Supplementary Information: Tropical tree drought sensitivity is jointly shaped by drought characteristics, species adaptations, and individual microenvironments

Contents

Authors

Krishna Anujan[1,2]* ORCiD: 0000-0003-3604-5895
Sean McMahon[2,3] ORCiD: 0000-0001-8302-6908
Sarayudh Bunyavejchewin[4] ORCiD: 0000-0002-1976-5041
Stuart J. Davies[3] ORCiD: 0000-0002-8596-7522
Helene C. Muller-Landau[3] ORCiD : 0000-0002-3526-9021
Nantachai Pongpattananurak[5] ORCiD: 0000-0001-8687-6182
Kristina Anderson-Teixeira[1,3] ORCiD: 0000-0001-8461-9713
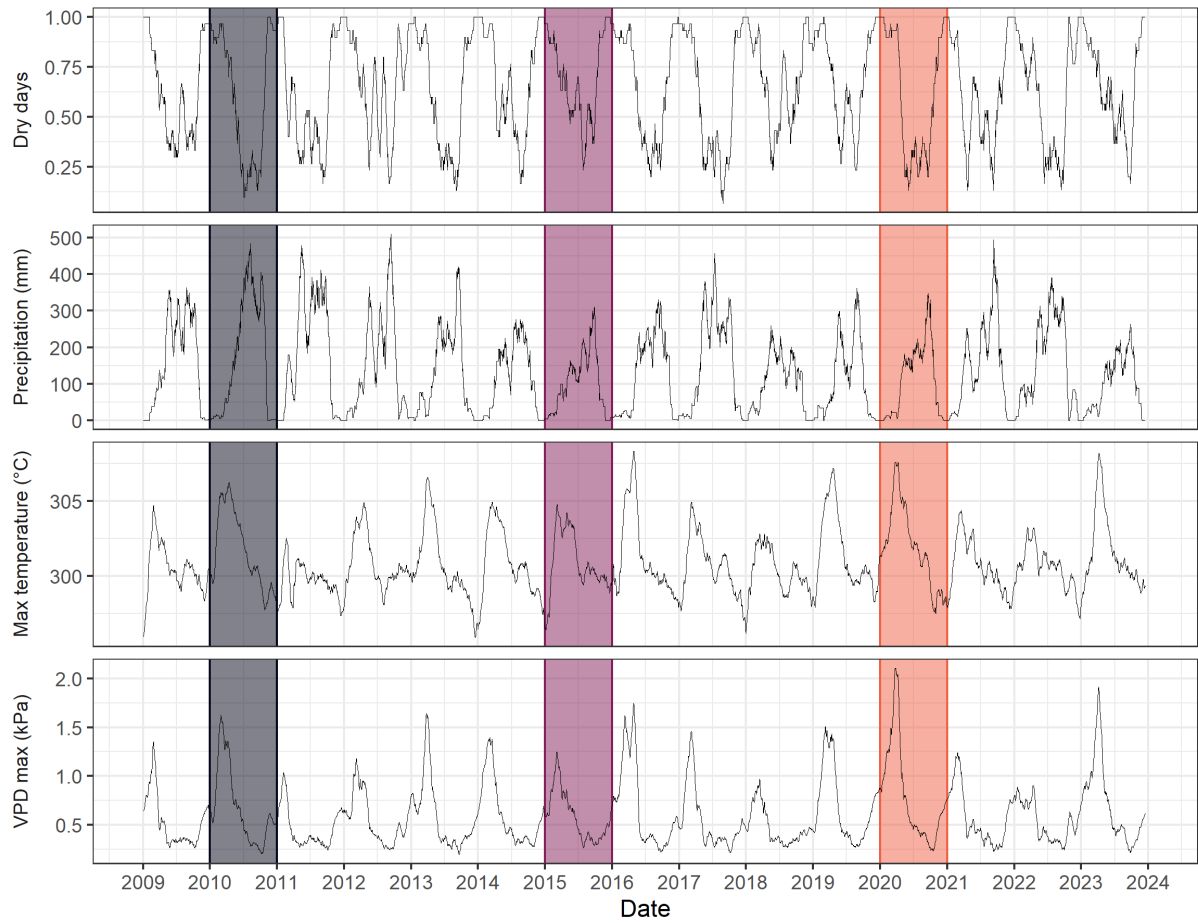
Climate data and correlations

Figure S1: Raw climate data timeseries from 2009 to 2023 from ERA5Land and CHIRPS. Measurements represent daily rolling means over a 30-day time window for precipitation, max temperature and VPD and rolling sum for number of dry days.
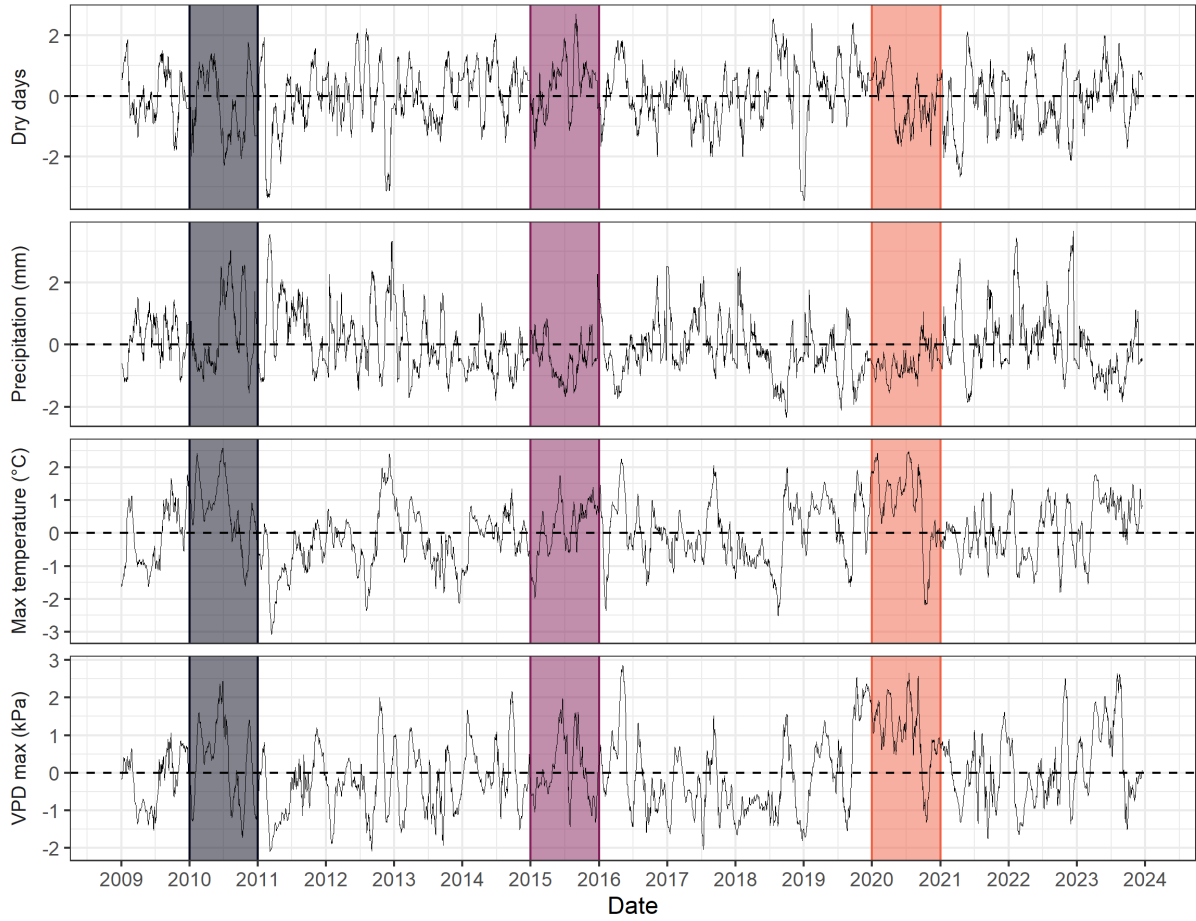
Figure S2: Climate anomalies for all variables from 2009 to 2020. Values represent number of standard deviations from the long-term mean for daily rolling mean values.

