

Supplementary material

Species Mixing Proportion and Aridity Influence in the Height–Diameter Relationship for Different Species Mixtures in Mediterranean Forests

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Supplementary Table S1: Stats (mean and range) of the main tree and plot variables characterizing selected SNFI plots used in our study

Species	Mixture	Plots	Trees	h (m)	d (cm)	Dg (cm)	BA (m ² · ha ⁻¹)	BAL (m ² · ha ⁻¹)	T (°C)	P (mm)	M (mm · °C ⁻¹)
<i>Pinus halepensis</i>	<i>Pinus nigra</i>	227	1911	8.7 (2.7-21)	20.1 (7.5-95.5)	17.3 (10-34.8)	13.98 (2.14-32.5)	7.61 (0-32.05)	12.4 (10.2-14.4)	564 (365-866)	25 (16-42)
	<i>Pinus pinaster</i>	210	2005	9.4 (3-34.5)	21.4 (7.5-66.8)	19.3 (9.2-43.9)	15.65 (3.77-44.42)	8.86 (0-40.56)	13.6 (11.2-16.8)	630 (371-818)	19 (14-35)
	<i>Pinus pinea</i>	160	1615	9.5 (3.5-22)	21.1 (7.5-64.4)	18.9 (10.3-34)	15.58 (3.26-40.14)	8.67 (0-39.71)	13.3 (10.8-16.5)	450 (352-791)	27 (15-37)
	<i>Quercus faginea</i>	63	774	8.5 (3-22)	19.8 (7.5-55)	16.7 (10.5-27.3)	15.66 (3.84-31.91)	8.89 (0-31.34)	12.8 (11.8-14.8)	566 (386-721)	25 (16-33)
	<i>Quercus ilex</i>	393	4049	9.6 (3-25)	20.9 (7.5-74.8)	16.7 (9.6-30.9)	15.94 (2.74-40.14)	8.81 (0-39.71)	13.2 (10.7-17.1)	583 (338-805)	25 (12-37)
<i>Pinus nigra</i>	<i>Pinus halepensis</i>	222	2157	8.6 (3-24)	18.9 (7.5-70.7)	17.1 (10-39.6)	16.07 (2.14-39.05)	9.37 (0-38.24)	12 (8.6-14.4)	613 (389-866)	28 (17-42)
	<i>Pinus pinaster</i>	293	3697	10.1 (3-28)	22.1 (7.5-86.6)	20.2 (9.5-50.9)	23.29 (4.02-55.61)	13.7 (0-54.8)	10.8 (8.6-14.1)	546 (381-1114)	26 (16-55)
	<i>Pinus sylvestris</i>	832	10495	10.1 (3-30)	21.3 (7.5-78)	18.7 (9.2-44.4)	21.91 (3.17-61.94)	12.44 (0-61.07)	10.1 (6.9-13.7)	653 (394-1051)	33 (18-59)
	<i>Quercus faginea</i>	187	2540	10 (3-26.5)	20.7 (7.5-76.4)	17.5 (9.2-50.9)	18.94 (2.85-44.23)	10.92 (0-42.6)	11.4 (9.1-13.3)	609 (394-732)	28 (18-34)
	<i>Quercus ilex</i>	410	5466	9.9 (3-27)	22 (7.5-76.4)	17.9 (8.7-42.8)	22.07 (2.87-54.14)	12.51 (0-52.85)	11 (7.2-14.1)	574 (426-992)	27 (20-58)
<i>Pinus pinaster</i>	<i>Pinus halepensis</i>	197	1773	9.3 (3-25.5)	25.7 (7.5-65.9)	22.6 (10.3-48.9)	19.15 (3.77-44.42)	10.6 (0-42.87)	11 (8.6-14.1)	521 (381-1114)	20 (14-35)
	<i>Pinus nigra</i>	310	4039	9.4 (3-28.5)	24.5 (7.5-79.9)	20.7 (9.5-42.8)	25.63 (4.02-62.14)	14.18 (0-61.73)	13.2 (10.1-17.8)	471 (337-797)	25 (16-55)
	<i>Pinus pinea</i>	268	3335	10.3 (3-24)	24.7 (7.5-82.1)	22.9 (9.1-41)	22.34 (4.01-41.74)	12.51 (0-41.28)	12.6 (10.6-16.5)	460 (366-791)	20 (14-33)
	<i>Pinus sylvestris</i>	360	6518	11.6 (3-30)	26.8 (7.5-76.1)	23 (10.4-49.1)	33.46 (4.04-70.45)	18.28 (0-69.85)	10 (7.7-14.5)	643 (358-1740)	32 (16-83)
