*Ecosphere*

**Appendix 1**

For:

Effects of short-interval disturbances continue to accumulate, overwhelming variability in local resilience

Katherine Hayes1, Brian Buma

1Author correspondence: [Katherine.hayes@ucdenver.edu](mailto:Katherine.hayes@ucdenver.edu)

**Contents of this file:**

Table S1: Fire characteristics and history across plot.

Table S2: Site level climate data.

Table S3: Spatial correlation analysis results.

Table S4: Canopy and understory composition by plot and site.

Table S5: Model selection parameters.

Figure S1: Comparison of topographic indices between upland and lowland sites.

Figure S2: Adventitious root depth.

**Data Availability**

Regeneration and soil datasets available on Zenodo (<http://doi.org/10.5281/zenodo.4016939>).

Table S1. Fire sequence history (in years) and size (acres) across upland and lowland plots.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Site | Plot ID # | # of Fires | Fire | Year | Fire Size (ac) |
| Upland | 12, 41, 48, 50, 52, 64, 65 | 1 | Fish Creek | 2005 | 101,585 |
| 42 | 1 | Erickson | 2003 | 117,156 |
| 56, 57, 47, 16, 8, 39 | 2 | Rogers | 1967 | 28,675 |
| Fish Creek | 2005 | 101,585 |
| 32, 40 | 2 | Rogers | 1967 | 28,675 |
| Erickson | 2003 | 117,156 |
| 7, 14, 15, 54, 55 | 3 | Rogers | 1967 | 28,675 |
| 132376 | 1991 | 55,978 |
| Fish Creek | 2005 | 101,585 |
| Lowland | 33, 29, 28, 18, 5 | 1 | Boglen Creek | 2004 | 201,894 |
| 20, 36 | 1 | Graveyard Creek | 2006 | 11,362 |
| 26, 27, 4, 3, 19 | 2 | Crazy Mountain | 1953 | 16,702 |
| Boglen Creek | 2004 | 201,894 |
| 34 | 2 | Central W-10 | 1957 | 49,701 |
| Boglen Creek | 2004 | 201,894 |
| 22, 17, 25, 35, 24, 23, 2 | 3 | Central W-10 | 1957 | 49,701 |
| Albert Creek | 1974 | 28,675 |
| Boglen Creek | 2004 | 201,894 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table S2.Climate data from nearest Western Regional Climate Center monitoring station. Upland data comes from Seven Mile Alaska Station and Lowland data is from the Preacher Creek Station. Variables are averaged across data from January 1993 to January 2019. Winter temperature (°F) includes averages from October through March, while summer temperature (°F) extends from June through August. | | | | | |
| Metric | Site | Mean | SD | Max | Min |
| Annual Precipitation (cm) | Upland | 18.8 | 8.6 | 37.1 | 8.6 |
| Lowland | 26.9 | 11.7 | 62 | 15 |
| Winter Temp (°F) | Upland | -13.8 | -7.3 | 8.2 | -33.5 |
| Lowland | -12.9 | -6.9 | 9.3 | -31.5 |
| Summer Temp (°F) | Upland | 10.2 | -10.2 | 20.3 | -7.6 |
| Lowland | 11 | -10.7 | 19.8 | -7.8 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table S3.Results from Moran’s I for spatial autocorrelation in density (stem count per hectare) and basal area (square meters per hectare) of trees within upland and lowland sites. | | | | | | |
| Site | Burn History | Variable | Observed | Expected | P-value | sd |
| Upland | 0 | Density | -0.002 | -0.03 | 0.32 | 0.03 |
| Basal Area | -0.21 | -0.33 | 0.18 | 0.09 |
| 1 | Density | -0.02 | -0.01 | 0.49 | 0.01 |
| Basal Area | -0.03 | -0.14 | 0.19 | 0.09 |
| 2 | Density | -0.02 | -0.01 | 0.76 | 0.01 |
| Basal Area | -0.07 | -0.14 | 0.54 | 0.11 |
| 3 | Density | -0.02 | -0.02 | 0.65 | 0.01 |
| Basal Area | -0.08 | -0.20 | 0.36 | 0.13 |
| Lowland | 0 | Density | < -0.01 | -0.03 | 0.32 | 0.03 |
| Basal Area | -0.36 | -0.33 | 0.87 | 0.18 |
| 1 | Density | -0.03 | -0.02 | 0.60 | 0.02 |
| Basal Area | -0.30 | -0.17 | 0.11 | 0.08 |
| 2 | Density | -0.02 | -0.02 | 0.83 | 0.02 |
| Basal Area | -0.04 | -0.20 | 0.42 | 0.19 |
| 3 | Density | -0.003 | -0.01 | 0.40 | 0.01 |