Data cleaning additional methods

- Data cleaning steps
- Calculating DBH equation
- Corroboration with tape measurements
- error distribution
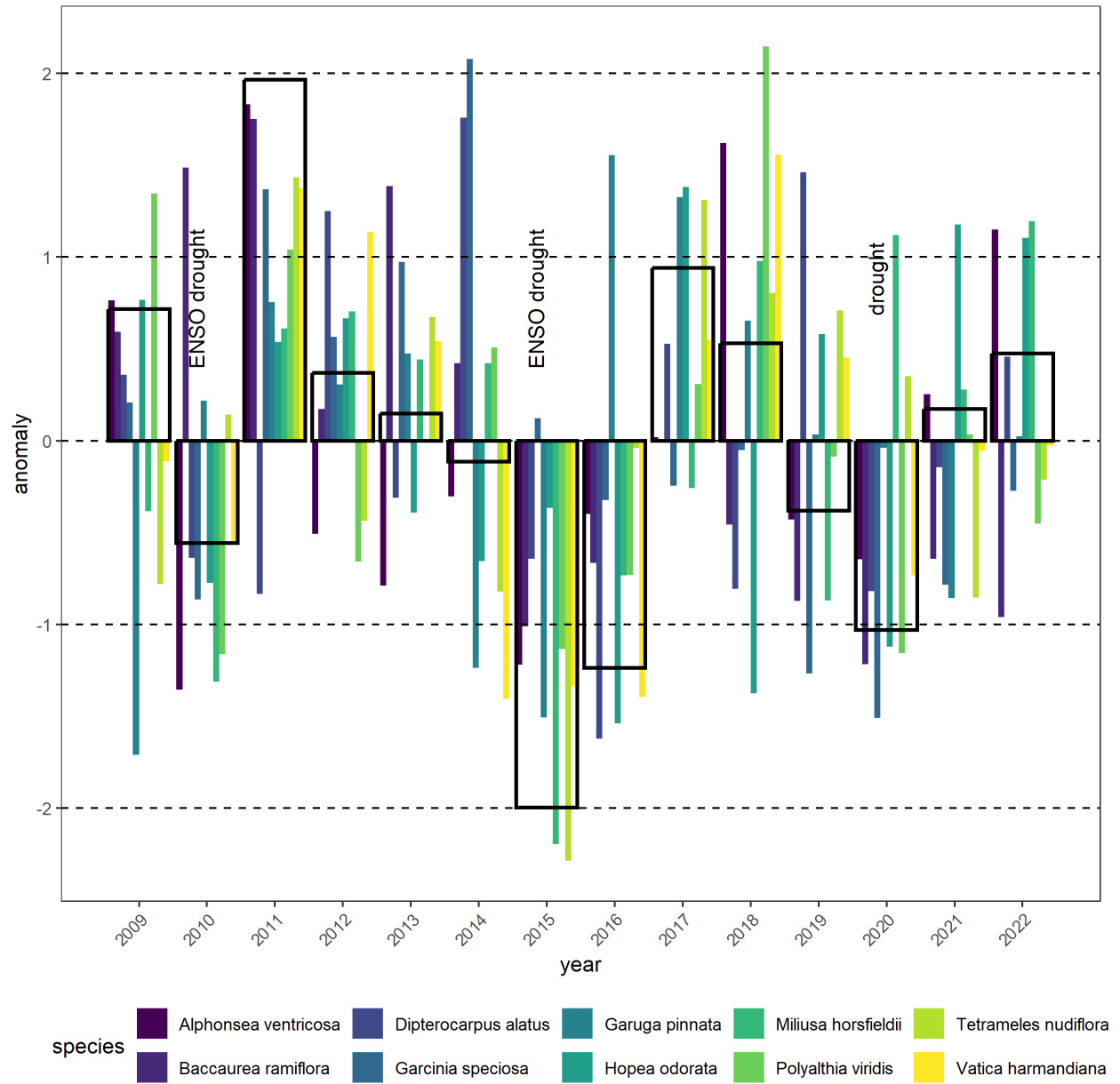
Growth timeseries and anomalies

Figure S3: Growth anomalies across the timeseries. Growth anomalies for each year calculated as the number of standard deviations in growth each year from mean growth across all years and summarised for plot and species.

