

Ecography

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**Supplementary material**

## **Appendix 1. Detailed methods of data compilation, collection, and analysis**

To assemble forest plot data sets from the Forest Inventory & Analysis Program (FIA) and Carolina Vegetation Survey (CVS) databases, we compiled all plots designated as forest or woodland, defined by greater than 10% cover of trees, consistent with definitions used by several national agencies (e.g. U.S. National Vegetation Classification, U.S.F.G.D.C. 2008; The U.S. Forest Service Inventory and Analysis Program, Gray et al. 2012). FIA plots with evidence of human disturbance or silvicultural treatment and CVS plots classified as “successional” were excluded from the analysis, as were plots not sampled according to the standard plot layout described below. In cases where a plot was surveyed more than once, we used the most recent survey.

CVS plots used in this analysis were 1000 m<sup>2</sup> in area. The presence of all vascular plant species was recorded within each plot and each species was assigned a cover class value (Peet et al. 1998). Additionally, all woody stems greater than breast height (1.37 m) were identified to species and tallied into diameter classes. A list of tree species for each plot was generated by removing all species classified as shrubs or herbs using growth form classifications reported in Radford et al. 1968; the USDA PLANTS Database, (USDA NRCS 2011), and Weakley 2012. Taxa recorded to subspecies or variety were combined (abundances summed) to the species level. Taxa that were hybrids between two species were combined with the parent species that had the highest abundance in the plot. If neither parent was present, the hybrid was assigned arbitrarily to one of the parent species. Ambiguous taxa and unknown taxa were removed from the data set. Some plots contained trees identified only to the genus level. These taxa were retained and assigned average trait values for the genus and added to the phylogeny at the genus node with a branch length equal to other species within that genus. Thereafter, percent cover was

calculated for each species in each plot using the midpoint of ten visually estimated cover classes (trace, 0-1%, 1-2%, 2-5%, 5-10%, 10-25%, 25-50%, 50-75%, 75-95%, 95-100%).

CVS plots in Florida (FL) and Georgia (GA) do not adequately represent all forest types present in these states and were mostly located in long-leaf pine (*Pinus palustris* L mill.) savannas. To ensure that including only this community type at the most arid end of the water deficit gradient did not bias our results, we conducted a series of sensitivity analyses excluding these plots. First, we examined the distribution of traits of species occurring in FL and GA plots to determine whether inclusion of these species may have altered our inference from null models. Only three species occurred exclusively in FL and GA plots (*Pinus clausa*, *Quercus chapmannii*, and *Q. myrtifolia*) and these species did not have trait values outside the range of the trait distribution all other species in the CVS data set (Figure A1.1). Second, we re-fit all of the regression models excluding plots in FL and GA, but doing so did not qualitatively alter any of the observed relationships between stress gradients and trait values, trait diversity, or phylogenetic diversity (Figures A1.2-3). Based on these analyses we decided to retain FL and GA plots in the final analysis.

Plots in the FIA dataset consisted of four circular subplots, 7.32 m in radius in which all trees greater than 12.7 cm at diameter at breast height (1.37 m; DBH) were identified and measured. Trees smaller than 12.7 cm were measured on four 2.07 m radius microplots nested within these subplots. To account for differences in sampling area, all species abundances for individuals less than 12.7 cm DBH were multiplied by a scaling factor. Seedlings (any tree shorter than breast height) were also counted in the microplots, but in some cases abundances greater than 6 individuals were not recorded. For these plots we estimated seedling abundance based on the average seedling abundance for each species from other plots in the dataset. A list

of tree species for each plot was generated directly from the tree and seedling records for each plot. We removed ambiguously assigned and unidentified species. Some FIA seedlings were only identified to genus and if a tree in that genus was present in the plot, genus-level seedlings were assumed to be that species. If no other tree was in the same genus, the seedling was assigned a genus-level name. Trees and seedlings with genus-level identification were assigned trait and phylogenetic diversity values using the same method as in the CVS database. Thereafter, we calculated basal area for each species on each plot, assuming that each seedling contributed  $0.25 \text{ cm}^2$  to basal area.

For FIA taxa not identified to species, we calculated genus-level trait values by averaging species-level traits from both the FIA and CVS datasets. For CVS taxa not identified to species, we calculated genus-level trait values using only species that were in the CVS database. These genus-level averages were also used for 30 species that were missing trait data (Table A1.1). Species for which we could find no data at the genus level were left with no data for that trait (Table A1.1). All 240 species in the FIA data set have complete trait information, while of the 211 species in the CVS data set, 4 species were missing data for seed mass, 9 for leaf nitrogen, and 15 for wood density. In addition to missing trait information, we were not able to calculate mean pairwise phylogenetic distance for several plots because they had only one functionally distinct species. Thus, 522 FIA plots and 8 CVS plots were excluded from analyses involving phylogenetic or trait diversity.

We calculated water deficit (D) for each plot by intersecting plot geographic coordinates with 30-arc-second resolution maps of long-term average annual PET and AET. However, estimates of D for FIA plots may be slightly inaccurate for two reasons. First, most FIA plot geographic coordinates are fuzzed within 0.5 miles and up to 1.0 miles. Second, 20% of plots on

private land are swapped with other private land plots that have similar plot characteristics and which are in the same county (average county area: 576 mi<sup>2</sup>, largest county: 6,829 mi<sup>2</sup>).

However, because of the relatively small spatial extent of fuzzing and the autocorrelations inherent in modeled spatial environmental data, we do not believe that this introduces any significant errors into the conclusions we draw. Twenty-seven FIA plots and six CVS plots had D values much larger than 600 and were concentrated around a small point in central Florida. Since these values were likely anomalies, we excluded them from analyses involving D. In addition, we were unable to calculate D for 118 CVS plots that were missing geographic coordinates and these plots were also excluded from analyses involving D.

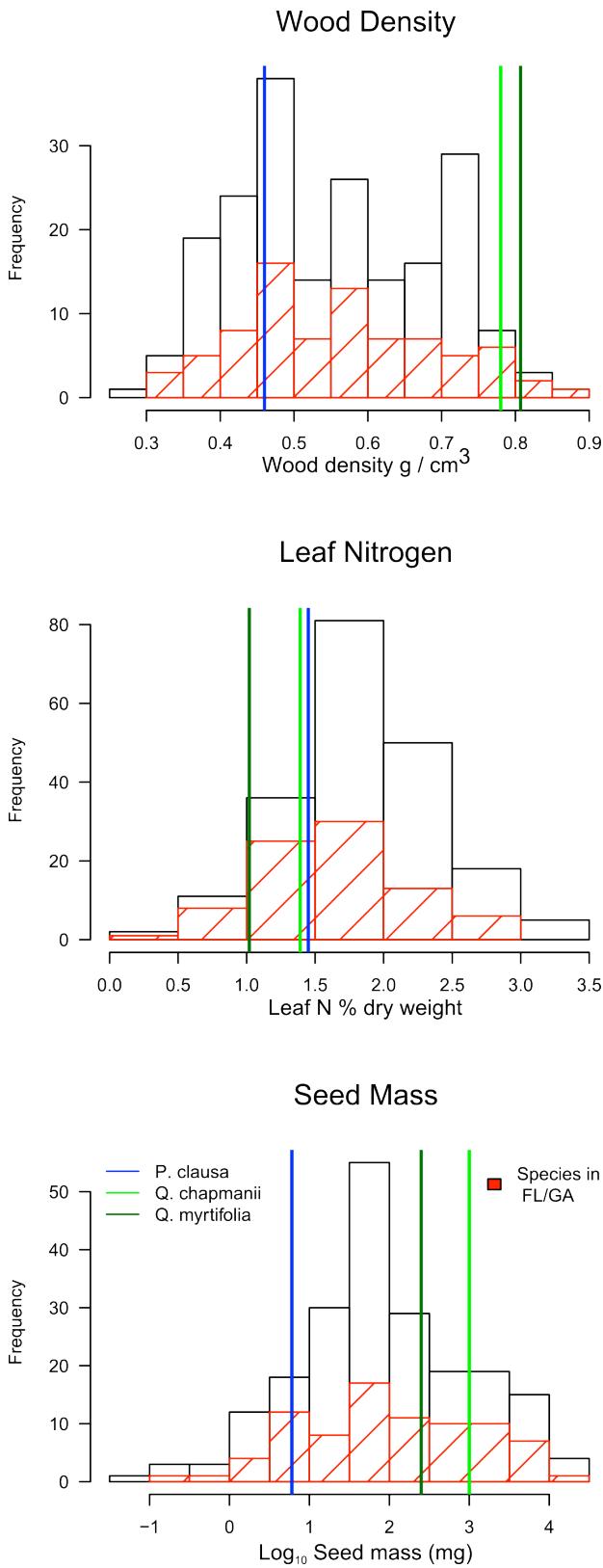
For CVS plots, we examined trait diversity, phylogenetic diversity and mean trait values along a soil nutrient availability gradient in addition to along D. During the time of sampling, soil samples were collected in each CVS plot from the A horizon (top 10 cm) and analyzed for texture (sand, silt, clay %), exchangeable cations (Ca, Mg, K, Na in ppm), extractable micro-nutrients (Al, Fe, Mn, Cu, B in ppm), percent of base saturation for Ca, Mg, K, Na, and H, estimated N release, soluble S, easily extractable P, percent organic matter, percent base saturation, total cation exchange capacity (meq/100g), pH, and bulk density (g/cc)(Peet et al. 1998). Extractions were carried out using the Mehlich III method (Mehlich 1984) and percent organic matter was determined by loss on ignition. Texture analysis employed the Bouyoucos hydrometer method (Patrick 1958).