	<i>Quercus ilex</i>	141	1774	9.5 (3-25)	24.9 (7.5-73.2)	20.8 (10.2-35.5)	23.68 (3.36-52.99)	13.33 (0-52.17)	11.5 (8.8-16.4)	544 (344-1175)	26 (14-56)
	<i>Quercus pyrenaica</i>	162	2747	9.6 (3-27.5)	23.1 (7.5-94.2)	19.9 (9.2-51.1)	25.24 (3.47-62.74)	14.26 (0-61.78)	10.8 (8.7-15.9)	583 (348-1594)	28 (15-68)
	<i>Quercus suber</i>	114	1346	9.7 (3-24)	20.9 (7.5-71.9)	19 (10.7-43.3)	20.65 (2.74-46.5)	11.62 (0-44.9)	14.3 (12.3-17.6)	593 (410-1716)	24 (16-75)
<i>Pinus pinea</i>	<i>Pinus halepensis</i>	99	744	8.6 (3-19)	23 (7.5-49.3)	20.2 (10.3-31)	19.12 (3.26-47.1)	10.51 (0-46.7)	14.4 (11.2-16.8)	611 (372-818)	25 (15-37)
	<i>Pinus pinaster</i>	221	2069	8.8 (3-20)	26.8 (7.5-80.2)	24.2 (9.1-41.2)	17.92 (4.01-50.81)	9.94 (0-50.23)	13.4 (11-17.8)	468 (334-797)	20 (14-33)
	<i>Quercus ilex</i>	157	1301	8.3 (3-19)	25.1 (7.5-110.1)	19.8 (9.6-41.2)	17.54 (3.06-56.99)	9.34 (0-55.98)	14.6 (10.9-17.7)	538 (336-823)	22 (14-37)
	<i>Quercus suber</i>	87	693	8.7 (3-19)	23.7 (7.5-56.9)	19.4 (9.4-31.8)	18.98 (2.78-33.08)	9.99 (0-31.04)	14.9 (12.1-17.7)	678 (449-822)	27 (18-37)
<i>Pinus sylvestris</i>	<i>Fagus sylvatica</i>	401	8702	13.7 (3-30.5)	27.1 (7.5-112.4)	23.8 (10.1-50.1)	32.57 (4.39-68.88)	18.32 (0-67.04)	9.2 (6-13.7)	702 (393-1083)	44 (28-82)
	<i>Pinus nigra</i>	903	12948	10 (3-26)	20.6 (7.5-76.4)	18.4 (9.2-44.4)	23.36 (3.17-61.94)	13.26 (0-50.01)	9.4 (6.9-14.5)	625 (358-1740)	37 (18-68)
	<i>Pinus pinaster</i>	409	8304	13.4 (3-33)	25.8 (7.5-98.7)	23.8 (9.5-51.8)	32.92 (4.04-67.89)	19.05 (0-66.68)	6.9 (3.9-10.4)	1030 (760-1358)	32 (16-83)
	<i>Pinus uncinata</i>	305	5668	12.1 (3-25)	26.8 (7.5-109.2)	22.6 (10.6-44.3)	29.88 (4.14-80.75)	16.64 (0-79.42)	8.2 (4.7-11.2)	797 (534-1233)	61 (39-96)
	<i>Quercus faginea</i>	224	3458	10.1 (3-22.5)	22.2 (7.5-71.9)	19.1 (9.4-34.2)	23.22 (2.95-52.99)	13.24 (0-52.39)	10 (5.6-12.9)	788 (483-1118)	40 (24-72)
	<i>Quercus ilex</i>	288	4146	10.4 (3-24.5)	21.9 (7.5-76.4)	18.4 (9.2-37.1)	21.66 (3.74-49.08)	12.15 (0-48.65)	10 5.9-13.6)	837 (474-1080)	42 (24-68)
	<i>Quercus petraea</i>	80	1445	12.5 (4-29.5)	23.7 (7.8-66.8)	20.5 (10.4-34.4)	27.78 (3.55-56.12)	15.63 (0-55.55)	9.1 (5.1-11.9)	853 (626-1264)	45 (33-82)
	<i>Quercus pyrenaica</i>	403	9236	13.4 (3-33)	27 (7.5-112.4)	23.7 (9.3-51.5)	33.68 (2.88-76.24)	19.17 (0-75.51)	8.6 (6.1-11.9)	662 (469-1341)	36 (23-74)
<i>Pinus uncinata</i>	<i>Pinus sylvestris</i>	238	4359	10.7 (3-27.5)	23.1 (7.5-89)	20.9 (10.6-42.6)	29.64 (4.14-61.2)	17.39 (0-60.42)	5.6 (3.5-8.7)	1157 (901-1358)	75 (50-96)

