negative correlations. **Yellow** circles/outlines represent positive correlatios.

PLANT SPECIES

Species found on both the foreland and at control points:
Luzula confusa
Saxifraga oppositifolia
Salix arctica ---------->
Cassiope tetragona

Species found only on the foreland:
Poa arctica
Saxifraga cernua
Saxifraga nivalis ---------->
Saxifraga caespitosa
Draba nivalis
Draba lactea
Draba species (unidentified)
Papaver radicatum ---------->
Chamaenerion latifolium
Cerastium alpinum
Minuartia rubella

Species found only at control points:
Carex nardina
Dryas integrifolia

CONCLUSIONS

> **Distance to seed source** appears to be the most important factor influencing the presence and abundance of plant species on the foreland.
> At the control points, **substrate** seems to be more important in determining presence and abundance of plant species.
> **Moss** has an important facilitating effect both on the foreland and at the control points.
> Soil moisture and nutrient measurements likely need to be taken at a higher density to get meaningful models.

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