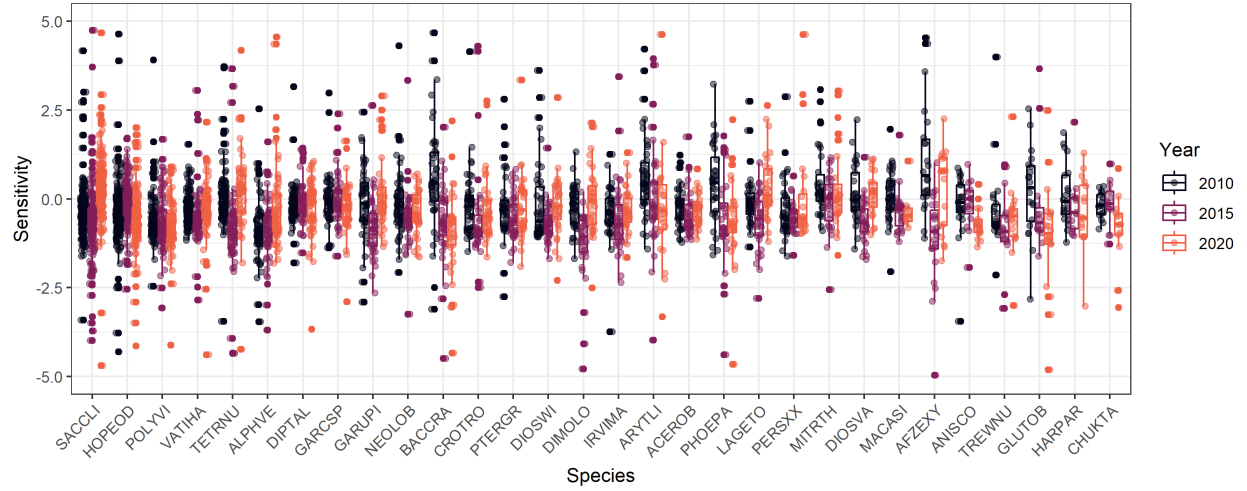## Drought year growth of species and individuals

Figure S4: Species sensitivities in drought years 2010 and 2015. Boxplots represent 25th, 50th (median) and 75th percentile of sensitivity for each species in each year and whiskers represent 95% CIs. All individual sensitivities represented by jittered points.
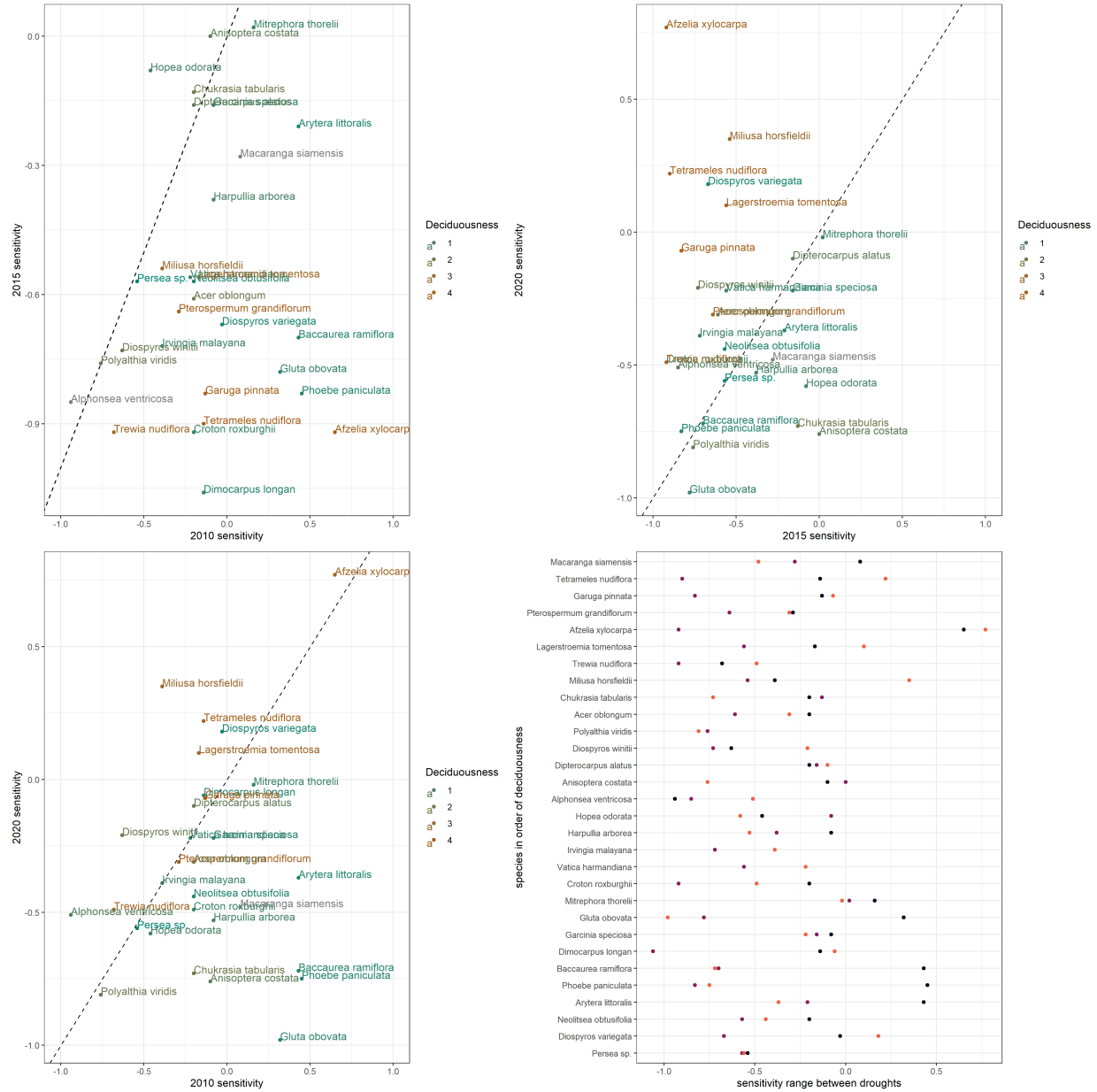
Figure S5: Correlations of species sensitivities across the two years. Panel a shows correlation of species median sensitivities in the two years and Pearson's correlation coefficient. Colour gradient represents deciduousness scale and dotted line is the 1:1 line. Panel b shows difference in magnitude of species median sensitivites among the two years
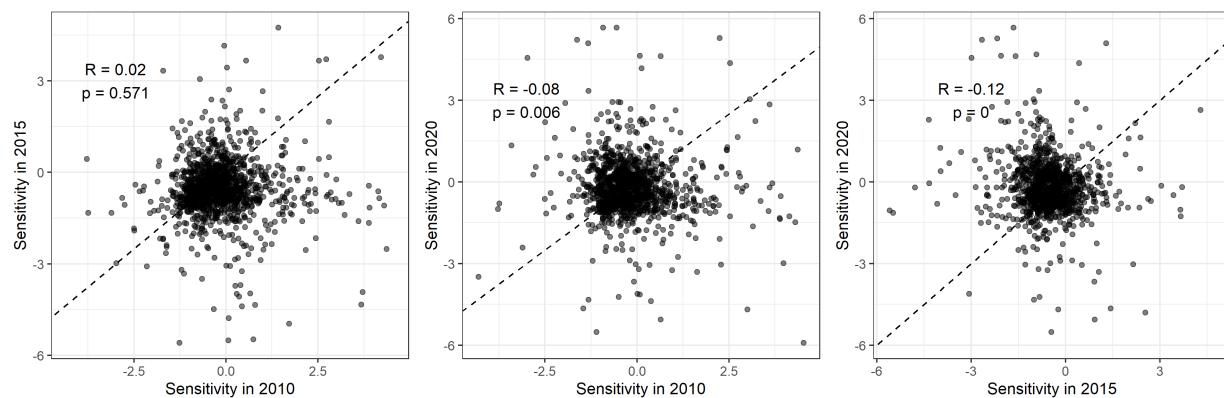
Figure S6: Correlation of individual sensitivities across the two years along with Pearson's correlation coefficient and the 1:1 line.