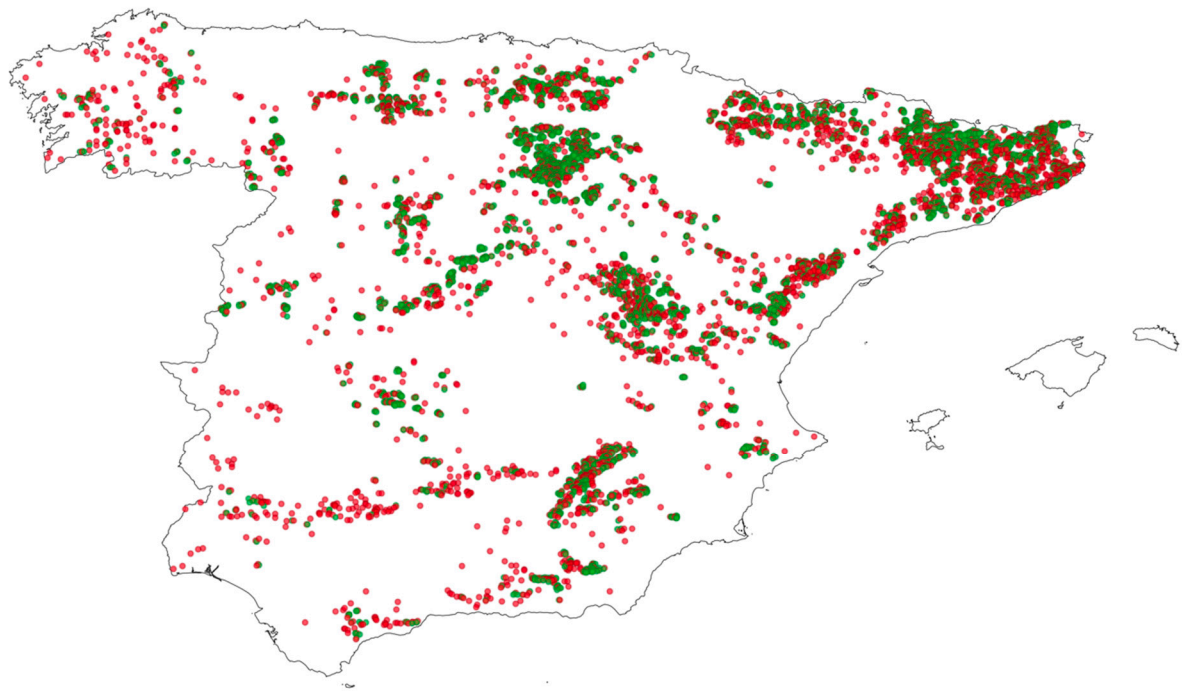
Supplementary Table S1 (Cont.) : Stats (mean and range) of the main tree and plot variables characterizing selected SNFI plots used in our study

