Supplementary Materials for

Heartwood Relationship with Stem Diameter in *Pinus canariensis* Plantations of Gran Canaria, Spain

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Figure S1: Cut stem showing the cross-sectional color difference between heartwood and sapwood in *Pinus canariensis*.

Figure S2: Cut stem showing the cross-sectional decay resistance of heartwood compared to sapwood in *Pinus canariensis*.

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Figure S1. Cut stem showing the cross-sectional color difference between heartwood and sapwood in *Pinus canariensis* (photo credit: Juan Guzmán Ojeda).

Figure S2: Cut stem showing the cross-sectional decay resistance of heartwood compared to sapwood in *Pinus canariensis*.

Figure S3. Walter-Lieth climate diagram for a representative station with temperature (red curve and labels) on the left y axis and total precipitation (blue curve and labels) on the right one. Despite the relatively high elevation of the study area, the wet season (blue vertical lines) is limited to the winter months (D-F), while the rest of the year is characterized by dry conditions (red vertical dashes).

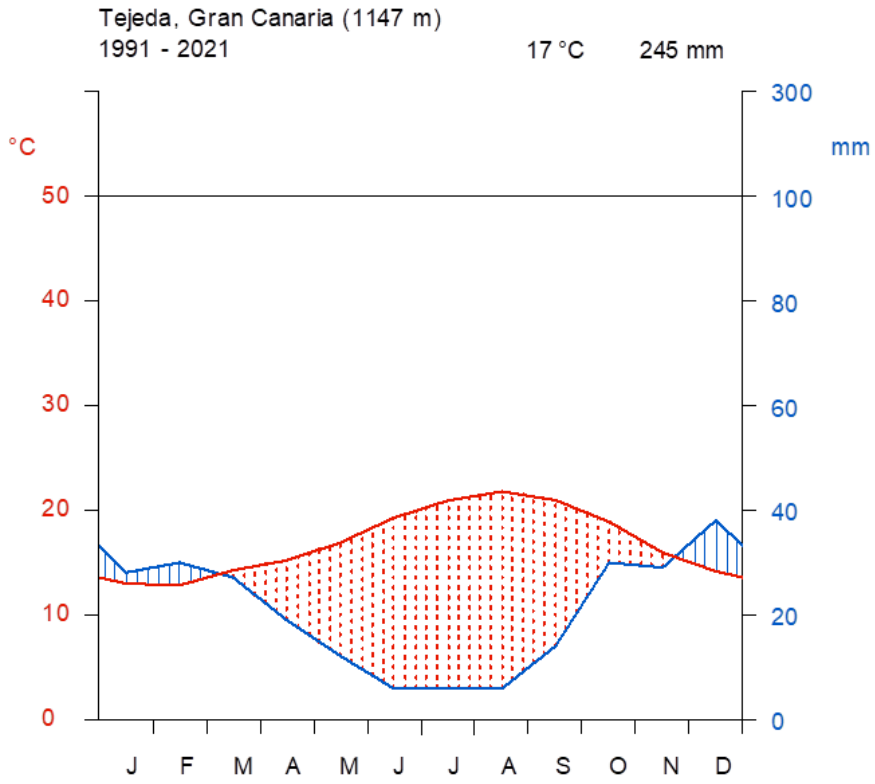

Figure S4. The first author coring a *Pinus canariensis* (pine #14) on one of the study plots.

Figure S5. The Applequist estimator for average ring width of 2.5 mm, which is obtained by including 20 concentric, equally spaced rings inside a circle with diameter of 50 mm.

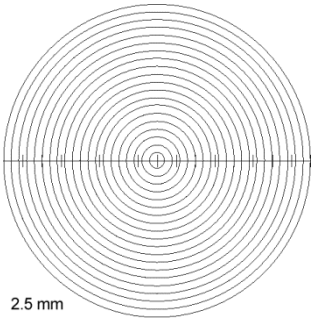

Figure S6. Paired sample rank correlations (Spearman's) between plot and tree variables measured at the study area. Frequency histograms are shown along the diagonal, and paired correlations are shown above the diagonal with font size directly proportional to the correlation value. Paired scatterplots (black empty circles), overlaid with a smoother (red line), are shown below the diagonal.

TWI = plot Topographic Wetness Index; SkyView = plot Sky View factor; LRtea = Log-transformed tree heartwood radius; R5(cm) = Radial size of the first 5 tree rings; Rtea(cm) = Radial size of tree heartwood; Age = number of tree annual growth rings either counted (pith included in wood increment core) or counted plus estimated (pith absent); H(m) = tree height; Bark(cm) = tree bark thickness; Diam(cm) = tree stem diameter; Ldens = Log-transformed plot density index; Slope(%) = plot terrain slope; Elev(m) = plot elevation above mean sea level.