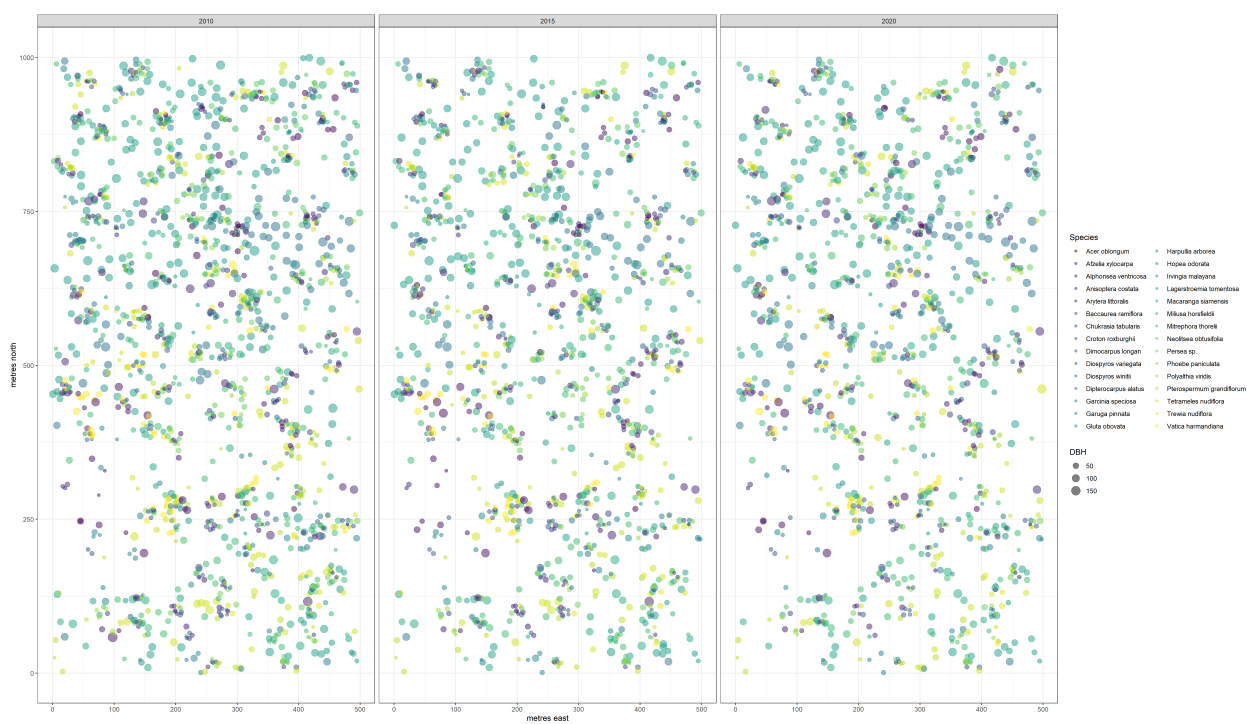# Variables and their distributions

Map of trees

Figure S7: Map of trees with dendrobands in HKK, included in analyses in the 2010 and 2015 datasets
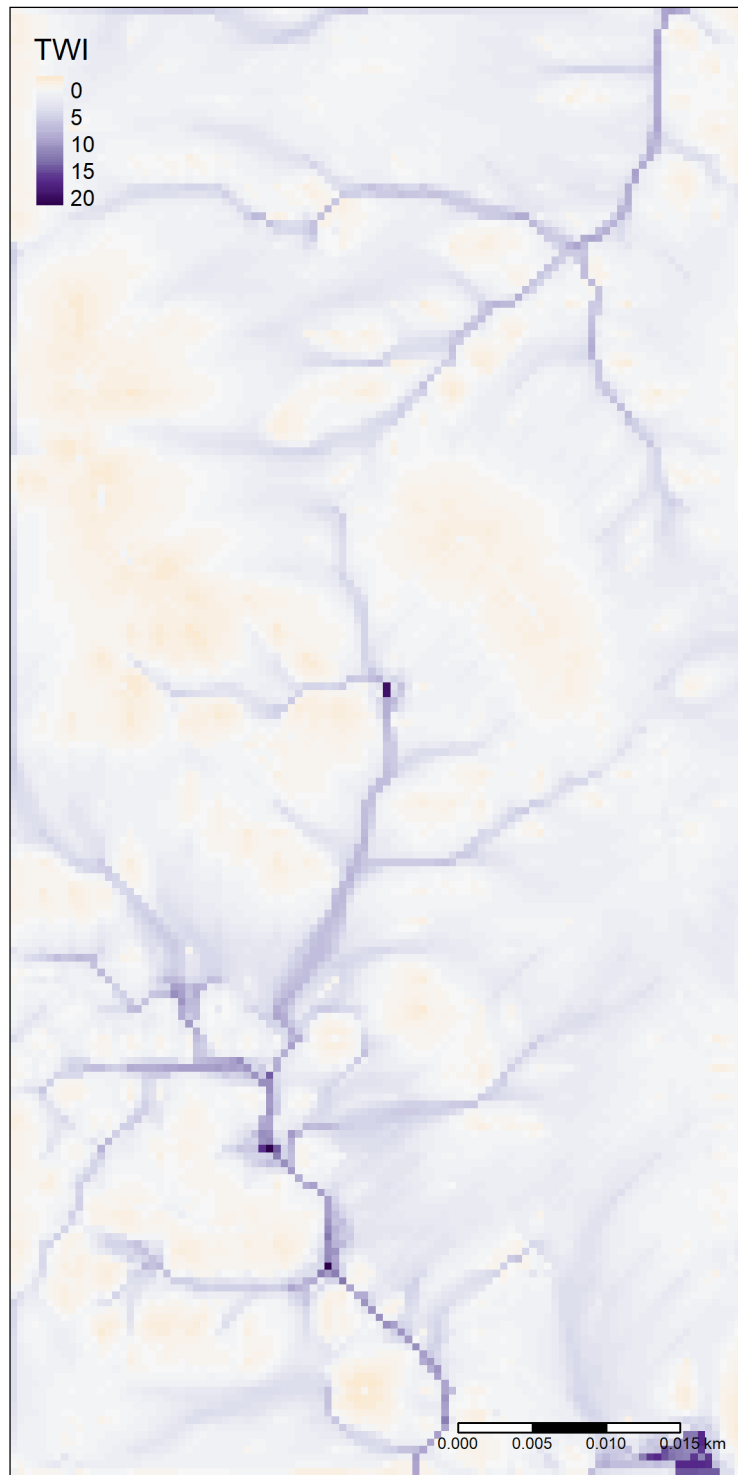
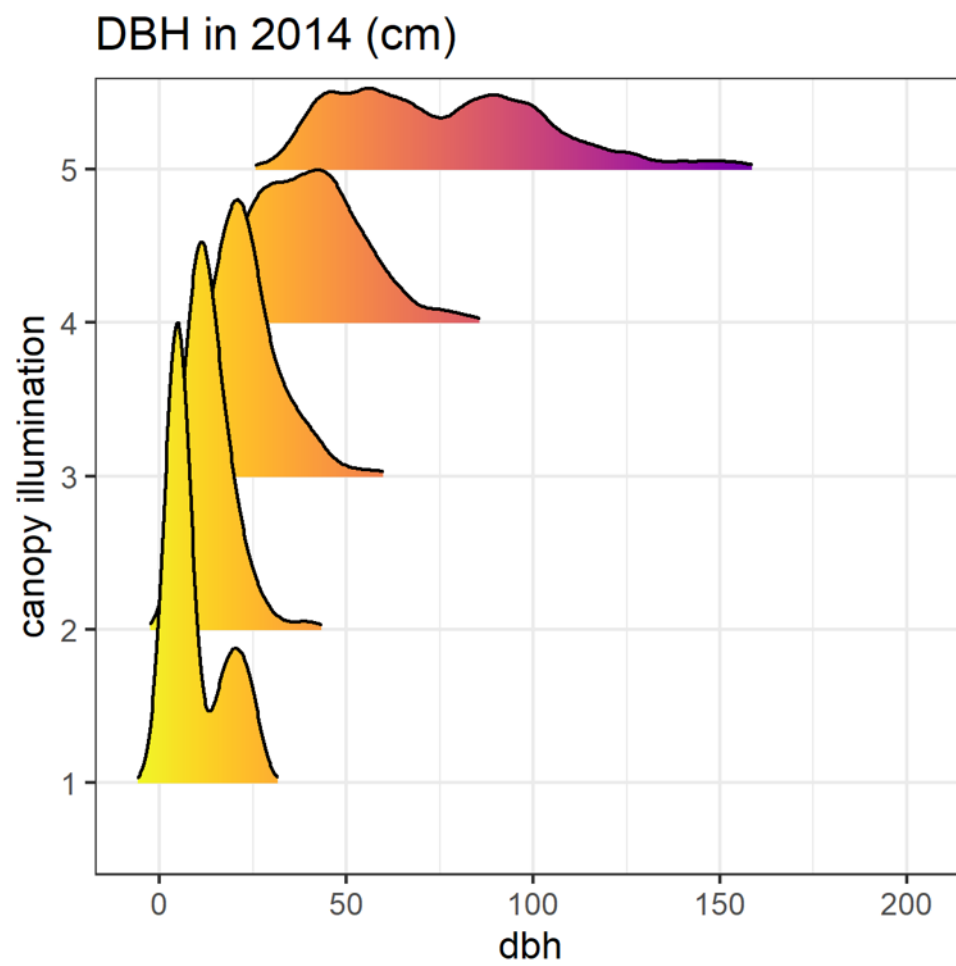**Figure S8:** Calculated Topographic Wetness Index (TWI) values for the HKK plot

Figure S9: Distribution of DBH with Crown Illumination Index (CII) in 2014.