We used principle components analysis (PCA) to extract a soil nutrient availability axis from the raw CVS soil data (PCA1, variation explained = 0.32). Before analysis, 9 of the 23 soil variables (Ca, Mg, Fe, Al, K, Na, Mn in ppm, soluble S, and easily extractable P))% were log10 transformed to normalize the data and give less weight to outliers. PCA1 was varimax rotated to

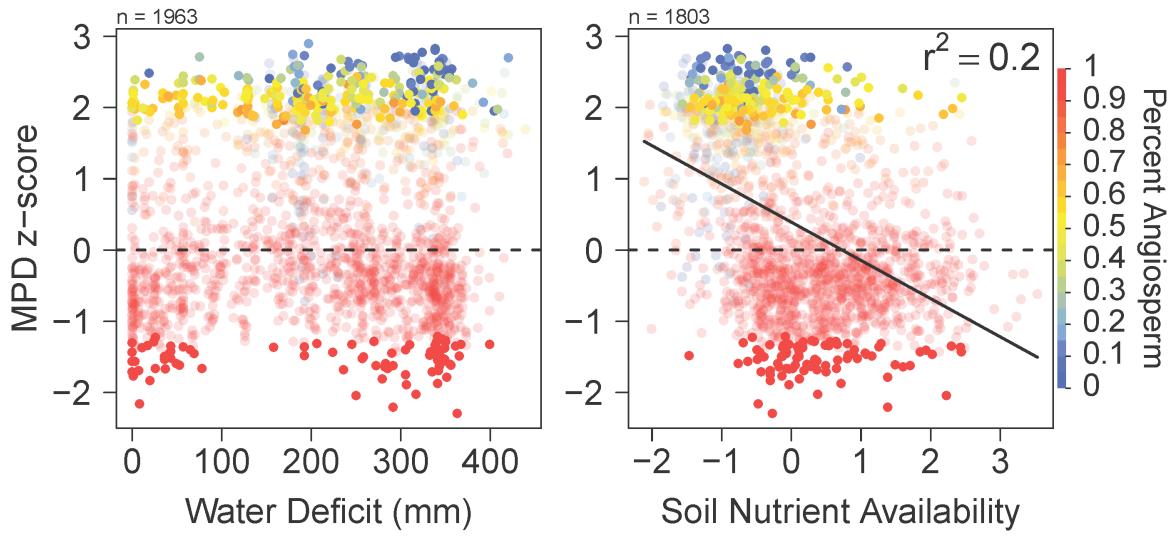
maximize the correlation between PCA1 and individual soil variables within the PCA. Base saturation (0.81), log Ca ppm (0.89) log Mg ppm (0.84) loaded strongly on PCA1, indicating PCA1 represents a soil nutrient availability axis ranging from acidic, stressful conditions to basic, benign conditions (Peet et al. 2013).

## References

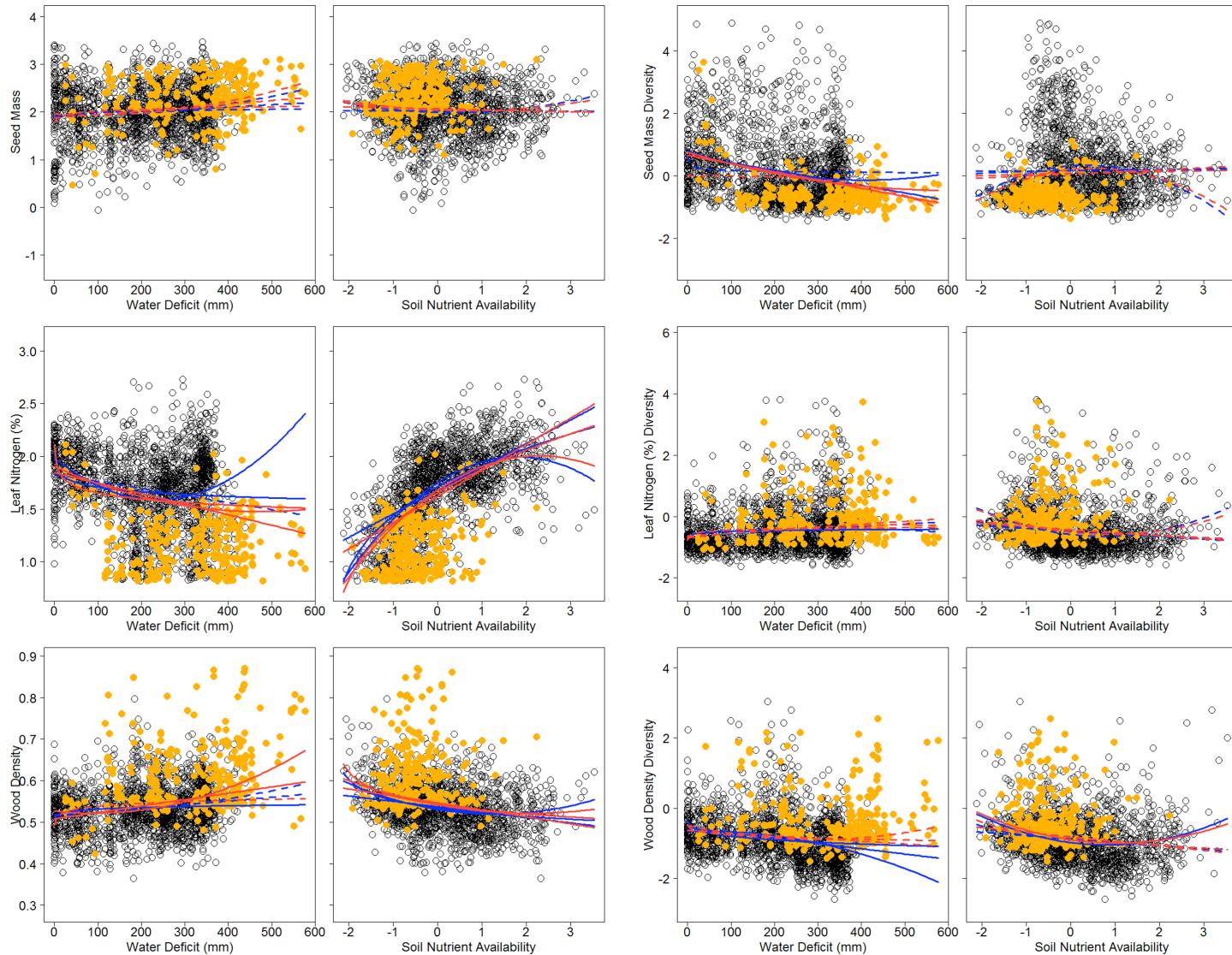
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**Figure A1.1 Trait distributions of species in all CVS plots versus CVS plots in Florida and Georgia.** Histograms in black show the distributions of traits of species in all CVS plots while histograms in red show the distributions of traits for species found in Florida and Georgia CVS plots. Three species were found exclusively in FL and GA plots and their trait values are indicated by vertical lines in blue (*Pinus clausa*), light green (*Quercus chapmanii*) and dark green (*Quercus myrtifolia*).



**Figure A1.2. Relationship between phylogenetic diversity and stress gradients in CVS plots not located in Florida or Georgia.** Removing CVS plots located in FL and GA does not change the relationship (compare to Figure 3).



**Figure A1.3. Relationships between stress gradients and mean traits and trait diversity in CVS plots when plots in Florida and Georgia are excluded.** Points in yellow are plots in FL and GA. Red lines show linear, quadratic, and power models fit to all plots. Blue lines show models fit to plots that are not in FL or GA. Dashed lines indicate  $r^2 < 0.05$ , while solid lines indicate  $r^2 \geq 0.05$ . Models appear to be mostly unaffected by the exclusion of FL and GA plots, especially away from the ends of the gradients where most plots occur.

## Appendix 2. Trait Data

Data for the following species were obtained from Nathan Swenson (Swenson and Weiser 2010).

Trait data for other species are in Tables A2.1-3.

Seed mass (23 species).

*Acer leucoderme, Amelanchier arborea, Bursera simaruba, Carya carolinae-septentrionalis, Carya ovalis, Carya pallida, Carya texana, Castanea pumila, Crataegus mollis, Ficus aurea, Juniperus coahuilensis, Laguncularia racemosa, Malus angustifolia, Planera aquatica, Populus nigra, Quercus margareta, Quercus margarettiae, Quercus minima, Quercus oglethorpeensis, Quercus prinoides, Quercus similis, Salix sepulcralis, Vernicia fordii*

Wood density (88 species):

*Abies fraseri, Acer barbatum, Acer floridanum, Acer leucoderme, Acer rubrum, Acer spicatum, Aesculus glabra, Aesculus sylvatica, Albizia julibrissin, Amelanchier arborea, Annona glabra, Asimina triloba, Avicennia germinans, Bursera simaruba, Carya alba, Carya carolinae-septentrionalis, Carya ovalis, Carya pallida, Carya texana, Castanea mollissima, Castanea pumila, Cladrastis kentukea, Conocarpus erectus, Cotinus obovatus, Crataegus crus-galli, Crataegus mollis, Ficus aurea, Fraxinus caroliniana, Fraxinus quadrangulata, Ginkgo biloba, Gleditsia aquatica, Gordonia lasianthus, Gymnocladus dioicus, Halesia diptera, Juniperus ashei, Juniperus coahuilensis, Juniperus deppeana, Laguncularia racemosa, Magnolia macrophylla, Magnolia tripetala, Malus angustifolia, Malus coronaria, Malus ioensis, Melaleuca quinquenervia, Morus rubra, Nyssa biflora, Nyssa ogeche, Osmanthus americanus, Persea borbonia, Picea engelmannii, Picea pungens, Pinus ponderosa, Planera aquatica, Populus heterophylla, Populus nigra, Prunus americana, Prunus nigra, Prunus persica, Prunus virginiana, Quercus ellipsoidalis, Quercus*

*ilicifolia*, *Quercus imbricaria*, *Quercus marilandica*, *Quercus minima*, *Quercus montana*,  
*Quercus muehlenbergii*, *Quercus oglethorpeensis*, *Quercus pagoda*, *Quercus prinoides*,  
*Quercus prinus*, *Quercus similis*, *Quercus sinuata*, *Rhizophora mangle*, *Sabal palmetto*, *Salix amygdaloides*, *Salix bebbiana*, *Salix caroliniana*, *Salix sepulcralis*, *Sideroxylon lanuginosum*, *Sorbus americana*, *Swietenia mahagoni*, *Syzygium cumini*, *Taxodium ascendens*, *Triadica sebifera*, *Tsuga caroliniana*, *Ulmus serotina*, *Ulmus thomasii*, *Vernicia fordii*

Leaf nitrogen content (91 species):

*Abies fraseri*, *Acer barbatum*, *Acer floridanum*, *Acer leucoderme*, *Acer nigrum*, *Acer rubrum*,  
*Aesculus flava*, *Ailanthus altissima*, *Albizia julibrissin*, *Annona glabra*, *Avicennia germinans*,  
*Bursera simaruba*, *Carya alba*, *Carya aquatica*, *Carya carolinae-septentrionalis*, *Carya laciniosa*, *Carya myristiciformis*, *Carya ovalis*, *Carya pallida*, *Castanea mollissima*,  
*Castanea pumila*, *Celtis laevigata*, *Conocarpus erectus*, *Cotinus obovatus*, *Crataegus crus-galli*, *Crataegus mollis*, *Ficus aurea*, *Fraxinus caroliniana*, *Fraxinus profunda*, *Fraxinus quadrangulata*, *Ginkgo biloba*, *Gleditsia aquatica*, *Gordonia lasianthus*, *Gymnocladus dioicus*, *Halesia carolina*, *Halesia diptera*, *Juniperus ashei*, *Juniperus coahuilensis*,  
*Juniperus deppeana*, *Laguncularia racemosa*, *Maclura pomifera*, *Magnolia acuminata*,  
*Magnolia tripetala*, *Magnolia virginiana*, *Malus angustifolia*, *Malus ioensis*, *Melaleuca quinquenervia*, *Melia azedarach*, *Nyssa aquatica*, *Nyssa biflora*, *Nyssa ogeche*, *Paulownia tomentosa*, *Picea engelmannii*, *Pinus clausa*, *Pinus glabra*, *Pinus ponderosa*, *Pinus pungens*,  
*Pinus serotina*, *Pinus virginiana*, *Planera aquatica*, *Populus nigra*, *Prunus americana*,  
*Prunus nigra*, *Prunus persica*, *Quercus bicolor*, *Quercus imbricaria*, *Quercus lyrata*,  
*Quercus margaretta*, *Quercus margarettiae*, *Quercus minima*, *Quercus muehlenbergii*,