Species	Mixture	Plots	Trees	h (m)	d (cm)	Dg (cm)	BA (m ² · ha ⁻¹)	BAL (m ² · ha ⁻¹)	T (°C)	P (mm)	M (mm · °C ⁻¹)
<i>Fagus sylvatica</i>	<i>Pinus sylvestris</i>	169	2606	15.1 (3.5-34)	24.6 (7.5-98.6)	21.4 (9.4-48.3)	27.13 (4.39-54.65)	16.13 (0-54.26)	8.4 (6.1-10.8)	812 (560-1141)	44 (28-71)
	<i>Quercus petraea</i>	121	2305	13.6 (3-32.5)	24 (7.5-90.7)	20.7 (11.3-54.8)	30.51 (4.73-80.08)	19.03 (0-79.63)	8.3 (6.1-11.6)	929 (563-1206)	51 (29-70)
	<i>Quercus pyrenaica</i>	124	2106	16.1 (3.5-36)	28 (7.5-92.3)	23.2 (9-49.1)	28.27 (3.35-54.85)	16.3 (0-54.28)	9.1 (6.7-11.1)	780 (538-1087)	41 (26-61)
	<i>Quercus robur</i>	68	1211	18.9 (3.5-34)	33.4 (7.5-98.7)	28.8 (11.3-60.7)	30.17 (5.17-67.27)	17.95 (0-66.45)	10.4 (6.8-13.2)	950 (692-1392)	47 (33-63)
<i>Quercus faginea</i>	<i>Pinus halepensis</i>	26	115	7.1 (4-15)	13.9 (7.5-53.8)	14.3 (10.5-20.7)	12.19 (3.84-18.39)	6.9 (0-18)	11.3 (9.1-13.3)	609 (394-738)	24 (16-33)
	<i>Pinus nigra</i>	97	563	7.3 (3-17)	15.1 (7.5-82.8)	15 (9.2-45.3)	15.44 (2.85-44.23)	9.12 (0-43.83)	10.6 (7.2-12.9)	784 (483-1009)	29 (18-36)
	<i>Pinus sylvestris</i>	125	985	7.7 (3-22)	16.3 (7.5-82.8)	15 (9.2-32.1)	17.21 (2.95-45.36)	10.16 (0-44.94)	11.2 (9.2-16.6)	624 (392-1115)	38 (24-56)
	<i>Quercus ilex</i>	184	1283	7.9 (3-22)	17.1 (7.5-92.3)	14.1 (8.4-53.2)	17.08 (2.32-50.01)	9.87 (0-47.86)	12.8 (11.9-14.8)	551 (386-721)	30 (17-50)
<i>Quercus ilex</i>	<i>Pinus halepensis</i>	286	2012	6.4 (3-16.5)	13.9 (7.5-60)	14.3 (9.3-30.9)	14.75 (2.74-31.48)	8.73 (0-31.09)	11.1 (7.2-14.1)	594 (426-992)	29 (12-43)
	<i>Pinus nigra</i>	248	1719	5.7 (3-14)	14.5 (7.5-72.6)	14.3 (8.6-28.4)	13.98 (2.69-36.51)	8.3 (0-35.65)	13.5 (9.8-17.2)	606 (336-900)	28 (20-58)
	<i>Pinus pinaster</i>	101	799	6.1 (3-11.5)	14.8 (7.5-92.3)	14.3 (9.2-35.1)	14.56 (3.36-29.52)	8.53 (0-29.11)	12.1 (8.8-16.4)	619 (344-1175)	28 (14-56)
	<i>Pinus pinea</i>	150	997	6.3 (3-18)	16 (7.5-68.1)	15.5 (8.9-37)	13.83 (3.06-30.37)	8.35 (0-29.96)	11.2 (6.9-13.6)	790 (474-1020)	26 (14-45)
	<i>Pinus sylvestris</i>	188	1789	6.3 (3-15)	14 (7.5-81.2)	13.4 (8.8-31.7)	17.07 (3.74-34.44)	10.02 (0-33.2)	11.1 (8.8-16.6)	642 (392-1115)	38 (24-60)
	<i>Quercus faginea</i>	219	1842	5.9 (3-17)	16.7 (7.5-92.9)	14.7 (8.4-51.4)	16.38 (2.32-50.01)	9.64 (0-49.61)	11.2 (9-14.5)	630 (331-1094)	31 (17-50)
	<i>Quercus pyrenaica</i>	38	298	6.1 (3-12.5)	19.3 (7.8-58.5)	17.2 (9.4-36.6)	16.59 (3.23-44.54)	9.58 (0-44.12)	13.8 (10.1-17.5)	714 (349-1038)	30 (14-52)
	<i>Quercus suber</i>	228	1779	7.2 (3-14.5)	19.2 (7.5-98.4)	18.6 (10-44.1)	17.09 (2.31-43.06)	10.33 (0-42.67)	12.9 (10.2-17.1)	654 (338-871)	30 (14-46)
<i>Quercus petraea</i>	<i>Fagus sylvatica</i>	73	809	12.4 (3-26.5)	24.9 (7.5-143.3)	19.2 (9.9-40.2)	25.56 (4.27-80.08)	14.62 (0-72.5)	9.8 (5.1-11.9)	853 (696-1248)	46 (29-68)
	<i>Pinus sylvestris</i>	34	269	8.5 (3.5-21)	17 (7.5-80.5)	16.5 (10.4-34.4)	16.16 (3.55-28.09)	9.37 (0-27.69)	9 (6.8-11.6)	865 (563-1206)	44 (33-82)
<i>Quercus pyrenaica</i>	<i>Fagus sylvatica</i>	160	2466	10.8 (3-27)	18.7 (7.5-129.9)	16.6 (9-51.3)	21.57 (3.35-45.43)	12.78 (0-44.88)	11.4 (8.8-15.9)	756 (413-1594)	34 (26-54)
	<i>Pinus pinaster</i>	64	529	10.1 (4-26)	17.8 (7.5-82.8)	17.1 (9.2-48.5)	20.04 (3.47-46.04)	11.55 (0-39.93)	9.6 (7.1-12.3)	673 (469-1341)	35 (17-68)
	<i>Pinus sylvestris</i>	199	2341	9.5 (3-26)	17.2 (7.5-76.4)	15.5 (8.5-79.9)	20.78 (2.88-63.83)	12.37 (0-62.63)	9.7 (7.4-11.1)	678 (522-1055)	34 (23-70)
	<i>Quercus ilex</i>	43	470	8.7 (3-21)	17.9 (7.7-55.4)	15.5 (10-36.6)	20.32 (3.23-44.54)	11.96 (0-43.67)	10.3 (6-14.4)	726 (333-1094)	36 (14-58)
	<i>Quercus robur</i>	36	221	11.8 (3-26.5)	24.4 (7.6-69.7)	23.4 (9.2-41.6)	20.82 (4.5-36.14)	12.15 (0-35.7)	12.1 (7.2-13.7)	1463 (945-1779)	66 (42-78)
<i>Quercus robur</i>	<i>Fagus sylvatica</i>	27	205	17.8 (7.5-29)	34.7 (8.2-107.9)	29.6 (13.1-60.7)	27.99 (5.77-55.24)	15.73 (0-46.05)	12.7 (11.2-14.5)	1559 (1096-1819)	47 (35-62)
	<i>Quercus pyrenaica</i>	45	477	12.9 (3-25)	28.8 (7.5-74.8)	23.3 (9.2-49.3)	21.11 (5.11-36.14)	11.79 (0-35.08)	12.1 (7.2-13.7)	1470 (921-1779)	66 (42-78)
<i>Quercus suber</i>	<i>Pinus pinaster</i>	112	892	6.9 (3-16)	21.9 (7.5-76.4)	18.8 (10.7-43.3)	17.67 (2.74-46.5)	9.91 (0-43.07)	14.5 (12.1-17.7)	696 (449-822)	27 (16-75)
	<i>Pinus pinea</i>	126	1327	6.2 (3-15.5)	18.9 (7.5-73.2)	17.2 (9.4-31.8)	16.69 (2.78-33.08)	9.72 (0-32.68)	14.3 (12.2-17.6)	662 (410-1716)	28 (18-37)
	<i>Quercus ilex</i>	289	2743	7.3 (3-17.5)	24.2 (7.5-112)	19.6 (10-44.1)	19.59 (2.31-44.99)	10.89 (0-44.56)	14.1 (10.9-17.5)	700 (349-849)	29 (14-41)