Conditional dependencies

To analyse the influence of microenvironmental variables on growth sensitivity, we first created a Directed Acyclic Graph describing the relationships. To be able to test the DAG with the dataset, we used *dagitty* to derive the conditional dependencies that need to be tested, namely CII ⫫ TWI and DBH ⫫ TWI.
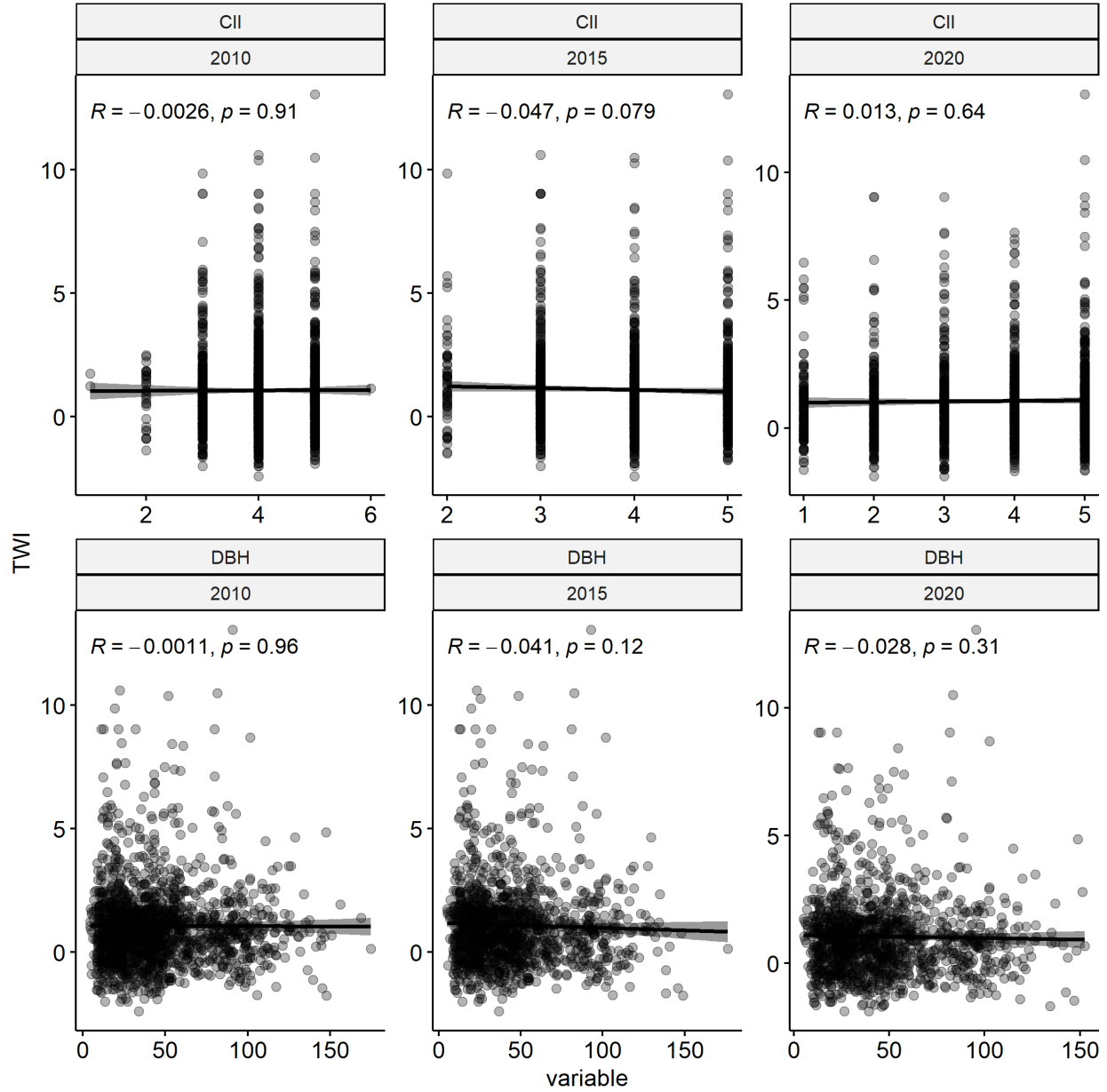