*Quercus oglethorpensis*, *Quercus phellos*, *Quercus prinoides*, *Quercus similis*, *Quercus sinuata*, *Rhizophora mangle*, *Sabal palmetto*, *Salix amygdaloïdes*, *Salix caroliniana*, *Salix sepulcralis*, *Sideroxylon lanuginosum*, *Swietenia mahagoni*, *Triadica sebifera*, *Tsuga caroliniana*, *Ulmus alata*, *Ulmus crassifolia*, *Ulmus pumila*, *Ulmus serotina*, *Ulmus thomasii*, *Vernicia fordii*

**Table A2.1. Seed mass values and data sources.** Seed mass is measured as the average mass of one seed in mg. Values used in the analysis of FIA and CVS data are listed separately because we calculated different genus-level average trait values for each data set. A dash indicates that a taxon did not occur in the data set. Data sources are in Table A2.4 and ‘derived’ indicates that the value is from a genus-level average or, for hybrids, an average of the two parent taxa.

Taxon	FIA	CVS	Data Source
Abies	7.52	-	derived
Abies balsamea	7.58	-	6
Abies fraseri	7.46	7.46	6
Acer	-	72.46	derived
Acer barbatum	64.80	-	6
Acer floridanum	-	64.80	6
Acer negundo	39.93	39.93	6
Acer nigrum	64.52	64.52	6
Acer pensylvanicum	39.93	39.93	6
Acer platanoides	171.82	-	6
Acer rubrum	19.96	19.96	6
Acer saccharinum	281.73	281.73	6
Acer saccharum	69.36	69.36	6
Acer spicatum	19.96	19.96	6
Aesculus	11173.38	-	derived
Aesculus flava	16199.73	16199.73	6
Aesculus glabra	7820.56	-	6
Aesculus pavia	4346.66	4346.66	4
Aesculus sylvatica	11339.81	11339.81	6
Ailanthus altissima	30.98	30.98	6
Albizia julibrissin	41.24	41.24	6

<i>Alnus glutinosa</i>	1.40	-	6
<i>Amelanchier</i>	5.54	36.32	derived
<i>Amelanchier arborea</i>	5.68	-	6
<i>Amelanchier laevis</i>	-	67.10	4
<i>Amelanchier sanguinea</i>	5.40	-	7
<i>Annona glabra</i>	229.00	-	4
<i>Aralia spinosa</i>	-	3.46	6
<i>Asimina</i>	-	650.78	derived
<i>Asimina triloba</i>	650.78	650.78	6
<i>Avicennia germinans</i>	10120.00	-	5
<i>Betula</i>	0.67	0.98	derived
<i>Betula alleghaniensis</i>	1.02	1.02	6
<i>Betula lenta</i>	0.70	0.70	6
<i>Betula nigra</i>	1.21	1.21	6
<i>Betula papyrifera</i>	0.33	-	6
<i>Betula populifolia</i>	0.11	-	6
<i>Carpinus caroliniana</i>	12.96	12.96	6
<i>Carya</i>	4761.23	5014.34	derived
<i>Carya alba</i>	6213.59	6213.59	6
<i>Carya aquatica</i>	2267.96	2267.96	6
<i>Carya cordiformis</i>	2907.64	2907.64	6
<i>Carya glabra</i>	2267.96	2267.96	6
<i>Carya illinoiensis</i>	3489.17	-	6
<i>Carya laciniosa</i>	15119.75	15119.75	6
<i>Carya myristiciformis</i>	3658.00	3658.00	6
<i>Carya ovata</i>	4724.92	4724.92	6
<i>Castanea dentata</i>	4535.92	4535.92	6
<i>Castanea mollissima</i>	6047.90	-	7
<i>Catalpa</i>	22.15	-	derived
<i>Catalpa bignonioides</i>	22.15	22.15	6
<i>Catalpa speciosa</i>	22.15	22.15	6
<i>Celtis</i>	108.36	108.36	derived
<i>Celtis laevigata</i>	206.18	206.18	6
<i>Celtis occidentalis</i>	10.55	10.55	6
<i>Celtis tenuifolia</i>	-	108.36	derived
<i>Cercis canadensis</i>	25.20	25.20	6
<i>Chamaecyparis thyoides</i>	0.99	0.99	6
<i>Chionanthus virginicus</i>	-	252.00	6
<i>Cinnamomum camphora</i>	108.00	-	4
<i>Cladrastis kentukea</i>	37.80	37.80	6
<i>Conocarpus erectus</i>	3.30	-	4
<i>Cornus</i>	-	78.97	derived
<i>Cornus alternifolia</i>	-	56.70	6

<i>Cornus florida</i>	101.25	101.25	6
<i>Cotinus obovatus</i>	8.95	-	4
<i>Crataegus</i>	90.52	36.29	derived
<i>Crataegus [collina + punctata]</i>	-	101.80	derived
<i>Crataegus aestivalis</i>	-	22.68	6
<i>Crataegus alleghaniensis</i>	-	22.68	6
<i>Crataegus aprica</i>	-	36.29	derived
<i>Crataegus berberifolia</i>	-	36.29	derived
<i>Crataegus crus-galli</i>	90.72	90.72	6
<i>Crataegus flava</i>	-	36.29	derived
<i>Crataegus intricata</i>	-	36.29	derived
<i>Crataegus iracunda</i>	-	36.29	derived
<i>Crataegus lacrimata</i>	-	36.29	derived
<i>Crataegus macrosperma</i>	-	36.29	derived
<i>Crataegus margareta</i>	-	36.29	derived
<i>Crataegus marshallii</i>	-	22.68	6
<i>Crataegus phaenopyrum</i>	-	53.47	4
<i>Crataegus pruinosa</i>	-	50.43	4
<i>Crataegus pulcherrima</i>	-	36.29	derived
<i>Crataegus schuettei</i>	-	36.29	derived
<i>Crataegus spathulata</i>	-	36.29	derived
<i>Crataegus viridis</i>	-	22.68	6
<i>Diospyros</i>	262.90	-	derived
<i>Diospyros virginiana</i>	377.99	377.99	6
<i>Elaeagnus</i>	-	87.91	derived
<i>Elaeagnus angustifolia</i>	87.91	87.91	6
<i>Fagus grandifolia</i>	283.50	283.50	6
<i>Frangula caroliniana</i>	-	171.47	4
<i>Fraxinus</i>	69.29	74.44	derived
<i>Fraxinus americana</i>	45.36	45.36	6
<i>Fraxinus caroliniana</i>	78.97	78.97	6
<i>Fraxinus nigra</i>	46.62	-	6
<i>Fraxinus pennsylvanica</i>	31.68	31.68	6
<i>Fraxinus profunda</i>	141.75	141.75	6
<i>Fraxinus quadrangulata</i>	71.40	-	4
<i>Ginkgo biloba</i>	1522.00	-	4
<i>Gleditsia</i>	156.60	-	derived
<i>Gleditsia aquatica</i>	151.20	151.20	6
<i>Gleditsia triacanthos</i>	162.00	162.00	6
<i>Gordonia lasianthus</i>	3.36	3.36	6
<i>Gymnocladus dioicus</i>	1972.14	-	6
<i>Halesia</i>	292.95	-	derived
<i>Halesia carolina</i>	283.50	283.50	6

<i>Halesia diptera</i>	302.39	-	6
<i>Halesia tetaptera</i>	-	283.50	derived
<i>Ilex</i>	-	10.54	derived
<i>Ilex cassine</i>	-	2.70	3
<i>Ilex decidua</i>	-	9.30	4
<i>Ilex montana</i>	-	12.73	4
<i>Ilex opaca</i>	15.95	15.95	6
<i>Ilex vomitoria</i>	-	12.00	6
<i>Juglans</i>	13229.78	-	derived
<i>Juglans cinerea</i>	15119.75	15119.75	6
<i>Juglans nigra</i>	11339.81	11339.81	6
<i>Juniperus</i>	63.29	-	derived
<i>Juniperus ashei</i>	42.90	-	4
<i>Juniperus deppeana</i>	177.62	-	4
<i>Juniperus virginiana</i>	10.40	10.40	6
<i>Larix</i>	1.55	-	derived
<i>Larix laricina</i>	1.55	-	6
<i>Liquidambar styraciflua</i>	5.53	5.53	6
<i>Liriodendron tulipifera</i>	32.40	32.40	6
<i>Maclura pomifera</i>	64.80	-	6
<i>Magnolia</i>	124.17	-	derived
<i>Magnolia [tripetala + virginiana]</i>	-	161.70	derived
<i>Magnolia acuminata</i>	83.23	83.23	6
<i>Magnolia fraseri</i>	99.69	99.69	6
<i>Magnolia grandiflora</i>	70.87	70.87	6
<i>Magnolia macrophylla</i>	167.80	167.80	4
<i>Magnolia tripetala</i>	263.16	263.16	4
<i>Magnolia virginiana</i>	60.24	60.24	6
<i>Malus</i>	21.76	25.09	derived
<i>Malus coronaria</i>	32.85	32.85	4
<i>Malus ioensis</i>	15.12	-	7
<i>Melaleuca quinquenervia</i>	0.22	-	4
<i>Melia azedarach</i>	348.00	348.00	4
<i>Morus</i>	2.22	1.62	derived
<i>Morus alba</i>	1.93	1.93	6
<i>Morus nigra</i>	3.40	-	4
<i>Morus rubra</i>	1.32	1.32	6
<i>Nyssa</i>	-	422.99	derived
<i>Nyssa aquatica</i>	944.98	944.98	6
<i>Nyssa biflora</i>	189.00	189.00	6
<i>Nyssa ogeche</i>	368.77	-	6
<i>Nyssa sylvatica</i>	135.00	135.00	6