Note: h – Total tree height (m), d – Diameter at breast height (cm), Dg - Mean quadratic diameter (cm), BA – Basal area (m² · ha⁻¹), BAL – Basal area of larger trees (m² · ha⁻¹), T – Mean Annual Temperature (°C), P – Annual Total Precipitation (mm), M – De Martonne Index (mm · °C⁻¹)

Supp. Table S2: Competition Equivalence Coefficients ($e_{2-1} = SDI_{\max,sp1}/SDI_{\max,sp2}$ | $e_{1-2} = SDI_{\max,sp2}/SDI_{\max,sp1}$) for the most representative species compositions in Spain

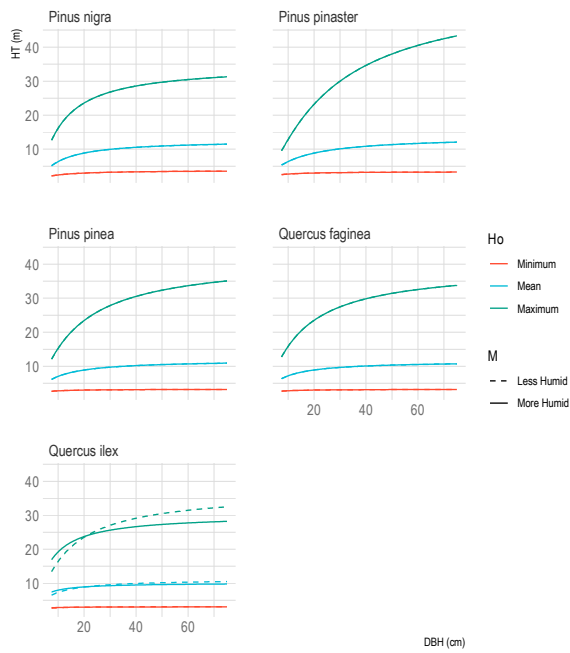
		Species 2												
Species 1		<i>Fagus sylvatica</i>	<i>Pinus halepensis</i>	<i>Pinus nigra</i>	<i>Pinus pinaster</i>	<i>Pinus pinea</i>	<i>Pinus sylvestris</i>	<i>Pinus uncinata</i>	<i>Quercus faginea</i>	<i>Quercus ilex</i>	<i>Quercus petraea</i>	<i>Quercus pyrenaica</i>	<i>Quercus robur</i>	<i>Quercus suber</i>
	<i>Fagus sylvatica</i>	1.00	0.54	1.04	1.16	0.61	1.20	0.86	0.76	0.45	0.89	0.81	0.79	0.64
	<i>Pinus halepensis</i>	1.85	1.00	1.73	1.96	1.31	2.11	1.60	1.02	0.65	1.31	1.31	1.44	1.09
	<i>Pinus nigra</i>	0.97	0.58	1.00	1.12	0.78	1.20	0.86	0.68	0.41	0.74	0.77	0.77	0.63
	<i>Pinus pinaster</i>	0.87	0.51	0.89	1.00	0.69	1.10	0.77	0.55	0.35	0.66	0.67	0.68	0.57
	<i>Pinus pinea</i>	1.65	0.77	1.31	1.48	1.00	1.66	1.28	0.68	0.45	0.93	0.96	1.23	0.83
	<i>Pinus sylvestris</i>	0.85	0.47	0.84	0.91	0.61	1.00	0.77	0.58	0.33	0.69	0.65	0.64	0.49
	<i>Pinus uncinata</i>	1.17	0.63	1.16	1.31	0.78	1.30	1.00	0.84	0.47	1.05	0.96	0.91	0.74
	<i>Quercus faginea</i>	1.36	1.08	1.50	1.95	1.61	1.81	1.20	1.00	0.66	1.10	1.13	1.06	1.20
	<i>Quercus ilex</i>	2.29	1.59	2.50	2.92	2.27	3.10	2.12	1.55	1.00	1.81	1.85	1.79	1.73
	<i>Quercus petraea</i>	1.15	0.83	1.41	1.58	1.21	1.60	0.96	0.92	0.56	1.00	1.03	0.95	0.93
	<i>Quercus pyrenaica</i>	1.24	0.78	1.32	1.52	1.11	1.59	1.04	0.89	0.55	0.98	1.00	0.97	0.88
	<i>Quercus robur</i>	1.27	0.69	1.32	1.46	0.81	1.59	1.11	0.96	0.57	1.05	1.03	1.00	0.83
	<i>Quercus suber</i>	1.58	0.92	1.59	1.75	1.21	2.03	1.36	0.91	0.59	1.11	1.15	1.22	1.00



Supplementary Figure S1: Location of the Spanish National Forest Inventory plots selected to fit the H-D models for the 29 different mixtures analyzed in this study.

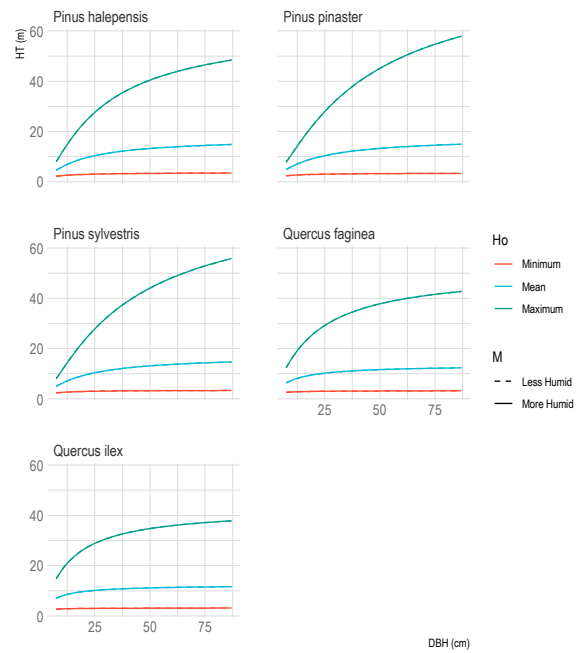
Note: Green points represent monospecific plots and red points represent mixed plots.