Figure S10: Testing correlations of variables across all individuals

There is low correlation between these two variable pairs across all individuals. We then tested conditional dependencies at the species level.

Most species (barring a few) had low correlation between these variables in our dataset, allowing us to proceed with analysis and interpretation.
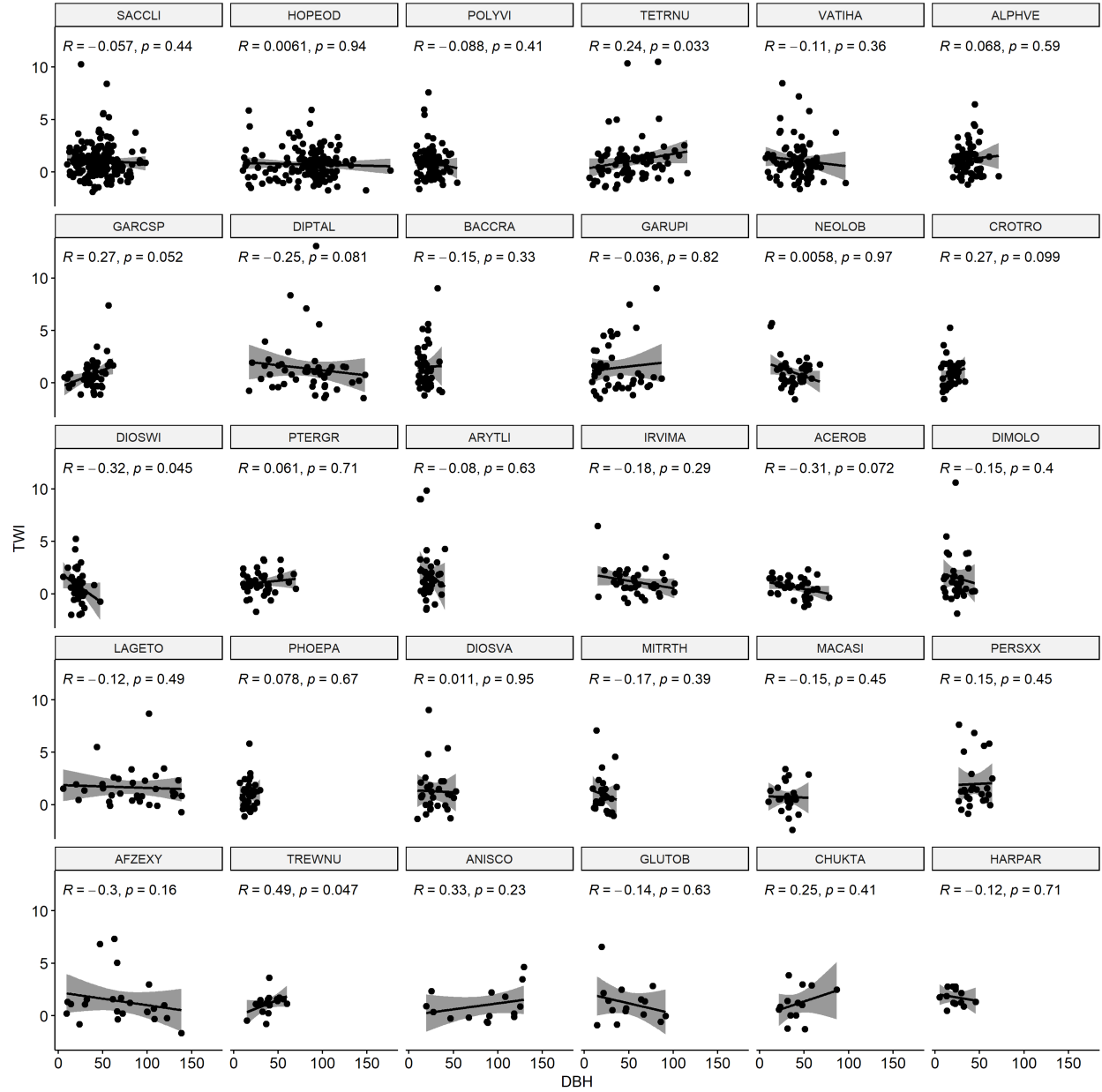
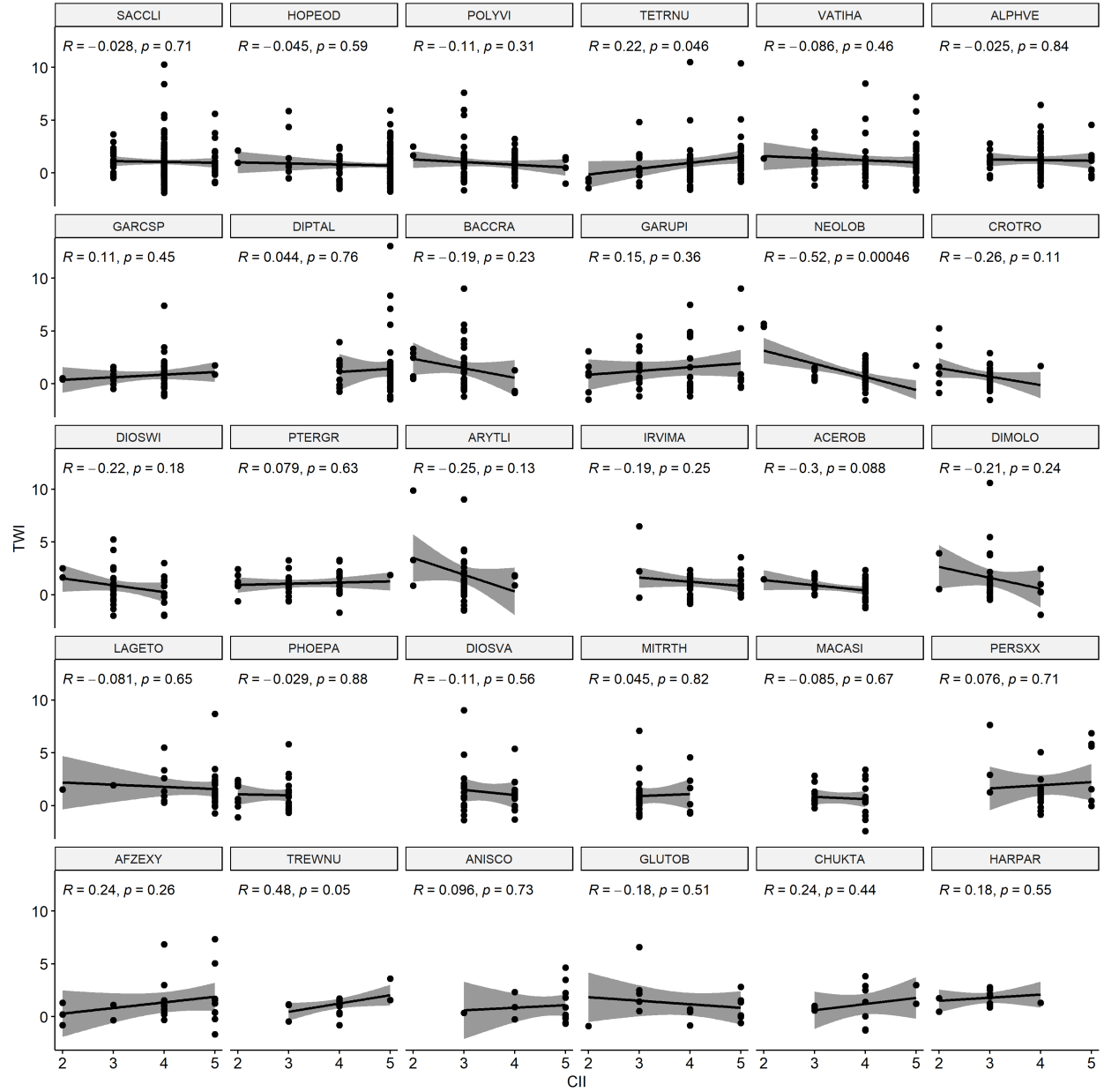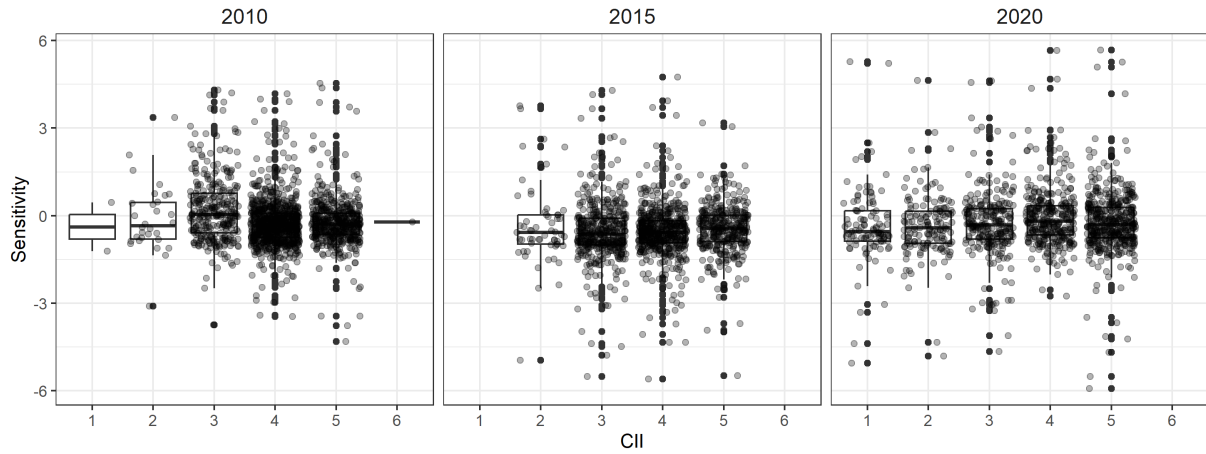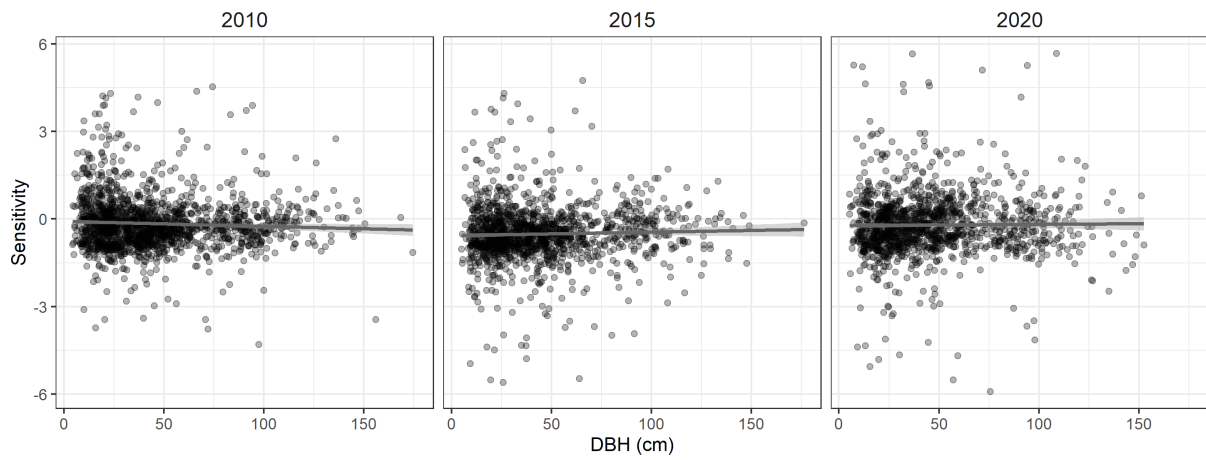**Figure S11:** Testing correlations for DBH ⫫ TWI by species