<i>Osmanthus americanus</i>	-	n.d.	no data
<i>Ostrya virginiana</i>	15.12	15.12	6
<i>Oxydendrum arboreum</i>	0.12	0.12	6
<i>Paulownia tomentosa</i>	0.16	0.16	6
<i>Persea</i>	216.00	-	derived
<i>Persea borbonia</i>	216.00	216.00	6
<i>Persea palustris</i>	-	216.00	derived
<i>Picea abies</i>	7.09	-	6
<i>Picea engelmannii</i>	3.36	-	7
<i>Picea glauca</i>	2.43	-	6
<i>Picea mariana</i>	1.12	-	6
<i>Picea pungens</i>	4.28	-	6
<i>Picea rubens</i>	3.24	3.24	6
<i>Pinus</i>	-	22.05	derived
<i>Pinus banksiana</i>	3.46	-	6
<i>Pinus clausa</i>	6.03	6.03	6
<i>Pinus echinata</i>	9.45	9.45	6
<i>Pinus elliottii</i>	31.33	31.33	6
<i>Pinus glabra</i>	9.78	9.78	6
<i>Pinus nigra</i>	17.39	-	6
<i>Pinus palustris</i>	106.98	106.98	6
<i>Pinus ponderosa</i>	37.80	-	6
<i>Pinus pungens</i>	13.26	13.26	6
<i>Pinus resinosa</i>	8.70	-	6
<i>Pinus rigida</i>	7.31	7.31	6
<i>Pinus serotina</i>	8.34	8.34	6
<i>Pinus strobus</i>	16.77	16.77	6
<i>Pinus sylvestris</i>	6.41	-	6
<i>Pinus taeda</i>	24.65	24.65	6
<i>Pinus virginiana</i>	8.70	8.70	6
<i>Platanus occidentalis</i>	2.36	2.36	6
<i>Populus</i>	3.21	-	derived
<i>Populus balsamifera</i>	0.24	-	4
<i>Populus deltoides</i>	1.07	1.07	6
<i>Populus grandidentata</i>	0.15	-	6
<i>Populus heterophylla</i>	2.98	2.98	6
<i>Populus tremuloides</i>	0.14	-	6
<i>Prunus</i>	495.61	195.93	derived
<i>Prunus alleghaniensis</i>	153.78	-	4
<i>Prunus americana</i>	521.37	521.37	6
<i>Prunus angustifolia</i>	-	441.70	4
<i>Prunus avium</i>	187.00	-	4
<i>Prunus caroliniana</i>	-	358.00	2

<i>Prunus injucunda</i>	-	181.44	6
<i>Prunus nigra</i>	93.04	93.04	6
<i>Prunus pensylvanica</i>	31.94	31.94	6
<i>Prunus persica</i>	2792.00	-	4
<i>Prunus serotina</i>	94.50	94.50	6
<i>Prunus umbellata</i>	-	195.93	derived
<i>Prunus virginiana</i>	91.25	91.25	6
<i>Pseudotsuga menziesii</i>	10.78	-	6
<i>Ptelea trifoliata</i>	-	37.80	6
<i>Pyrus calleryana</i>	-	12.90	4
<i>Quercus</i>	2115.43	1693.84	derived
<i>Quercus "waccamawensis"</i>	-	1693.84	derived
<i>Quercus alba</i>	3543.69	3543.69	6
<i>Quercus arkansana</i>	-	1693.84	derived
<i>Quercus austrina</i>	-	1330.00	1
<i>Quercus bicolor</i>	3779.94	-	6
<i>Quercus chapmanii</i>	-	1000.00	1
<i>Quercus coccinea</i>	1930.18	1930.18	6
<i>Quercus ellipsoidalis</i>	1557.93	-	4
<i>Quercus falcata</i>	839.99	839.99	6
<i>Quercus geminata</i>	-	640.00	1
<i>Quercus hemisphaerica</i>	-	740.00	1
<i>Quercus ilicifolia</i>	648.49	648.49	4
<i>Quercus imbricaria</i>	1092.99	1092.99	6
<i>Quercus incana</i>	1000.00	1000.00	4
<i>Quercus laevis</i>	1148.34	1148.34	6
<i>Quercus laurifolia</i>	809.99	809.99	6
<i>Quercus lyrata</i>	3239.95	3239.95	6
<i>Quercus macrocarpa</i>	6047.90	-	6
<i>Quercus marilandica</i>	647.99	647.99	6
<i>Quercus michauxii</i>	5336.38	5336.38	6
<i>Quercus montana</i>	-	4535.92	6
<i>Quercus muehlenbergii</i>	1133.98	1133.98	6
<i>Quercus myrtifolia</i>	-	250.00	1
<i>Quercus nigra</i>	1148.34	1148.34	6
<i>Quercus pagoda</i>	782.06	782.06	6
<i>Quercus palustris</i>	1106.32	1106.32	6
<i>Quercus phellos</i>	981.80	981.80	6
<i>Quercus prinus</i>	4535.92	-	6
<i>Quercus rubra</i>	3628.74	3628.74	6
<i>Quercus shumardii</i>	4535.92	4535.92	6
<i>Quercus sinuata</i>	1567.00	-	4
<i>Quercus stellata</i>	1193.66	1193.66	6

<i>Quercus texana</i>	4785.00	-	4
<i>Quercus velutina</i>	1851.40	1851.40	6
<i>Quercus virginiana</i>	1288.61	1288.61	6
<i>Rhizophora mangle</i>	10100.00	-	4
<i>Robinia</i>	-	18.90	derived
<i>Robinia pseudoacacia</i>	18.90	18.90	6
<i>Sabal palmetto</i>	270.80	270.80	6
<i>Salix</i>	0.14	-	derived
<i>Salix alba</i>	0.12	-	4
<i>Salix amygdaloides</i>	0.17	-	6
<i>Salix bebbiana</i>	0.18	-	4
<i>Salix caroliniana</i>	0.05	0.05	6
<i>Salix nigra</i>	0.18	0.18	6
<i>Salix pyrifolia</i>	0.14	-	derived
<i>Sassafras albidum</i>	90.72	90.72	6
<i>Sideroxylon lanuginosum</i>	79.56	79.56	4
<i>Sideroxylon lycioides</i>	-	90.72	6
<i>Sideroxylon salicifolium</i>	79.56	-	derived
<i>Sideroxylon tenax</i>	-	85.14	derived
<i>Sorbus</i>	16.36	-	derived
<i>Sorbus americana</i>	2.83	2.83	6
<i>Sorbus decora</i>	29.88	-	7
<i>Staphylea</i>	-	56.61	4
<i>Staphylea trifolia</i>	-	41.53	4
<i>Stewartia ovata</i>	-	n.d.	no data
<i>Styphnolobium japonicum</i>	-	118.10	4
<i>Styrax grandifolius</i>	-	56.30	4
<i>Swietenia mahagoni</i>	62.48	-	6
<i>Symplocos tinctoria</i>	-	n.d.	no data
<i>Syzygium cumini</i>	113.40	-	6
<i>Taxodium ascendens</i>	90.72	90.72	6
<i>Taxodium distichum</i>	87.23	87.23	6
<i>Thuja occidentalis</i>	1.31	-	6
<i>Tilia</i>	95.19	95.19	derived
<i>Tilia americana</i>	95.19	95.19	6
<i>Triadica sebifera</i>	133.00	133.00	4
<i>Tsuga</i>	3.85	-	derived
<i>Tsuga canadensis</i>	2.42	2.42	6
<i>Tsuga caroliniana</i>	5.27	5.27	6
<i>Ulmus</i>	14.73	7.18	derived
<i>Ulmus alata</i>	4.07	4.07	6
<i>Ulmus americana</i>	6.40	6.40	6
<i>Ulmus crassifolia</i>	6.77	-	6

<i>Ulmus pumila</i>	6.98	-	6
<i>Ulmus rubra</i>	11.06	11.06	6
<i>Ulmus serotina</i>	3.04	-	6
<i>Ulmus thomasii</i>	64.80	-	6
<i>Vaccinium arboreum</i>	-	1.24	4
<i>Zanthoxylum clava-herculis</i>	-	28.50	4

**Table A2.2. Wood density values and data sources.** Wood density is measured as the oven dry mass divided by green volume in g/cm<sup>3</sup>. Values used in the analysis of FIA and CVS data are listed separately because we calculated different genus-level average trait values for each data set. A dash indicates that a taxon did not occur in the data set. Data sources are in Table A2.4 and ‘derived’ indicates that the value is from a genus-level average or, for hybrids, an average of the two parent taxa.

Taxon	FIA	CVS	Data Source
<i>Abies</i>	0.42	-	derived
<i>Abies balsamea</i>	0.33	-	1
<i>Acer</i>	-	0.49	derived
<i>Acer negundo</i>	0.42	0.42	1
<i>Acer nigrum</i>	0.52	0.52	1
<i>Acer pensylvanicum</i>	0.44	0.44	1
<i>Acer platanoides</i>	0.53	-	1
<i>Acer rubrum</i>	-	0.49	1
<i>Acer saccharinum</i>	0.44	0.44	1
<i>Acer saccharum</i>	0.56	0.56	1
<i>Aesculus</i>	0.36	-	derived
<i>Aesculus flava</i>	0.35	0.35	1
<i>Aesculus pavia</i>	0.36	0.37	derived
<i>Ailanthus altissima</i>	0.46	0.46	1
<i>Alnus glutinosa</i>	0.42	-	1
<i>Amelanchier</i>	0.76	0.76	derived
<i>Amelanchier arborea</i>	-	0.76	derived
<i>Amelanchier laevis</i>	-	0.76	derived
<i>Amelanchier sanguinea</i>	0.76	-	derived
<i>Aralia spinosa</i>	-	-	1
<i>Asimina</i>	-	0.38	derived
<i>Betula</i>	0.51	0.55	derived
<i>Betula alleghaniensis</i>	0.55	0.55	1
<i>Betula lenta</i>	0.60	0.60	1
<i>Betula nigra</i>	0.49	0.49	1
<i>Betula papyrifera</i>	0.48	-	1
<i>Betula populifolia</i>	0.45	-	1

