Supplementary Material 1:

 Details on modelling framework

## Neighborhood analyses: testing H2:

### Description of confounding predictors

In absence of actual soil data, site-differences were included in the model by calculating an aridity index “Martonne” (IM ) (Martonne 1926). This index represents a measure of the water supply and was derived from the annual precipitation and average annual temperature of years 2000-2015:

$I\_{M}=\frac{Precip\left(mm\right)}{T\left(°C\right)+10}$ eq. 1

A high value of IM indicates favorable growing conditions and a low value indicates unfavorable (more arid) conditions. We considered the effect of tree size by including tree DBH of 2016 as a fixed effect in the neighborhood model. We acknowledge that tree age is also a relevant growth factor, but to avoid overfitting our model and considering the commonly found strong relationship of age with DBH, we deemed it sufficient to include DBH. To account for the competition intensity in neighborhoods of each sample tree, a modified Hegyi Index (HegyiCPA*)* was calculated (Lee und Gadow 1997) as follows:

$Hegyi\_{CPA }= \sum\_{j=1}^{n}\frac{CPA\_{j}}{CPA\_{i}}\* \frac{1}{Dist\_{ij}}$ eq. 2

where CPAi is the crown projection area (CPA) of the sample tree, CPAj is the CPA of a neighboring tree; and Distij is the distance between the central and neighboring trees. We used species-specific allometric functions (Pretzsch 2014) to calculate CPA from DBH data (beech: ln(CPA) = 0.18 \* 1.02 \* ln(DBH), fir: ln(CPA) = 0.37 \* 0.82 \*ln(DBH)), equations for other species were also obtained from (Pretzsch 2014). To account for size-asymmetric competition, we included a second competition-related effect “BAL” (Basal Area Larger trees), into the model. This variable was calculated as the cumulative basal area (from DBH measurements) of neighbors larger than the central tree (based on DBH).

To examine the effect of mixing on tree growth (i.e. testing H2), we calculated admixture proportions in % (parameter a) in eq. 2) as

$Admixture\left(\%\right)=\frac{Hegyi\_{other}}{Hegyi\_{CPA}}\*100$eq. 3

With HegyiCPA being the same value as calculated in eq. 4and withHegyiother as

$Hegyi\_{other }= \sum\_{j=1}^{n}\frac{CPA\_{j other}}{CPA\_{i}}\* \frac{1}{Dist\_{ij other}}$ eq. 4

, where CPAi  is the crown projection area (CPA) of the sample tree, CPAj other is the CPA of neighboring trees belonging to other species as the sample tree; and Distij is the distance between the central and neighboring trees belonging to other species.

### Model selection for neighborhood analyses, see also SUP 2

Collinearity between the predictors of the full model was moderate and the strongest correlation was between HegyiCPA and DBH (spearman r=-0.70, SUP2), which is still considered acceptable according to the rules of thumb by (Dormann et al. 2013). The optimal random structure included 1 random effect “site” on the intercept of the model. We tested different methods of incorporating heterogeneity into the model (variance structures) (Zuur et al. 2009). To address heteroscedasticity of the predictor variables we tested either a constant variance structure per group (varIdent) an exponential (varExp) or power (varPower) variance function for continuous predictor variables (Pinheiro et al. 2019).

The fixed-effects structure was optimized based on the maximum likelihood (ML) method using a backward selection starting with the full model that included the optimal random structure: Non-significant (P > 0.05) fixed effects were removed in order of decreasing P-values determined with conditional F-tests. For the different models, we performed an Akaike’s information criterion based model selection, corrected for small sizes (AICc), that considered the base model and all simplified versions. We selected the best model with the lowest AIC and highest Akaike weights (i.e., the likelihood of being the best-fitting model based on AIC values), respectively, as the most parsimonious model. Parameter estimates of the best-fitting model were based on restricted maximum likelihood (REML) estimation.

## Analyses of the tree-level drought response: testing H3

Since we could not assume that neighborhood conditions regarding competition (i.e., density) were stable in the last 15 years, we decided against assigning trees into competition-related categories. We grouped trees into two categories: mixed vs monospecific neighborhoods, to test the effect of mixing on the responses. We included the interaction of mixing category with species identity to allow for species-specific drought responses. To account for differences in tree size (and potentially of competition), we included DBH and its interaction with mixing category into the model as was done for neighborhood analyses. We decided against including any climate-related effect into the model as we analyzed only one drought event, which was comparably dry at all sites according to climatic data. The optimal random structure was found to be “sites”.

References

Dormann, Carsten F.; Elith, Jane; Bacher, Sven; Buchmann, Carsten; Carl, Gudrun; Carré, Gabriel et al. (2013): Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. In: *Ecography* 36 (1), S. 27–46. DOI: 10.1111/j.1600-0587.2012.07348.x.

Lee, Woo-Kyun; Gadow, K. Von (1997): Iterative bestimmung der konkurrenzbäume in Pinus densiflora beständen. In: *ALLG. FORST- JAGDZTG* 168 (3-4), S. 41–45.

Martonne, Emmanuel de (1926): L'indice d'aridité. In: *Bulletin de l'Association de Géographes Français* 3 (9), S. 3–5. DOI: 10.3406/bagf.1926.6321.

Pinheiro J; Bates D:; DebRoy S; Sarkar D; R Core Team (2019): nlme: Linear and Nonlinear Mixed Effects Models. Online verfügbar unter https://CRAN.R-project.org/package=nlme.

Pretzsch, Hans (2014): Canopy space filling and tree crown morphology in mixed-species stands compared with monocultures. In: *Forest Ecology and Management* 327, S. 251–264. DOI: 10.1016/j.foreco.2014.04.027.

Zuur, Alain F.; Ieno, Elena N.; Walker, Neil; Saveliev, Anatoly A.; Smith, Graham M. (2009): Mixed effects models and extensions in ecology with R. New York, NY: Springer New York.