Climatic influence on Total Tree Height for *Pinus halepensis*



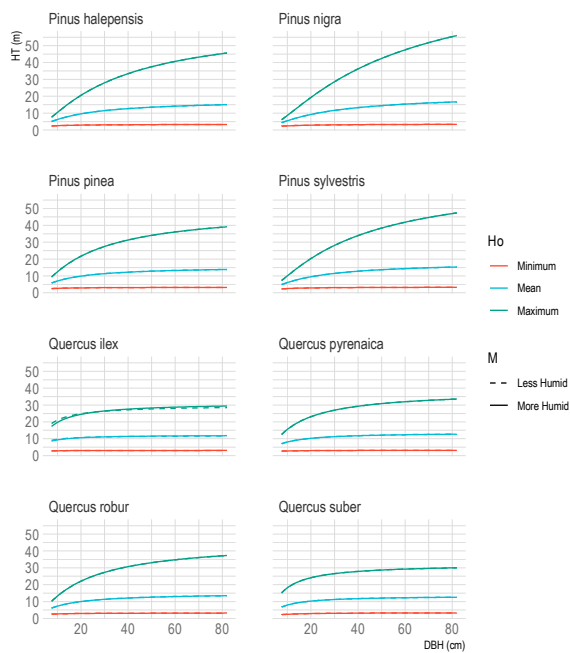
(a)

Climatic influence on Total Tree Height for *Pinus nigra*



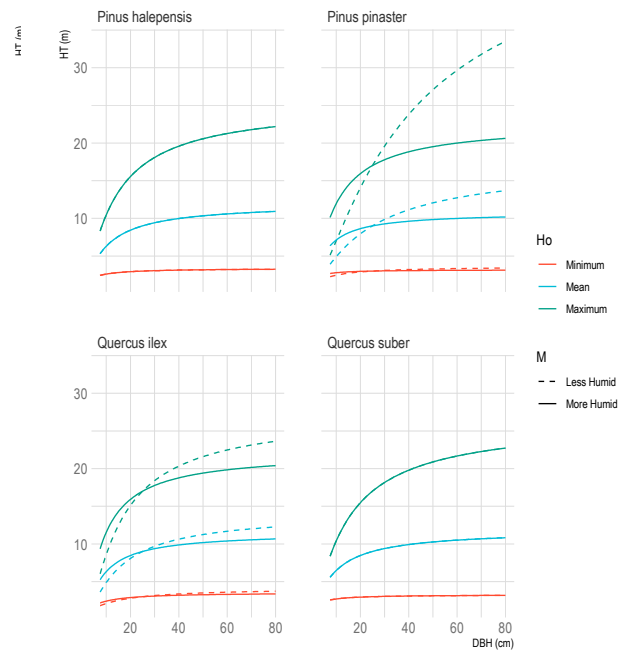
(b)

Climatic influence on Total Tree Height for *Pinus pinaster*



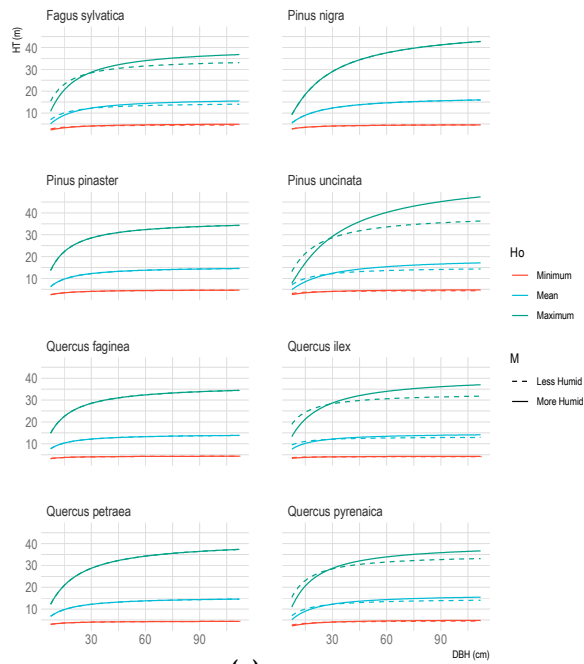
(c)

Climatic influence on Total Tree Height for *Pinus pinea*



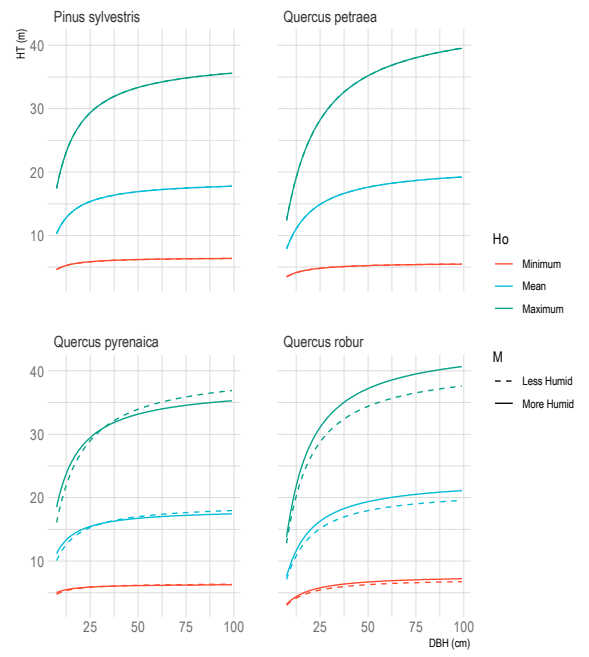
(d)