<i>Carpinus caroliniana</i>	0.58	0.58	1
<i>Carya</i>	0.66	0.67	derived
<i>Carya aquatica</i>	0.61	0.61	1
<i>Carya cordiformis</i>	0.60	0.60	1
<i>Carya glabra</i>	0.66	0.66	1
<i>Carya illinoinensis</i>	0.60	-	1
<i>Carya laciniosa</i>	0.62	0.62	1
<i>Carya myristiciformis</i>	0.56	0.56	1
<i>Carya ovata</i>	0.64	0.64	1
<i>Castanea dentata</i>	0.40	0.40	1
<i>Catalpa</i>	0.37	-	derived
<i>Catalpa bignonioides</i>	0.36	0.36	1
<i>Catalpa speciosa</i>	0.38	0.38	1
<i>Celtis</i>	0.48	0.48	derived
<i>Celtis laevigata</i>	0.47	0.47	1
<i>Celtis occidentalis</i>	0.49	0.49	1
<i>Celtis tenuifolia</i>	-	0.48	derived
<i>Cercis canadensis</i>	0.65	0.65	1
<i>Chamaecyparis thyoides</i>	0.31	0.31	1
<i>Chionanthus virginicus</i>	-	n.d.	no data
<i>Cinnamomum camphora</i>	0.62	-	1
<i>Cornus</i>	-	0.64	derived
<i>Cornus alternifolia</i>	-	0.64	derived
<i>Cornus florida</i>	0.64	0.64	1
<i>Crataegus</i>	0.72	0.72	derived
<i>Crataegus [collina + punctata]</i>	-	0.72	derived
<i>Crataegus aestivalis</i>	-	0.72	derived
<i>Crataegus alleghaniensis</i>	-	0.72	derived
<i>Crataegus aprica</i>	-	0.72	derived
<i>Crataegus berberifolia</i>	-	0.72	derived
<i>Crataegus flava</i>	-	0.72	derived
<i>Crataegus intricata</i>	-	0.72	derived
<i>Crataegus iracunda</i>	-	0.72	derived
<i>Crataegus lacrimata</i>	-	0.72	derived
<i>Crataegus macrosperma</i>	-	0.72	derived
<i>Crataegus margareta</i>	-	0.72	derived
<i>Crataegus marshallii</i>	-	0.72	derived
<i>Crataegus phaenopyrum</i>	-	0.72	derived
<i>Crataegus pruinosa</i>	-	0.72	derived
<i>Crataegus pulcherrima</i>	-	0.72	derived
<i>Crataegus schuettei</i>	-	0.72	derived
<i>Crataegus spathulata</i>	-	0.72	derived
<i>Crataegus viridis</i>	-	0.72	derived
<i>Diospyros</i>	0.67	-	derived
<i>Diospyros virginiana</i>	0.67	0.67	1
<i>Elaeagnus</i>	-	0.46	derived
<i>Elaeagnus angustifolia</i>	0.46	0.46	1
<i>Fagus grandifolia</i>	0.56	0.56	1
<i>Frangula caroliniana</i>	-	n.d.	no data
<i>Fraxinus</i>	0.51	0.51	derived

<i>Fraxinus americana</i>	0.55	0.55	1
<i>Fraxinus nigra</i>	0.45	-	1
<i>Fraxinus pennsylvanica</i>	0.53	0.53	1
<i>Fraxinus profunda</i>	0.48	0.48	1
<i>Gleditsia</i>	0.66	-	derived
<i>Gleditsia triacanthos</i>	0.60	0.60	1
<i>Halesia</i>	0.42	-	derived
<i>Halesia carolina</i>	0.42	0.42	1
<i>Halesia tetraptera</i>	-	0.42	derived
<i>Ilex</i>	-	0.50	derived
<i>Ilex cassine</i>	-	0.50	derived
<i>Ilex decidua</i>	-	0.50	derived
<i>Ilex montana</i>	-	0.50	derived
<i>Ilex opaca</i>	0.50	0.50	1
<i>Ilex vomitoria</i>	-	0.50	derived
<i>Juglans</i>	0.44	-	derived
<i>Juglans cinerea</i>	0.36	0.36	1
<i>Juglans nigra</i>	0.51	0.51	1
<i>Juniperus</i>	0.54	-	derived
<i>Juniperus virginiana</i>	0.44	0.44	1
<i>Larix</i>	0.49	-	derived
<i>Larix laricina</i>	0.49	-	1
<i>Liquidambar styraciflua</i>	0.46	0.46	1
<i>Liriodendron tulipifera</i>	0.40	0.40	1
<i>Maclura pomifera</i>	0.76	-	1
<i>Magnolia</i>	0.42	-	derived
<i>Magnolia [tripetala + virginiana]</i>	-	0.43	derived
<i>Magnolia acuminata</i>	0.44	0.44	1
<i>Magnolia fraseri</i>	0.40	0.40	1
<i>Magnolia grandiflora</i>	0.37	0.37	1
<i>Magnolia virginiana</i>	0.42	0.42	1
<i>Malus</i>	0.71	0.67	derived
<i>Melia azedarach</i>	0.38	0.38	1
<i>Morus</i>	0.59	0.59	derived
<i>Morus alba</i>	0.59	0.59	1
<i>Morus nigra</i>	0.59	-	derived
<i>Nyssa</i>	-	0.48	derived
<i>Nyssa aquatica</i>	0.46	0.46	1
<i>Nyssa sylvatica</i>	0.46	0.46	1
<i>Ostrya virginiana</i>	0.63	0.63	1
<i>Oxydendrum arboreum</i>	0.50	0.50	1
<i>Paulownia tomentosa</i>	0.28	0.28	1
<i>Persea</i>	0.64	-	derived
<i>Persea palustris</i>	-	0.64	derived
<i>Picea abies</i>	0.37	-	1
<i>Picea glauca</i>	0.33	-	1
<i>Picea mariana</i>	0.38	-	1
<i>Picea rubens</i>	0.37	0.37	1
<i>Pinus</i>	-	0.47	derived
<i>Pinus banksiana</i>	0.40	-	1

<i>Pinus clausa</i>	0.46	0.46	1
<i>Pinus echinata</i>	0.47	0.47	1
<i>Pinus elliottii</i>	0.54	0.54	1
<i>Pinus glabra</i>	0.41	0.41	1
<i>Pinus nigra</i>	0.42	-	1
<i>Pinus palustris</i>	0.54	0.54	1
<i>Pinus pungens</i>	0.49	0.49	1
<i>Pinus resinosa</i>	0.41	-	1
<i>Pinus rigida</i>	0.47	0.47	1
<i>Pinus serotina</i>	0.51	0.51	1
<i>Pinus strobus</i>	0.34	0.34	1
<i>Pinus sylvestris</i>	0.39	-	1
<i>Pinus taeda</i>	0.47	0.47	1
<i>Pinus virginiana</i>	0.45	0.45	1
<i>Platanus occidentalis</i>	0.46	0.46	1
<i>Populus</i>	0.34	-	derived
<i>Populus balsamifera</i>	0.31	-	1
<i>Populus deltoides</i>	0.37	0.37	1
<i>Populus grandidentata</i>	0.36	-	1
<i>Populus tremuloides</i>	0.35	-	1
<i>Prunus</i>	0.45	0.45	derived
<i>Prunus alleghaniensis</i>	0.45	-	derived
<i>Prunus angustifolia</i>	-	0.45	derived
<i>Prunus avium</i>	0.47	-	1
<i>Prunus caroliniana</i>	-	0.45	derived
<i>Prunus injucunda</i>	-	0.45	derived
<i>Prunus pensylvanica</i>	0.36	0.36	1
<i>Prunus serotina</i>	0.47	0.47	1
<i>Prunus umbellata</i>	-	0.45	derived
<i>Pseudotsuga menziesii</i>	0.43	-	1
<i>Ptelea trifoliata</i>	-	n.d.	no data
<i>Pyrus calleryana</i>	-	n.d.	no data
<i>Quercus</i>	0.65	0.66	derived
<i>Quercus "waccamawensis"</i>	-	0.66	derived
<i>Quercus alba</i>	0.60	0.60	1
<i>Quercus arkansana</i>	-	0.66	derived
<i>Quercus austrina</i>	-	0.75	1
<i>Quercus bicolor</i>	0.66	-	1
<i>Quercus chapmanii</i>	-	0.78	1
<i>Quercus coccinea</i>	0.60	0.60	1
<i>Quercus falcata</i>	0.52	0.52	1
<i>Quercus geminata</i>	-	0.87	1
<i>Quercus hemisphaerica</i>	-	0.69	1
<i>Quercus incana</i>	0.71	0.71	1
<i>Quercus laevis</i>	0.64	0.64	1
<i>Quercus laurifolia</i>	0.56	0.56	1
<i>Quercus lyrata</i>	0.57	0.57	1
<i>Quercus macrocarpa</i>	0.58	-	1
<i>Quercus margarettae</i>	-	0.76	1
<i>Quercus margarettiae</i>	0.76	-	1

<i>Quercus michauxii</i>	0.60	0.60	1
<i>Quercus myrtifolia</i>	-	0.81	1
<i>Quercus nigra</i>	0.56	0.56	1
<i>Quercus palustris</i>	0.58	0.58	1
<i>Quercus phellos</i>	0.56	0.56	1
<i>Quercus rubra</i>	0.56	0.56	1
<i>Quercus shumardii</i>	0.64	0.64	1
<i>Quercus stellata</i>	0.60	0.60	1
<i>Quercus texana</i>	0.64	-	derived
<i>Quercus velutina</i>	0.56	0.56	1
<i>Quercus virginiana</i>	0.80	0.80	1
<i>Robinia</i>	-	0.66	derived
<i>Robinia pseudoacacia</i>	0.66	0.66	1
<i>Salix</i>	0.35	-	derived
<i>Salix alba</i>	0.28	-	1
<i>Salix nigra</i>	0.36	0.36	1
<i>Salix pyrifolia</i>	0.35	-	derived
<i>Sassafras albidum</i>	0.42	0.42	1
<i>Sideroxylon lycioides</i>	-	0.67	derived
<i>Sideroxylon salicifolium</i>	0.81	-	derived
<i>Sideroxylon tenax</i>	-	0.67	derived
<i>Sorbus</i>	0.54	-	derived
<i>Sorbus decora</i>	0.54	-	derived
<i>Staphylea</i>	-	n.d.	no data
<i>Staphylea trifolia</i>	-	n.d.	no data
<i>Stewartia ovata</i>	-	n.d.	no data
<i>Styphnolobium japonicum</i>	-	n.d.	no data
<i>Styrax grandifolius</i>	-	n.d.	no data
<i>Symplocos tinctoria</i>	-	n.d.	no data
<i>Taxodium distichum</i>	0.42	0.42	1
<i>Thuja occidentalis</i>	0.29	-	1
<i>Tilia</i>	0.32	0.32	derived
<i>Tilia americana</i>	0.32	0.32	1
<i>Tsuga</i>	0.38	-	derived
<i>Tsuga canadensis</i>	0.38	0.38	1
<i>Ulmus</i>	0.57	0.51	derived
<i>Ulmus alata</i>	0.60	0.60	1
<i>Ulmus americana</i>	0.46	0.46	1
<i>Ulmus crassifolia</i>	0.64	-	3
<i>Ulmus pumila</i>	0.55	-	1
<i>Ulmus rubra</i>	0.48	0.48	1
<i>Vaccinium arboreum</i>	-	n.d.	no data
<i>Zanthoxylum clava-herculis</i>	-	n.d.	no data

**Table A2.3. Leaf nitrogen values and data sources.** Leaf nitrogen content is measured as the as a percent of dry leaf weight. Values used in the analysis of FIA and CVS data are listed separately because we calculated different genus-level average trait values for each data set. A

dash indicates that a taxon did not occur in the data set. Data sources are in Table A2.4 and ‘derived’ indicates that the value is from a genus-level average or, for hybrids, an average of the two parent taxa.