Figure S12: Testing correlations for CII ⊥⊥ TWI by species
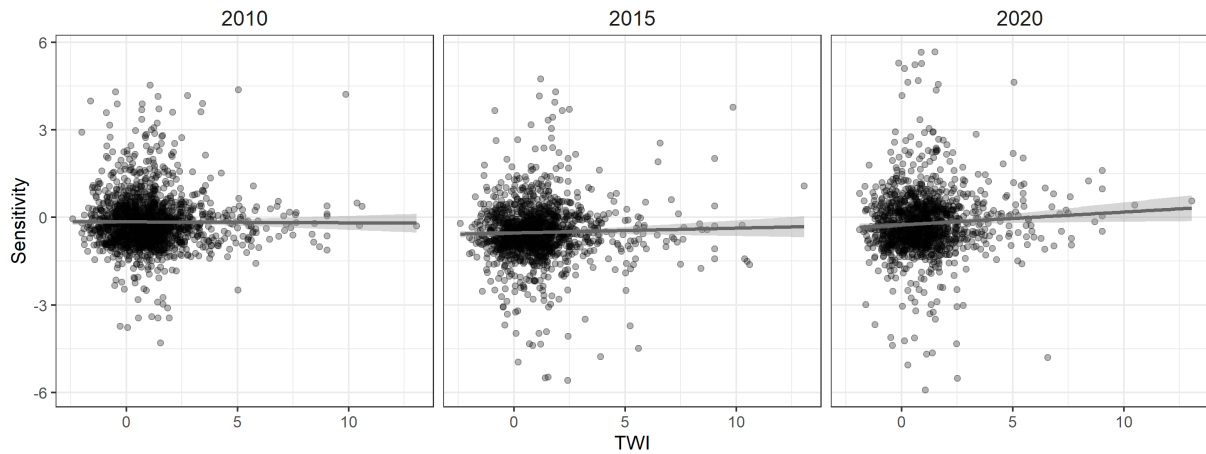
Visualising sensitivity with predictors

Alternate models using Topographic Position Index

As an alternate measure of wetness to Topographic Wetness Index (TWI) that requires the total upslope area, we used Topographic Position Index (TPI), a localised convexity/concavity-based metric of water availability

as a predictor. We calculated TPI using the package *spatialEco* (Evans & Murphy, 2023) using a circular buffer window of 1, 3, 5 and 7 pixels. Larger window sizes while providing a smoother surface on the plot, clip out larger portions of the plot margin where the window might bleed outside. We chose to use the 5-pixel version because of the balance between smoothness across the landscape and data loss.

TPI and TWI had better resolution in different parts of the wetness gradient, with TWI capturing larger resolution among wetter locations and TPI capturing larger resolution among drier locations. Interaction models of deciduousness with TPI showed qualitatively similar results with the TWI models across the three drought years.
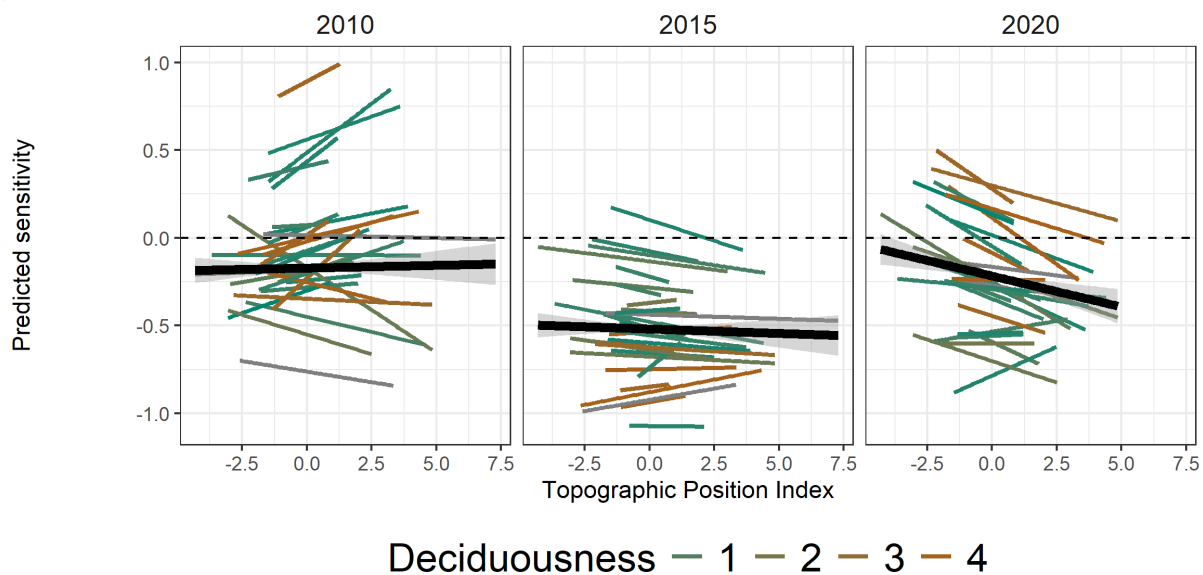

Similarly, models accounting for DBH and CII showed similar directional effects of wetness whether TWI or TPI was used. Please note that left to right represents wet to dry, given the way that TPI is calculated.

a
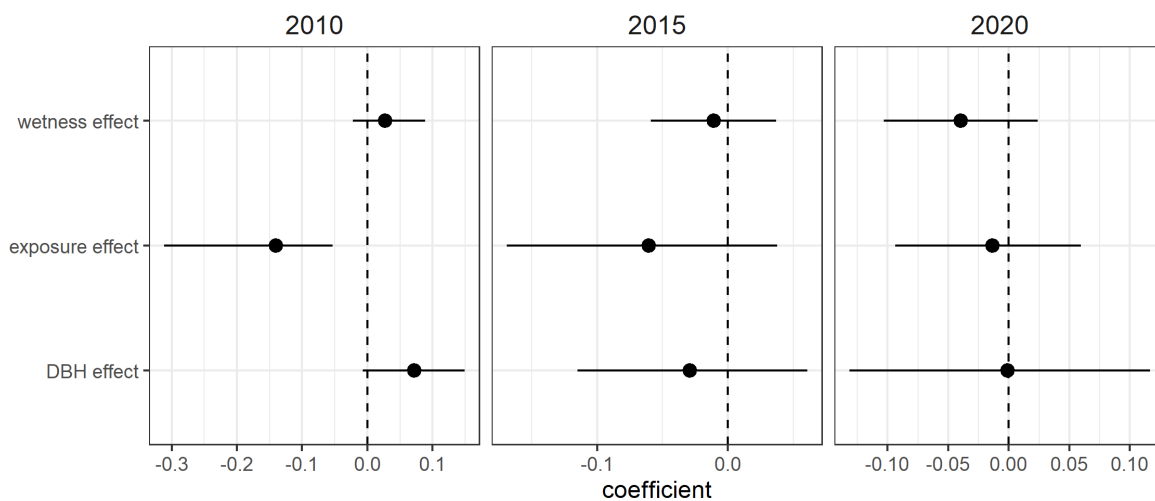
b

References

Evans JS, Murphy MA. **2023**. *spatialEco*.