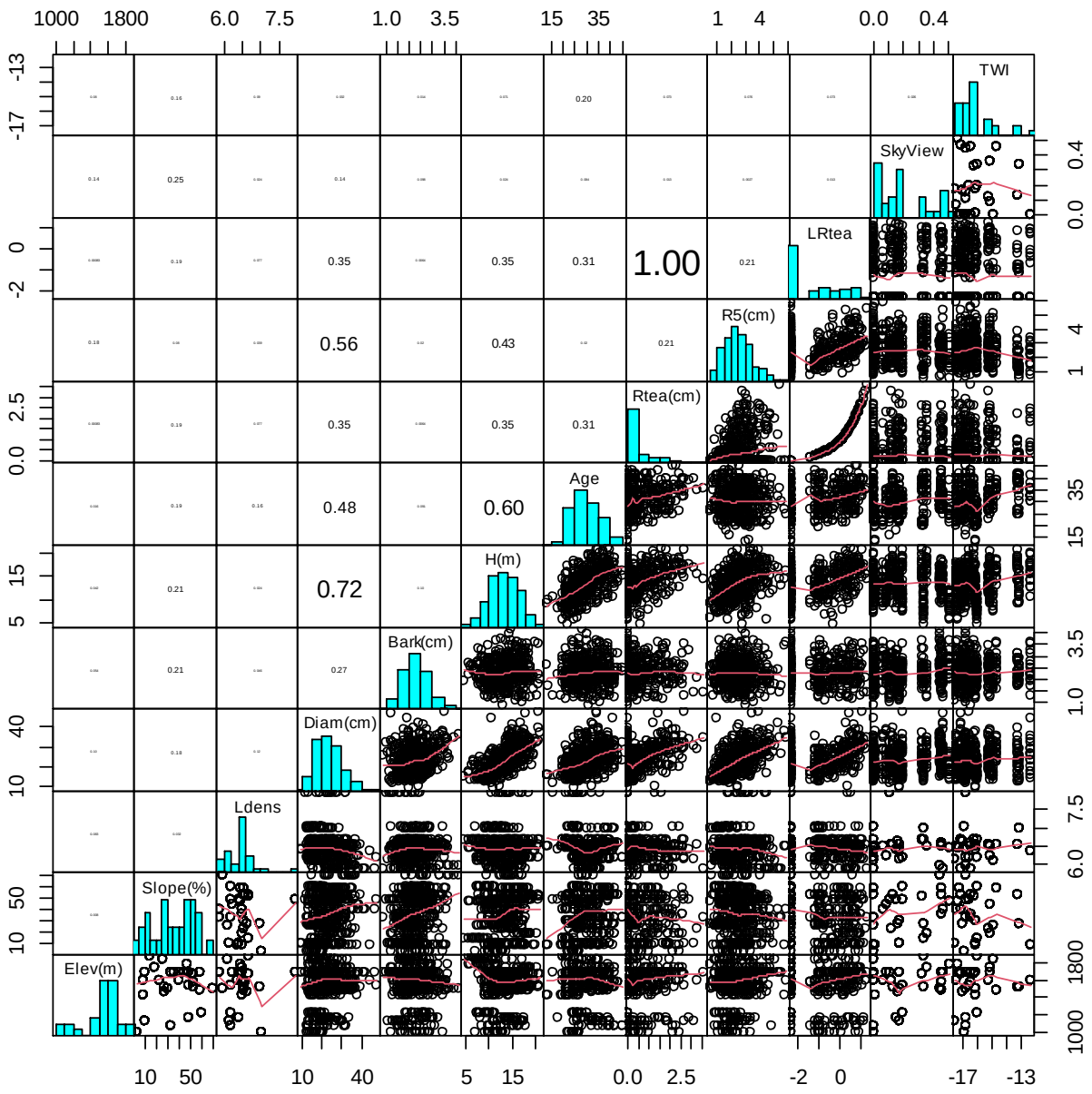

Figure S7. Omnidirectional sample variogram (blue dots and connecting segments) and fitted exponential model (blue line) for heartwood radius (Rtea) at the study area. A spherical model could also have been fitted, which, together with a relatively low difference between the nugget value (y-intercept of blue line) and the sill (asymptotically horizontal portion of the blue line) suggested an overall limited amount of spatial autocorrelation.