Taxon	FIA	CVS	Data Source
<i>Abies</i>	1.43	-	derived
<i>Abies balsamea</i>	1.29	-	33
<i>Acer</i>	-	2.11	derived
<i>Acer negundo</i>	2.50	2.50	37
<i>Acer pensylvanicum</i>	1.90	1.90	37
<i>Acer platanoides</i>	1.62	-	37
<i>Acer rubrum</i>	-	1.84	37
<i>Acer saccharinum</i>	2.60	2.60	25
<i>Acer saccharum</i>	1.85	1.85	37
<i>Acer spicatum</i>	2.49	2.49	33
<i>Aesculus</i>	2.11	-	derived
<i>Aesculus glabra</i>	2.08	-	22
<i>Aesculus pavia</i>	2.11	2.02	derived
<i>Aesculus sylvatica</i>	1.90	1.90	10
<i>Alnus glutinosa</i>	3.54	-	37
<i>Amelanchier</i>	1.80	1.80	derived
<i>Amelanchier arborea</i>	1.80	1.80	8
<i>Amelanchier laevis</i>	-	1.80	derived
<i>Amelanchier sanguinea</i>	1.80	-	derived
<i>Aralia spinosa</i>	-	n.d.	no data
<i>Asimina</i>	-	3.50	derived
<i>Asimina triloba</i>	3.50	3.50	1
<i>Betula</i>	2.09	2.18	derived
<i>Betula alleghaniensis</i>	2.20	2.20	20
<i>Betula lenta</i>	2.05	2.05	33
<i>Betula nigra</i>	2.28	2.28	37
<i>Betula papyrifera</i>	2.20	-	37
<i>Betula populifolia</i>	1.74	-	37
<i>Carpinus caroliniana</i>	2.00	2.00	37
<i>Carya</i>	2.05	2.03	derived
<i>Carya cordiformis</i>	2.60	2.60	37
<i>Carya glabra</i>	1.66	1.66	37
<i>Carya illinoiensis</i>	2.05	-	33
<i>Carya ovata</i>	1.98	1.98	37
<i>Carya texana</i>	2.19	-	derived
<i>Castanea dentata</i>	2.59	2.59	37
<i>Catalpa</i>	1.73	-	derived
<i>Catalpa bignonioides</i>	1.60	1.60	5
<i>Catalpa speciosa</i>	1.85	1.85	26
<i>Celtis</i>	2.39	2.39	derived
<i>Celtis occidentalis</i>	2.39	2.39	37
<i>Celtis tenuifolia</i>	-	2.39	derived
<i>Cercis canadensis</i>	1.92	1.92	34

<i>Chamaecyparis thyoides</i>	0.74	0.74	23
<i>Chionanthus virginicus</i>	-	1.76	37
<i>Cinnamomum camphora</i>	1.60	-	25
<i>Cladrastis kentukea</i>	1.50	1.50	13
<i>Cornus</i>	-	1.55	derived
<i>Cornus alternifolia</i>	-	1.70	37
<i>Cornus florida</i>	1.40	1.40	37
<i>Crataegus</i>	1.73	1.73	derived
<i>Crataegus [collina + punctata]</i>	-	1.73	derived
<i>Crataegus aestivalis</i>	-	1.73	derived
<i>Crataegus alleghaniensis</i>	-	1.73	derived
<i>Crataegus aprica</i>	-	1.73	derived
<i>Crataegus berberifolia</i>	-	1.73	derived
<i>Crataegus flava</i>	-	1.73	derived
<i>Crataegus intricata</i>	-	1.73	derived
<i>Crataegus iracunda</i>	-	1.73	derived
<i>Crataegus lacrimata</i>	-	1.73	derived
<i>Crataegus macrosperma</i>	-	1.73	derived
<i>Crataegus margareta</i>	-	1.73	derived
<i>Crataegus marshallii</i>	-	1.73	derived
<i>Crataegus phaenopyrum</i>	-	1.73	derived
<i>Crataegus pruinosa</i>	-	1.73	derived
<i>Crataegus pulcherrima</i>	-	1.73	derived
<i>Crataegus schuettei</i>	-	1.73	derived
<i>Crataegus spathulata</i>	-	1.73	derived
<i>Crataegus viridis</i>	-	1.73	derived
<i>Diospyros</i>	2.82	-	derived
<i>Diospyros virginiana</i>	2.82	2.82	22
<i>Elaeagnus</i>	-	3.30	derived
<i>Elaeagnus angustifolia</i>	3.30	3.30	7
<i>Fagus grandifolia</i>	2.30	2.30	20
<i>Frangula caroliniana</i>	-	n.d.	no data
<i>Fraxinus</i>	2.12	2.03	derived
<i>Fraxinus americana</i>	2.10	2.10	37
<i>Fraxinus nigra</i>	2.10	-	37
<i>Fraxinus pennsylvanica</i>	1.80	1.80	37
<i>Gleditsia</i>	2.75	-	derived
<i>Gleditsia triacanthos</i>	2.80	2.80	25
<i>Halesia</i>	1.98	-	derived
<i>Halesia tetraptera</i>	-	1.98	derived
<i>Ilex</i>	-	0.90	derived
<i>Ilex cassine</i>	-	0.73	35
<i>Ilex decidua</i>	-	0.90	derived
<i>Ilex montana</i>	-	1.30	5
<i>Ilex opaca</i>	1.12	1.12	37
<i>Ilex vomitoria</i>	-	0.45	17
<i>Juglans</i>	2.78	-	derived
<i>Juglans cinerea</i>	2.60	2.60	37
<i>Juglans nigra</i>	2.96	2.96	26
<i>Juniperus</i>	2.25	-	derived

<i>Juniperus virginiana</i>	1.64	1.64	26
<i>Larix</i>	2.01	-	derived
<i>Larix laricina</i>	2.01	-	33
<i>Liquidambar styraciflua</i>	1.45	1.45	37
<i>Liriodendron tulipifera</i>	2.13	2.13	37
<i>Magnolia</i>	1.32	-	derived
<i>Magnolia [tripetala + virginiana]</i>	-	1.04	derived
<i>Magnolia fraseri</i>	2.29	2.29	37
<i>Magnolia grandiflora</i>	1.34	1.34	37
<i>Magnolia macrophylla</i>	2.04	2.04	22
<i>Malus</i>	1.62	1.62	derived
<i>Malus coronaria</i>	1.62	1.62	33
<i>Morus</i>	2.17	2.17	derived
<i>Morus alba</i>	2.03	2.03	37
<i>Morus nigra</i>	2.17	-	derived
<i>Morus rubra</i>	2.31	2.31	26
<i>Nyssa</i>	-	1.78	derived
<i>Nyssa sylvatica</i>	1.84	1.84	37
<i>Osmanthus americanus</i>	-	0.80	4
<i>Ostrya virginiana</i>	2.20	2.20	37
<i>Oxydendrum arboreum</i>	1.86	1.86	37
<i>Persea</i>	1.64	-	derived
<i>Persea borbonia</i>	1.64	1.64	37
<i>Persea palustris</i>	-	1.64	derived
<i>Picea abies</i>	1.19	-	37
<i>Picea glauca</i>	1.20	-	37
<i>Picea mariana</i>	1.02	-	37
<i>Picea pungens</i>	1.33	-	24
<i>Picea rubens</i>	1.10	1.10	20
<i>Pinus</i>	-	1.24	derived
<i>Pinus banksiana</i>	1.24	-	26
<i>Pinus echinata</i>	1.07	1.07	15
<i>Pinus elliottii</i>	1.11	1.11	19
<i>Pinus nigra</i>	1.18	-	37
<i>Pinus palustris</i>	0.82	0.82	37
<i>Pinus resinosa</i>	1.17	-	26
<i>Pinus rigida</i>	1.16	1.16	37
<i>Pinus strobus</i>	1.35	1.35	37
<i>Pinus sylvestris</i>	1.39	-	26
<i>Pinus taeda</i>	1.50	1.50	27
<i>Platanus occidentalis</i>	2.07	2.07	22
<i>Populus</i>	1.91	-	derived
<i>Populus balsamifera</i>	1.90	-	37
<i>Populus deltoides</i>	2.36	2.36	26
<i>Populus grandidentata</i>	2.50	-	37
<i>Populus heterophylla</i>	2.40	2.40	37
<i>Populus tremuloides</i>	1.94	-	37
<i>Prunus</i>	2.50	2.17	derived
<i>Prunus alleghaniensis</i>	2.50	-	derived
<i>Prunus angustifolia</i>	-	0.32	17

<i>Prunus avium</i>	1.80	-	15
<i>Prunus caroliniana</i>	-	1.25	4
<i>Prunus injucunda</i>	-	2.17	derived
<i>Prunus pensylvanica</i>	2.40	2.40	37
<i>Prunus serotina</i>	2.68	2.68	37
<i>Prunus umbellata</i>	-	2.17	derived
<i>Prunus virginiana</i>	2.80	2.80	37
<i>Pseudotsuga menziesii</i>	1.08	-	37
<i>Ptelea trifoliata</i>	-	n.d.	no data
<i>Pyrus calleryana</i>	-	1.95	24
<i>Quercus</i>	1.63	1.59	derived
<i>Quercus "waccamawensis"</i>	-	1.59	derived
<i>Quercus alba</i>	2.20	2.20	37
<i>Quercus arkansana</i>	-	1.59	derived
<i>Quercus austrina</i>	-	1.94	37
<i>Quercus chapmanii</i>	-	1.39	37
<i>Quercus coccinea</i>	1.73	1.73	37
<i>Quercus ellipsoidalis</i>	2.10	-	26
<i>Quercus falcata</i>	1.47	1.47	37
<i>Quercus geminata</i>	-	0.87	37
<i>Quercus hemisphaerica</i>	-	1.69	11
<i>Quercus ilicifolia</i>	1.40	1.40	33
<i>Quercus incana</i>	0.95	0.95	37
<i>Quercus laevis</i>	1.53	1.53	37
<i>Quercus laurifolia</i>	1.32	1.32	37
<i>Quercus macrocarpa</i>	2.36	-	37
<i>Quercus marilandica</i>	1.38	1.38	15
<i>Quercus michauxii</i>	1.59	1.59	33
<i>Quercus montana</i>	-	1.50	37
<i>Quercus myrtifolia</i>	-	1.02	37
<i>Quercus nigra</i>	1.29	1.29	37
<i>Quercus pagoda</i>	1.44	1.44	33
<i>Quercus palustris</i>	2.33	2.33	22
<i>Quercus prinus</i>	1.50	-	37
<i>Quercus rubra</i>	2.01	2.01	37
<i>Quercus shumardii</i>	1.68	1.68	37
<i>Quercus stellata</i>	1.73	1.73	37
<i>Quercus texana</i>	0.99	-	13
<i>Quercus velutina</i>	1.38	1.38	37
<i>Quercus virginiana</i>	1.32	1.32	37
<i>Robinia</i>	-	2.97	derived
<i>Robinia pseudoacacia</i>	2.97	2.97	37
<i>Salix</i>	1.99	-	derived
<i>Salix alba</i>	1.64	-	6
<i>Salix bebbiana</i>	1.67	-	21
<i>Salix nigra</i>	2.50	2.50	37
<i>Salix pyrifolia</i>	1.99	-	derived
<i>Sassafras albidum</i>	1.90	1.90	8
<i>Sideroxylon lycioides</i>	-	2.44	derived
<i>Sideroxylon salicifolium</i>	2.44	-	derived