Climatic influence on Total Tree Height for *Pinus sylvestris*



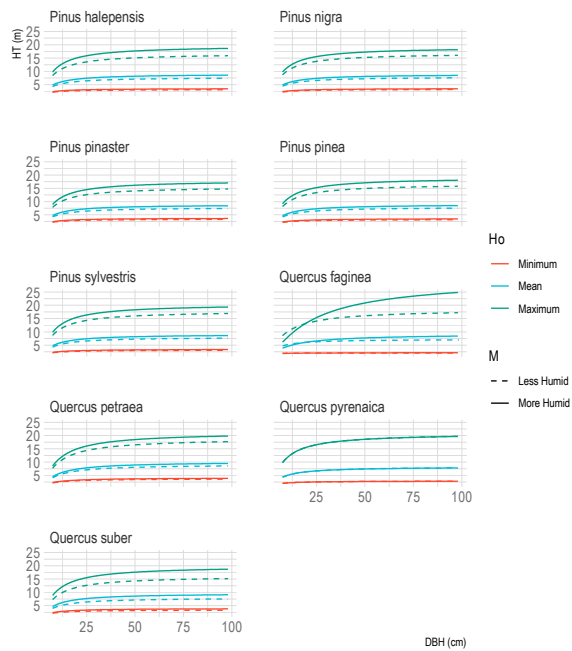
(e)

Climatic influence on Total Tree Height for *Fagus sylvatica*



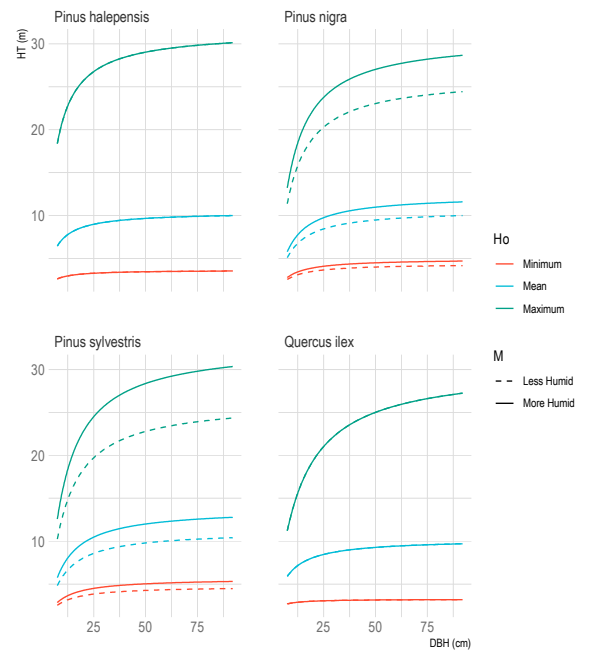
(f)