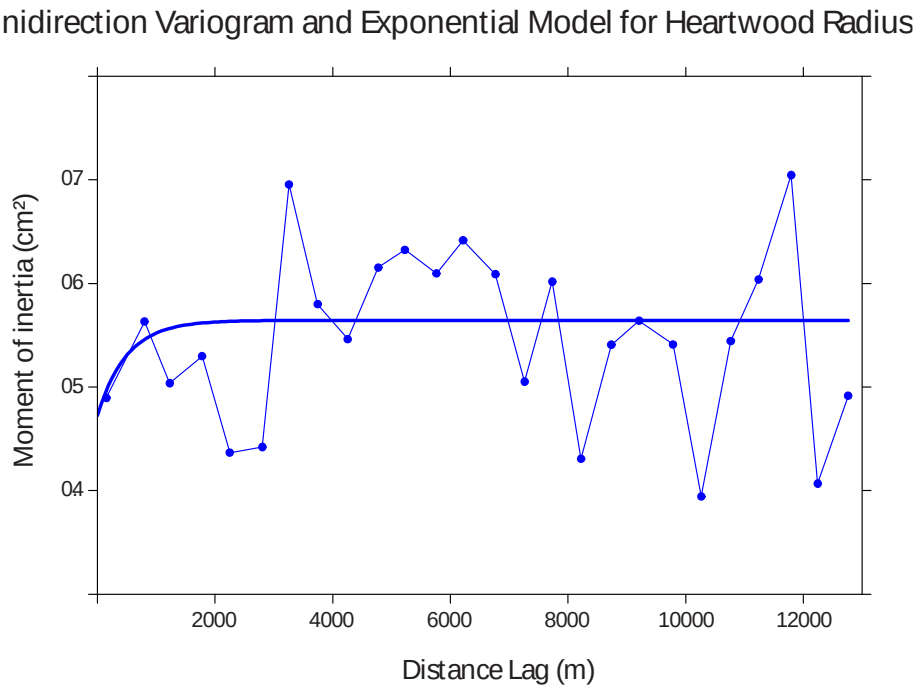

Table S1. Summary information for sampled plots (# 4, 5 and 8 are included in Figure 1). Geographical coordinates are in the Universal Transverse Mercator ("UTM") system (zone 28N). The stand "Density Index" was calculated using the linear distances from the plot center to the nearest 15th and 30th tree. "Sky View" and Topographic Wetness Index ("TWI") values were calculated from a 30-m Digital Elevation Model (DEM) to estimate, respectively, site insolation and moisture (Figure 2).

Plot #	Elevation (m)	X_UTM (m)	Y_UTM (m)	Thinned	Slope (%)	Exposure (°)	Density Index (n ha^{-1})	Sky View	TWI
1	1875	444391	3093283	Yes	15	5	194	0.34048	-16.02606
2	1680	442622	3094739	Yes	11	0/360	155	0.17165	-16.13523
3	1705	442258	3094069	Yes	33	142	89	0.00000	-16.39934
4	1680	442874	3093703	No	44	39	129	0.08781	-15.09456
5	1735	443310	3093785	No	19	328	166	0.35463	-15.05277
6	1655	446344	3093938	Yes	58	214	162	0.00000	-17.19556
7	1605	446845	3093754	Yes	49	151	687	0.10892	-16.75226
8	1830	443747	3093622	Yes	26	0/360	113	0.00000	-14.91591
9	1695	443718	3094467	No	47	330	159	0.50751	-17.33732
10	1555	440357	3100176	No	49	160	121	0.19206	-16.49754
11	1690	440252	3099367	Yes	40	315	91	0.46853	-17.08072
12	1665	446749	3093190	No	53	286	200	0.00000	-17.03066
13	1695	446403	3093918	No	51	80	196	0.32983	-16.16746
14	1575	447938	3091833	No	60	45	171	0.17238	-16.11971
15	1480	439151	3101936	Yes	70	295	97	0.44644	-16.73437
16	1455	438628	3101671	No	58	260	173	0.45648	-14.63678
17	1480	439645	3101253	No	53	90	175	0.12930	-13.25992
18	1585	439691	3100421	No	9	280	148	0.00000	-12.31515
19	1585	439929	3100872	No	53	285	181	0.45203	-16.45677
20	1570	439408	3100888	No	27	108	269	0.33521	-13.11000
21	1590	441217	3099364	Yes	24	30	172	0.11612	-15.20418
22	1225	444088	3098168	No	49	295	153	0.15197	-16.78119
23	1495	438160	3099605	Yes	27	0	191	0.16837	-16.96772
24	1575	438585	3099461	Yes	41	200	167	0.06473	-17.41026
25	1435	437543	3099684	Yes	9	270	167	0.01307	-16.05485
26	1005	433594	3099945	No	4	180	284	0.00000	-16.87134
27	1060	443342	3101151	No	11	210	118	0.17875	-17.45985
28	995	433956	3100681	Yes	33	96	123	0.00000	-16.74466
29	1240	435339	3099875	No	60	205	120	0.19153	-16.02298
30	1680	446480	3092234	No	36	215	169	0.45648	-16.39285

Table S2. Output of mixed effects models estimated using R packages.