Sideroxylon tenax	-	2.44	derived
Sorbus	2.60	-	derived
Sorbus americana	2.60	2.60	33
Sorbus decora	2.60	-	derived
Staphylea	-	n.d.	no data
Staphylea trifolia	-	n.d.	no data
Stewartia ovata	-	n.d.	no data
Styphnolobium japonicum	-	1.60	13
Styrax grandifolius	-	n.d.	no data
Symplocos tinctoria	-	2.40	8
Syzygium cumini	2.01	-	37
Taxodium ascendens	1.06	1.06	2
Taxodium distichum	1.19	1.19	37
Thuja occidentalis	1.28	-	26
Tilia	2.88	2.88	derived
Tilia americana	2.88	2.88	37
Tsuga	0.99	-	derived
Tsuga canadensis	0.99	0.99	37
Ulmus	2.17	2.18	derived
Ulmus americana	2.00	2.00	37
Ulmus rubra	2.50	2.50	37
Vaccinium arboreum	-	1.21	37
Zanthoxylum clava-herculis	-	n.d.	no data

**Table A2.4. Sources of trait data.**

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## Leaf Nitrogen

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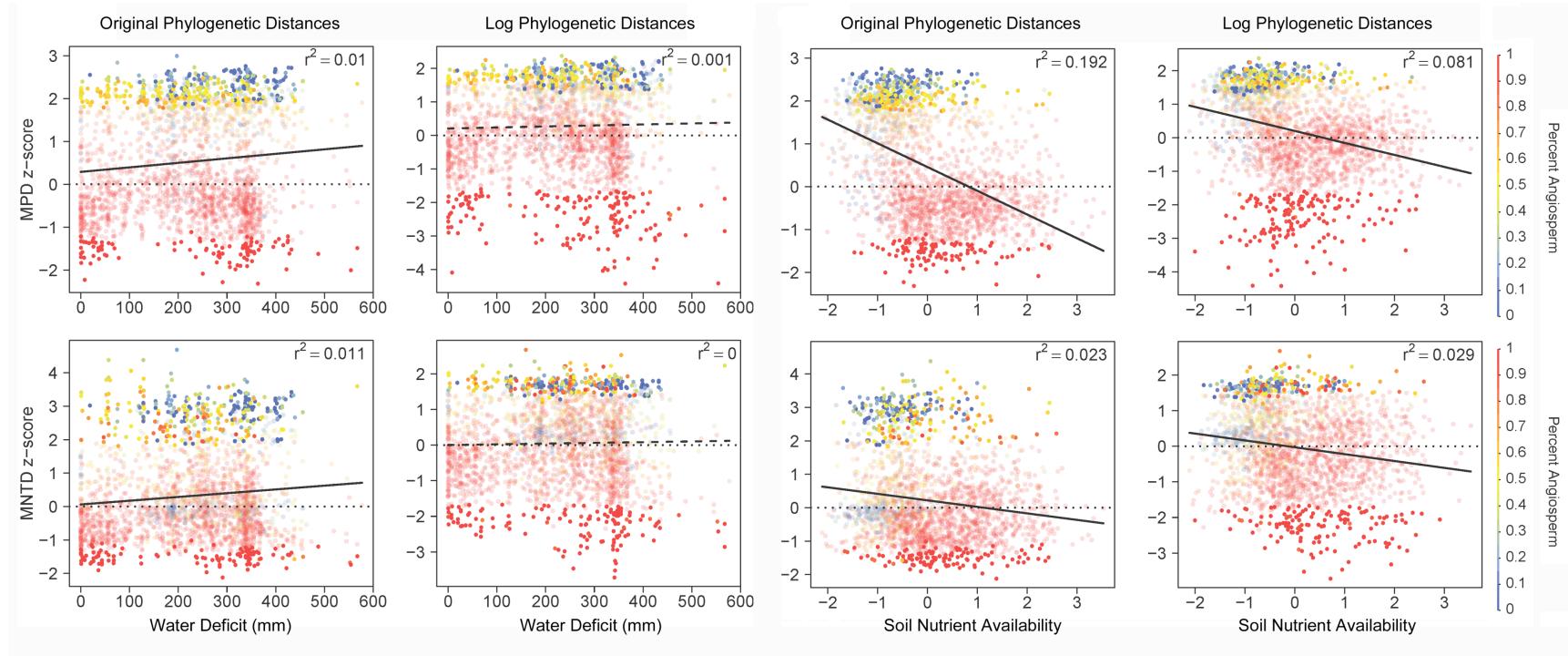
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### **Appendix 3. Analyses of alternative phylogenetic diversity metrics and distances.**

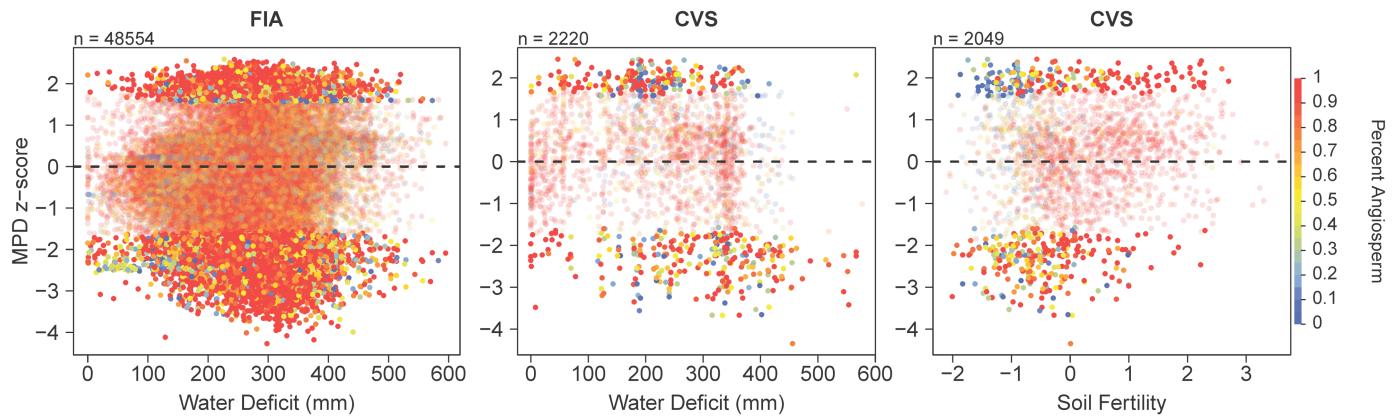
Our analyses of phylogenetic diversity (PD) of communities along water deficit and soil nutrient availability gradients indicated that PD, as measured by the mean pair-wise phylogenetic distance (MPD) between the taxa in a community, was strongly influenced by the relative proportion of angiosperm and gymnosperm taxa. Therefore, for the CVS data set, we also evaluated the mean nearest taxon distance (MNTD; Webb 2000) which may be less sensitive to the angiosperm-gymnosperm split. Since the distance between any angiosperm species and any gymnosperm species was more than 80% greater than the largest distance between any two angiosperm species, we also calculated PD metrics on a log-transformed distance matrix to attempt to ameliorate the effects of the angiosperm-gymnosperm bifurcation.

All metrics were strongly influenced by the relative proportion of angiosperm and gymnosperm taxa and using different metrics did not qualitatively influence the relationships between PD and the two stress gradients (Figure A3.1). For all metrics, using log-transformed distances weakened correlations between PD and the stress gradients, but did not alter the direction of these relationships.

We also calculated MPD only among the angiosperm taxa in each plot to determine whether changes in PD within a taxonomically restricted subset of each community exhibited patterns consistent with the stress-dominance hypothesis. Patterns of PD along stress gradients were different among angiosperms than among all taxa in the community (Figure A3.2).



**Figure A3.1. Effect of using different phylogenetic diversity metrics and phylogenetic distances on the relationship between stress gradients and phylogenetic diversity in CVS plots.** Mean pair-wise phylogenetic distance (MPD) and mean nearest taxon distance (MNTD) were calculated from the original distances between taxa from the phylogeny as well as from log-transformed distances. The z-scores of these metrics are plotted on the y-axis against the two stress gradients, climatic water deficit and soil nutrient availability. Positive z-score values indicate higher diversity and negative values indicate lower diversity relative to a null model of random community assembly with respect to phylogenetic relationships. Opaque points are above the 95<sup>th</sup> or below the 5<sup>th</sup>



