**Supplemental Tables and Figures**

Chart, scatter chart

Description automatically generated

**Supplemental Figure S1:** Soil pH (A) and soil organic matter (B) by elevation band (transect) on the subset of mountains in northeastern United States where these data were collected. Means ± 1 SE are shown.

Chart, histogram

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**Supplemental Figure S2:** Observed and estimated soil pH and SOM values on ten study mountains in northeastern United States. The estimated values were derived from data imputation with the mice package in R (R Core Team 2019). Predictive mean matching was used to estimate missing values based on the strong linear relationship between elevation and the two soil variables (see Supplemental Figure S1). Five iterations of estimated missing data are plotted above against observed data to display how well the algorithm matched field derived trends.

**Calendar

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**Supplemental Figure S3:** Species distributions (probability of presence) over elevation for seedlings (seed, green lines) and adults (adlt, red lines) of four common tree species on ten study mountains in the northeastern United States. Probability of presence was modeled using logistic regression from site-level frequencies of each species and demographic class at each elevation. In most cases, the vertical lines mark either the elevations of 50% probability of presence (for American beech, sugar maple, and balsam fir) or the elevation of the peak (maximum) probability of presence (for red spruce). For mountains where 50% probability of presence was not reached within the study range, the lowest elevation site (for deciduous species) or the highest elevation site (for conifer species) was used as a conservative estimate for adult and seedling 50% occurrence probability. Mountains lacking individuals from all demographic stages at more than one site (indicated by the lack of vertical lines) were not included in calculating demographic elevations mismatches: the number of mountains included thus ranged from 7 (American beech, sugar maple) to 9 (red spruce, balsam fir).

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**Supplemental Figure S4:** Species distributions (probability of presence) over elevation for seedlings and adults (adlt, red lines) of four common tree species on ten study mountains in the northeastern United States. Seedlings were surveyed between different light environments (non-gaps = NG seed, green lines; gaps = G seed, blue lines) and were modelled separately here. Probability of presence was modeled using logistic regression from site-level frequencies of each species and demographic class at each elevation. In most cases, the vertical lines mark either the elevations of 50% probability of presence (for American beech, sugar maple, and balsam fir) or the elevation of the peak (maximum) probability of presence (for red spruce). For mountains where 50% probability of presence was not reached within the study range, the lowest elevation site (for deciduous species) or the highest elevation site (for conifer species) was used as a conservative estimate for adult and seedling 50% occurrence probability. Mountains lacking individuals from all demographic stages at more than one site (indicated by the lack of vertical lines) were not included in calculating demographic elevations mismatches: the number of mountains included thus ranged from 7 (American beech, sugar maple) to 9 (red spruce, balsam fir).

Chart

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**Supplemental Figure S5:** Seedling density across all study mountains as a function of elevation partitioned between northern hardwood (sugar maple, American beech), spruce-fir (balsam fir, red spruce), and sub-dominant species (yellow birch, Betula alleghaniensis Britton; mountain paper birch, Betula cordifolia Regel; American mountain-ash, Sorbus americana Marshall; striped maple, Acer pensylvanicum L.; mountain maple, Acer spicatum Lam.; and red maple, Acer rubrum L.). (A) Seedling density of subdominant species is shown to be highest within the ecotone. (B) Seedling density of both dominant groups of species is shown to be lower within the ecotone than within their core ranges. Symbols in (A) and bars in (B) indicate mean values (±SE). The shaded area represents ecotone elevations.

**Supplemental Table S1:** Coefficients from species distribution models along elevational gradients for adults (Adult), saplings (Sap), and seedlings (Seed) of four dominant tree species common on mountains in the northeastern United States. Species importance values were expressed as a function of climate, landform, and soil variables (see Table 2), with significant coefficients (alpha = 0.05) reported for the best models determined using likelihood ratio tests. Sites occupied indicate the number of sites with species present (maximum 57; sites where species did not occur were also included in the models). Coefficients were scaled (mean = 0, SD = 1) prior to model fitting to facilitate comparisons. R2c (conditional) and R2m (marginal) represent the variance explained by all effects (fixed and random) or only fixed effects, respectively.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **Climate** | | | | | | **Landform** | | **Soil** | | |
| **Species** | **Life Stage** | **Sites Occupied** | **R2c** | **R2m** | **GDD** | **GDD2** | **PPT** | **T mean** | **VPD min** | **VPD max** | **Aspect** | **Slope** | **pH** | **Depth** | **SOM** |
| Beech | Adult | 16 | 0.48 | 0.37 | 0.026 | 0.032 |  |  | 0.189 | -0.162 |  |  | -0.050 | -0.016 | -0.052 |
|  | Sap | 20 | 0.54 | 0.39 | 0.094 | 0.030 | -0.026 |  | 0.761 | -0.733 | 0.022 | -0.014 | -0.098 |  | -0.085 |
|  | Seed | 17 | 0.51 | 0.43 | 0.050 | -0.011 | -0.016 | 0.015 | 0.455 | -0.444 |  |  | -0.060 |  | -0.066 |
| Sugar maple | Adult | 20 | 0.49 | 0.41 | 0.146 | -0.031 | -0.017 |  | 1.065 | -1.079 | 0.035 | -0.017 | -0.021 |  | -0.071 |
|  | Sap | 17 | 0.44 | 0.44 | 0.073 |  |  |  | 0.552 | -0.570 | 0.024 |  | 0.012 |  | -0.020 |
|  | Seed | 21 | 0.54 | 0.50 | 0.124 | -0.073 | -0.017 |  | 0.464 | -0.478 | 0.035 |  | 0.076 | -0.022 | -0.045 |
| Red spruce | Adult | 36 | 0.38 | 0.23 | 0.032 |  |  | -0.019 | -0.263 | 0.283 | -0.024 |  | -0.016 | 0.017 | 0.046 |
|  | Sap | 41 | 0.30 | 0.17 | 0.068 | -0.023 | 0.039 |  | -0.272 | 0.316 | -0.012 |  | -0.038 | 0.027 | 0.047 |
|  | Seed | 36 | 0.40 | 0.40 |  |  |  | -0.035 | -0.167 | 0.161 | -0.013 | -0.012 |  |  | 0.022 |
| Balsam fir | Adult | 35 | 0.75 | 0.60 | -0.012 | -0.135 | 0.035 | -0.079 |  |  |  |  |  |  |  |
|  | Sap | 33 | 0.69 | 0.58 |  | -0.188 | 0.025 | -0.083 |  |  |  |  |  |  |  |
|  | Seed | 37 | 0.72 | 0.66 | -0.083 | -0.070 | 0.054 | -0.100 | -0.969 | 0.903 |  |  |  |  |  |