| Basal Area | -0.08 | -0.17 | 0.21 | 0.07 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table S4**.** Current species-specific composition of regeneration. Average relative proportion (stems of a species divided by total stems present) of sum of trees and seedlings of all species between upland and lowland sites and across reburn sequence. Species absent at a given site were not included. | | | | | | |
| Fires | Site |  | Species | Regeneration % | Standard Error (%) |
| 0 | Upland | Conifer | *Picea mariana* | 87.9 | 2.5 |
| Deciduous | *Betula neoalaskana* | 1.9 | 0.8 |
| *Salix* | 10.2 | 2.0 |
| Lowland | Conifer | *Picea mariana* | 97 | 1.5 |
| Deciduous | *Salix* | 1.5 | 1 |
| 1 | Upland | Conifer | *Picea mariana* | 57.8 | 10.6 |
| Deciduous | *Alnus crispa* | 2.6 | 1.7 |
| *Betula neoalaskana* | 11.5 | 6.1 |
| *Populus tremuloides* | 0.1 | 0.1 |
| *Salix* | 28 | 7.9 |
| Lowland | Conifer | *Picea mariana* | 61.7 | 8.3 |
| Deciduous | *Alnus crispa* | 0.5 | 0.5 |
| *Betula neoalaskana* | 5.5 | 1.9 |
| *Populus ttremuloides* | 3.1 | 1.7 |
| *Salix* | 29.3 | 6.7 |
| 2 | Upland | Conifer | *Picea glauca* | 3.9 | 3.9 |
| *Picea mariana* | 22.3 | 6.8 |
| Deciduous | *Alnus crispa* | 6.7 | 4.2 |
| *Betula neoalaskana* | 22.7 | 5.6 |
| *Populus tremuloides* | 4.5 | 3.5 |
| *Salix* | 39.9 | 8.1 |
| Lowland | Conifer | *Picea mariana* | 33.3 | 4.9 |
| Deciduous | *Alnus crispa* | 0.3 | 0.2 |
| *Betula glandulosa* | 0.9 | 0.6 |
| *Betula neoalaskana* | 4.2 | 0.6 |
| *Populus tremuloides* | 6.3 | 1.2 |
| *Salix* | 55 | 4.9 |
| 3 | Upland | Conifer | *Picea mariana* | 1.7 | 1.2 |
| Deciduous | *Alnus crispa* | 6.8 | 3 |
| *Betula neoalaskana* | 62.9 | 8.7 |
| *Populus tremuloides* | 0.4 | 0.3 |
| *Salix* | 28.1 | 6.4 |
| Lowland | Conifer | *Picea mariana* | 4.4 | 4.9 |
| Deciduous | *Alnus crispa* | 0.3 | 0.2 |
| *Betula glandulosa* | 2.7 | 1.3 |
| *Betula neoalaskana* | 11 | 3.9 |
| *Populus balsamifera* | 0.1 | 0.1 |
| *Populus tremuloides* | 23.5 | 6.8 |
| *Salix* | 58 | 7.7 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table S5. Model parameters of competing model structure. Basal area is abbreviated as “BA”. Deviance is abbreviated as “Dev.” | | | | | | |
| Model | Model Structure | Null Dev. | Resid. Dev. | df | RSME | AIC |
| Conif.  Density | Fire + Site + (Fire \* Site) | 124.6 | 50.5 | 36 | 0.94 | **924.4** |
| Fire + Site + Slope + (Fire \* Site) |  |  | 35 | 0.94 | 926.4 |
| Decid. Density | Fire + Site + (Fire \* Site) | 59.6 | 49.6 | 36 | 1.27 | **1087.6** |
| Fire + Site + Slope + (Fire \* Site) |  |  | 35 | 1.27 | 1089.6 |
| Decid. BA | Fire + Site + (Fire \* Site) | 77.4 | 25.8 | 36 | 0.80 | 55.2 |
| Fire + Site + Slope + (Fire \* Site) |  | 24.1 | 35 | 0.73 | **54.1** |

Figure S1.Histograms of topographic variables of Upland and Lowland Plots. Dotted vertical lines represent mean of site. A) Distribution of slope (degrees) of plots. Upland plots were more steeply sloped on average than lowland plots. B) Histogram of plot elevation (meters above sea level). On average, lowland plots were lower in elevation than upland plots. C) Annual average solar radiation (watts per square meter). Upland plots received greater annual solar radiation on average than lowland plots.

**A screenshot of a cell phone

Description automatically generated**

Figure S2. Adventitious root depth (cm). Distance in centimeters between highest adventitious black spruce roots to soil surface according to number of fires.

A close up of a logo

Description automatically generated

Adventitious roots were only available to sample in once- and twice-burned plots, as thrice-burned plots had no black spruce snags left to assess. Depth of adventitious roots implied greater fire intensity (soil consumption) in upland plots, particularly after one fire.