(a) GLMM (one fixed effect) estimated by *nlme*

```
Linear mixed-effects model fit by REML
      AIC        BIC               logLik
 884.0288   916.8672          -434.0144

Random effects:
 Formula: ~1 + Diam | fPlot
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev            Corr
(Intercept)  0.51449420        (Intr)
Diam         0.03070529        -0.969
Residual     0.59219516

Correlation Structure: Exponential spatial correlation
 Formula: ~XUTMm + YUTMm | fPlot
 Parameter estimate(s):
     Range                nugget
491.4657137         0.9979945

Fixed effects:  Rtea ~ 1 + Diam
                Value          Std.Error     DF        t-value        p-value
(Intercept) -0.7276459        0.15133592    419      -4.808151              0
Diam         0.0522202        0.00757851    419       6.890569              0
 Correlation:
             (Intr)
Diam         -0.955

Standardized Within-Group Residuals:
      Min              Q1                Med              Q3             Max
-2.6089875       -0.5710996        -0.1453637       0.3372145       3.6477256
```

(b) GLMM (one fixed effect) estimated by *glmmML*

```
Call:  glmmML(formula = RteaB ~ 1 + Diam, family = binomial, data = out, cluster = RandomPlot)
                coef            se(coef)              z              Pr(>|z|)
(Intercept)   -0.03807            0.20807         -0.1829              0.855
Diam          0.08895             0.01944          4.5758              4.74e-06

Scale parameter in mixing distribution:  0.9761 gaussian
Std. Error:                      0.1871

      LR p-value for H_0: sigma = 0:  3.223e-10
Residual deviance: 565.1 on 447 degrees of freedom      AIC: 571.1
```

(c) GLMM (two fixed effects) estimated by *nlme*

```
Linear mixed-effects model fit by REML
      AIC        BIC               logLik
 896.9126   937.9157          -438.4563

Random effects:
 Formula: ~1 + Diam | fPlot
 Structure: General positive-definite, Log-Cholesky parametrization
                StdDev            Corr
(Intercept)  0.51096094        (Intr)
Diam         0.03085406        -0.969
Residual     0.59267040

Correlation Structure: Exponential spatial correlation
 Formula: ~XUTMm + YUTMm | fPlot
 Parameter estimate(s):
```

```
     Range            nugget
502.7884099         0.9986758

Fixed effects:  Rtea ~ 1 + Diam * Thinned
                    Value      Std.Error  DF    t-value p-value
(Intercept)    -0.8320463     0.20370564 418 -4.084552  0.0001
Diam            0.0570172     0.01023653 418  5.569974  0.0000
Thinned         0.2331077     0.30375921  28  0.767410  0.4493
Diam:Thinned   -0.0106749     0.01530051 418 -0.697685  0.4858
 Correlation:
               (Intr)  Diam   Thinned
Diam           -0.955
Thinned        -0.671  0.640
Diam:Thinned    0.639 -0.669  -0.954

Standardized Within-Group Residuals:
      Min          Q1         Med          Q3         Max
-2.6637707 -0.5663838 -0.1491465  0.3173857  3.6985685
```

(d) GLMM (two fixed effects) estimated by *glmmML*

```
Call:  glmmML(formula = RteaB ~ 1 + Diam + R5, family = binomial, data = out, cluster = RandomPlot)
             Coef  se(coef)      z Pr(>|z|)
(Intercept) -0.03308 0.21774 -0.1519 0.879
Diam         0.12213 0.02531  4.8263 1.39e-06
R5          -0.34432 0.15541 -2.2155 0.0267

Scale parameter in mixing distribution:  1.034 gaussian
Std. Error:                      0.195

      LR p-value for H_0: sigma = 0:   4.981e-11
Residual deviance: 560 on 446 degrees of freedom       AIC: 568
```

(e) GLMM (two fixed effects) estimated by function *glmmPQL* from *MASS*

```
Linear mixed-effects model fit by maximum likelihood

Random effects:
 Formula: ~1 | fPlot
             (Intercept)  Residual
StdDev:       0.9886244 0.9618006

Variance function:
 Structure: fixed weights
 Formula: ~invwt

Fixed effects:  RteaB ~ 1 + Diam + R5
                Value  Std.Error  DF    t-value p-value
(Intercept) -0.0304602 0.20766831 418 -0.146677  0.8835
Diam         0.1164294 0.02307112 418  5.046543  0.0000
R5          -0.3300212 0.14387653 418 -2.293780  0.0223
 Correlation:
            (Intr)  Diam
Diam         0.017
R5          -0.015 -0.607

Standardized Within-Group Residuals:
      Min          Q1         Med          Q3         Max
-4.1259610 -0.7966016 -0.3182852  0.8189689  2.3383799
```