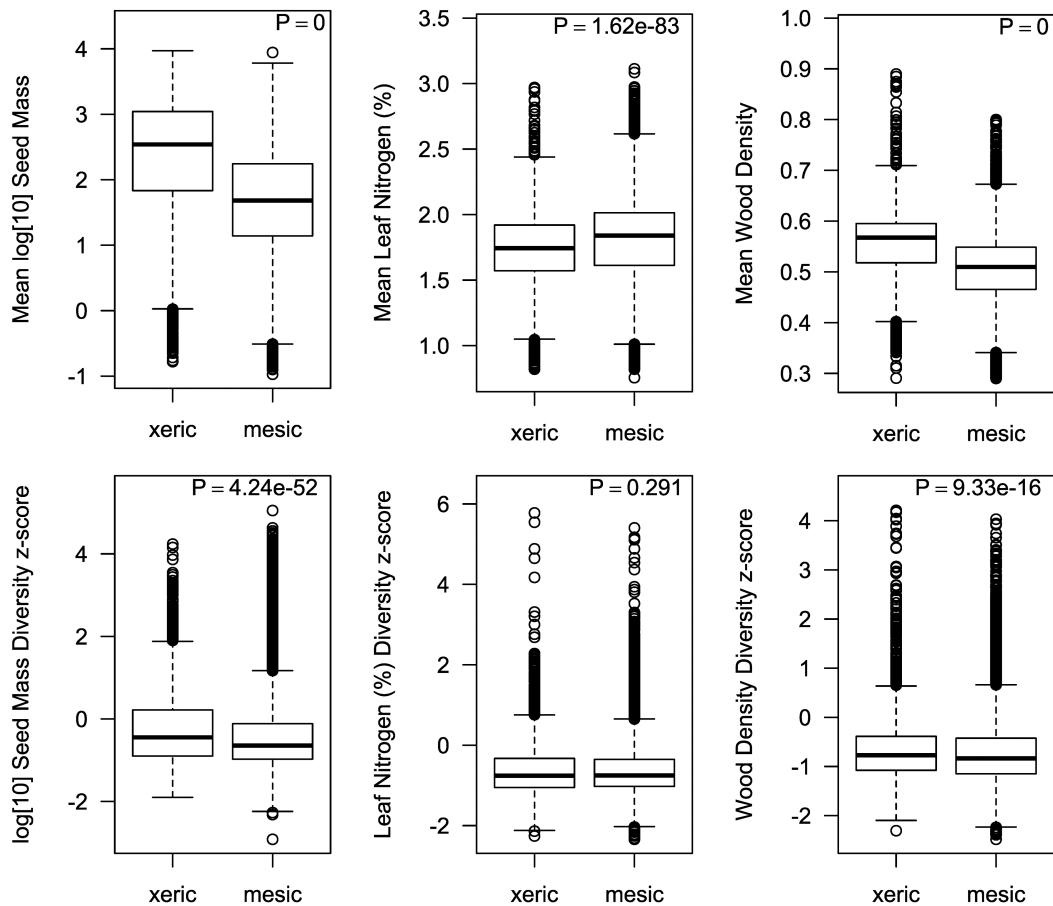
**Figure A3.2. Phylogenetic diversity (MPD-mean pairwise distance) for angiosperm taxa occurring in FIA and CVS plots along stress gradients.** Axes and points are as described in Figure A3.1. Plotting angiosperms only eliminated the previously observed negative correlation between phylogenetic diversity and soil nutrient availability in the CVS plots, suggesting phylogenetic diversity is being driven primarily by the deep basal split between angiosperms and gymnosperms on the phylogeny. Points are still colored by percent angiosperm abundance for visual reference of plots that contain gymnosperms.

**Appendix 4.** Model selection table showing AIC values for all models.

**Table A4.1.** AIC values of models between seed mass, leaf nitrogen, and wood density mean trait and trait diversity values and water deficit and soil nutrient availability. Linear and power models were fit to all combinations of mean trait, trait diversity, and environmental stress variables, while quadratic models were fit to only those combinations where a unimodal peak was hypothesized. Values in bold indicate the model chosen for inference.

Predictor	Response	Dataset	Linear	Power	Quadratic
Water deficit	Seed mass	FIA	<b>132778.8</b>	133033.9	-
		CVS	<b>3597.7</b>	3623.0	
	Wood density	FIA	<b>-124392.9</b>	123120.2	
		CVS	<b>-6203.0</b>	-6088.9	
	Nitrogen %	FIA	<b>24041.5</b>	24419.1	
		CVS	<b>2096.3</b>	2113.2	
	Seed mass diversity	FIA	123193.5	123207.6	<b>122582.7</b>
		CVS	6446.6	6630.3	<b>6442.3</b>
	Wood density diversity	FIA	91701.8	91906.9	<b>91675.0</b>
		CVS	4789.2	4793.5	<b>4766.1</b>
Soil nutrient availability	Nitrogen % diversity	FIA	91738.4	91742.1	<b>91683.8</b>
		CVS	<b>5026.9</b>	5053.9	5025.8
	PD	FIA	157861.2	157850.6	<b>157024.5</b>
		CVS	7452.6	7430.8	<b>7418.5</b>
	Seed mass	CVS	3276.6	<b>3272.8</b>	
	Wood density	CVS	-5659.0	<b>-5673.4</b>	
Environmental stress	Nitrogen %	CVS	1281.4	<b>1220.6</b>	
	Seed mass diversity	CVS	6153.5	6155.2	<b>6096.4</b>
	Wood density diversity	CVS	4465.3	4451.6	<b>4421.2</b>
	Nitrogen % diversity	CVS	4691.6	4684.7	<b>4649.0</b>
	PD	CVS	6416.5	6608.1	<b>6348.9</b>

**Appendix 5.** Comparison of community-weighted mean trait values and trait diversity between xeric and mesic FIA plots.



**Figure A5.1. Boxplots of community-weighted mean trait values and trait diversity between xeric and mesic FIA plots.** P-values in the upper right corner of panels test whether group means are different using a Mann-Whitney U test. Xeric plots have higher wood density, higher seed mass and lower leaf nitrogen content than mesic plots. There are only slight differences in trait diversity between xeric and mesic plots.

## **Appendix 6. Environmentally constrained null models**

Using a subset of the FIA data (8,426 plots in North Carolina, South Carolina, Georgia, and Florida) and the entire CVS data set, we recalculated trait diversity z-scores using environmentally constrained null models. For the CVS data set, we defined environmental niches for each species as the range of water deficit (D) and soil fertility values within which each species was observed to occur in our data set. When shuffling species across sites in the null model, only species whose niches matched the environmental conditions at each site were permitted to occur. For the FIA data we used five environmental variables to define species niches (D, minimum temperature, annual precipitation, precipitation during the driest 3-month period, and the xeric-mesic-hydric site classification assigned by the FIA survey crew), where the three additional variables were derived from WorldClim 10 arc-minute bioclimatic variables (<http://www.worldclim.org/current>).

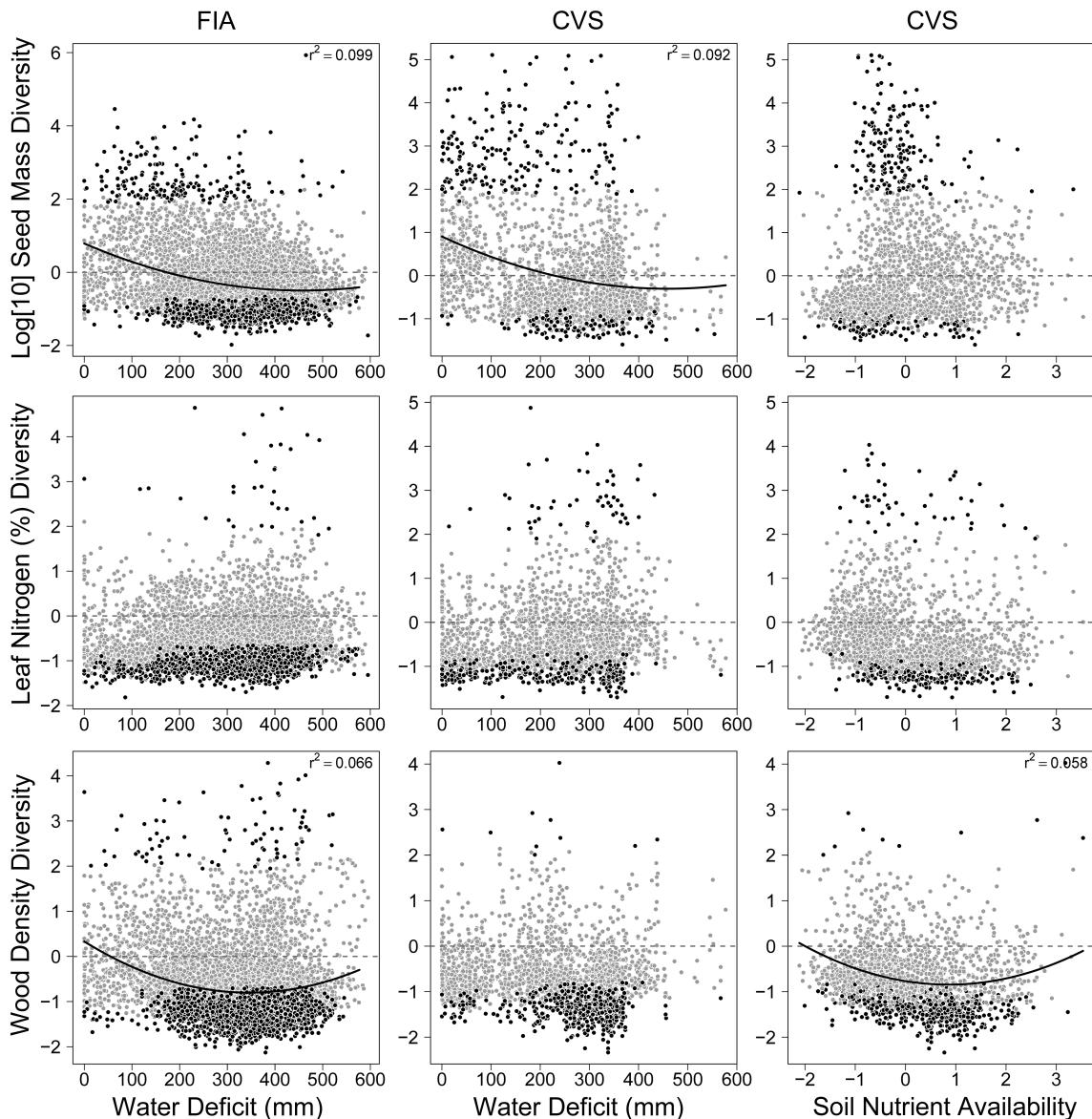
Using environmentally constrained null models generally decreased the number of underdispersed plots observed, but did not alter the lack of relationships between environmental variables and trait diversity.

**Table A6.1. Change in the proportion of CVS and FIA plots with significantly overdispersed and underdispersed trait diversity when using an environmentally constrained null model compared to an unconstrained null model.** Overdispersed plots have trait diversity above the 95<sup>th</sup> percentile of the null distribution, underdispersed plots are below the 5<sup>th</sup> percentile, and random plots are between the 5<sup>th</sup> and 95<sup>th</sup> percentiles.

	Overdispersed %		Random %		Underdispersed %	
	Original	Constrained	Original	Constrained	Original	Constrained
FIA Wood density diversity	0.9	1.0	61.3	70.5	37.8	28.5

CVS Wood density diversity	0.5	0.4	70.9	77.3	28.6	22.3	
FIA Leaf nitrogen diversity	0.5	0.4	78.9	86.7	20.6	12.9	
CVS Leaf nitrogen diversity	1.7	2.3	86.4	85.4	11.9	12.3	
FIA Seed mass diversity	1.3	2.3	82.6	89.3	16.1	8.4	
CVS Seed mass diversity	7.5	9.0	88.9	85.8	3.6	5.2	

**Figure A6.1. Relationship between trait diversity and environmental variables under constrained null models.** Compare to Figures 4 and 5. Note that FIA data in this figure only contains plots from four states.



percentile of the null distribution and points are colored by the proportion of the community that is comprised of angiosperm taxa.

Solid regression lines are shown for relationships with  $r^2 > 0.05$ , whereas dashed lines indicate  $r^2 \geq 0.05$ .