Climatic influence on Total Tree Height for *Quercus ilex*

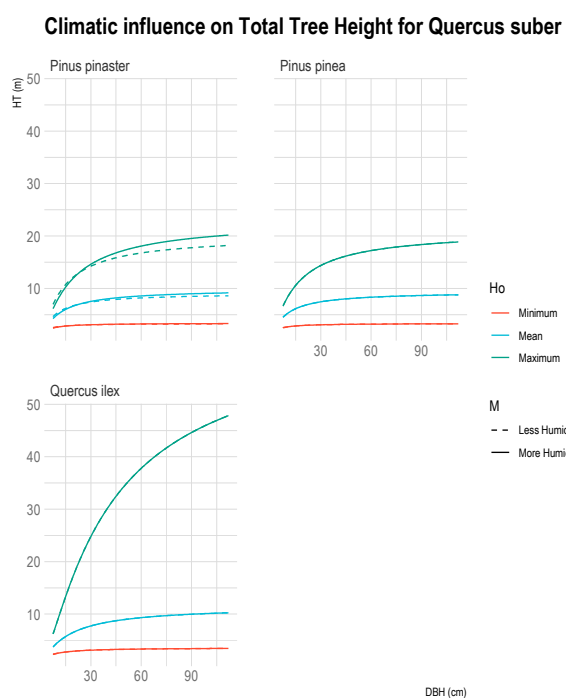
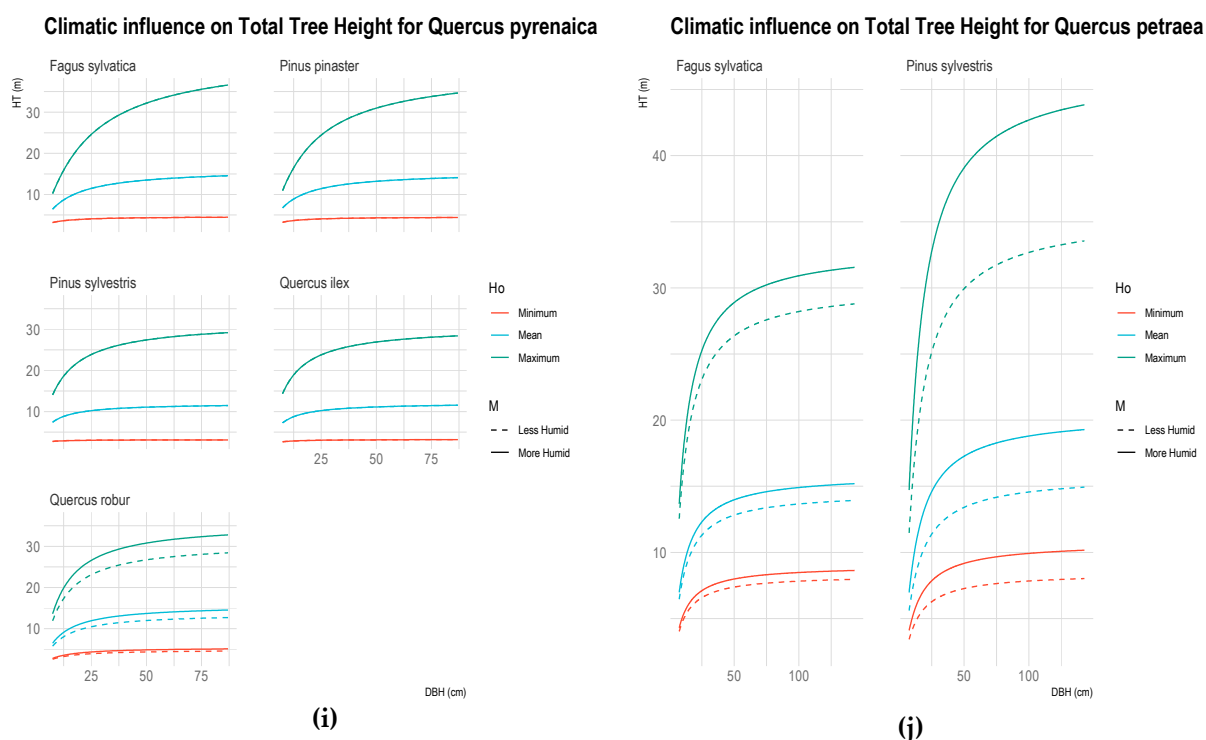


(g)

Climatic influence on Total Tree Height for *Quercus faginea*

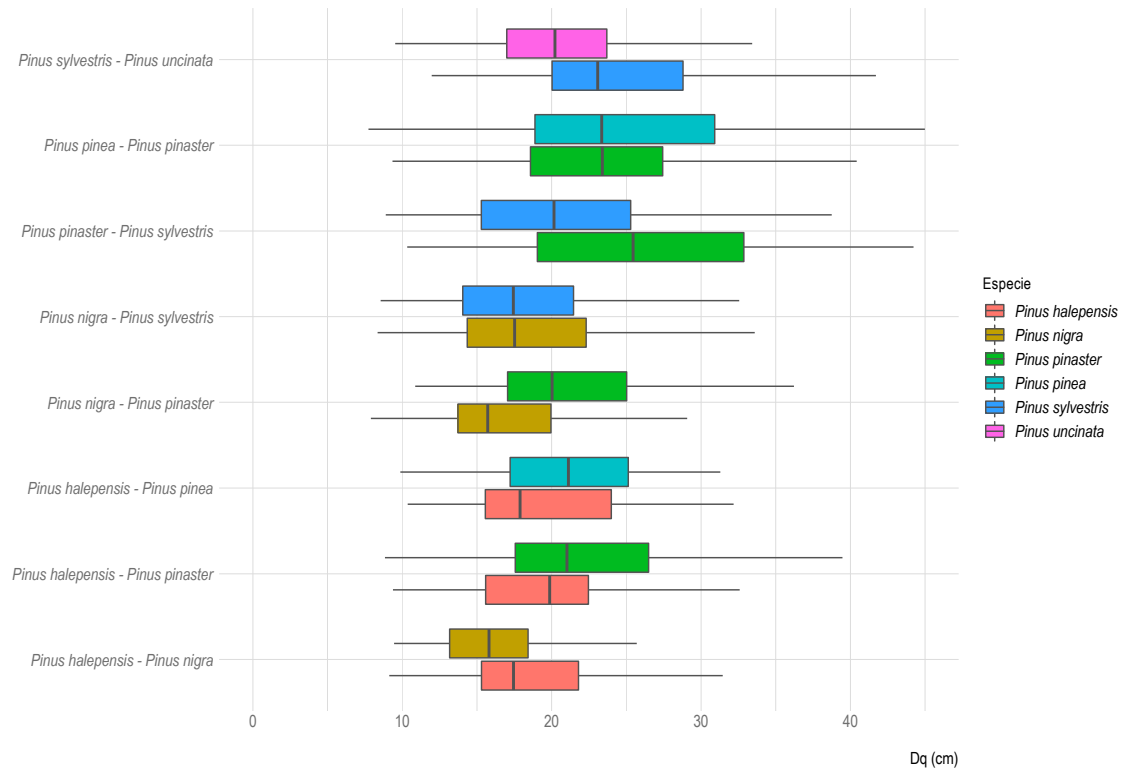


(h)



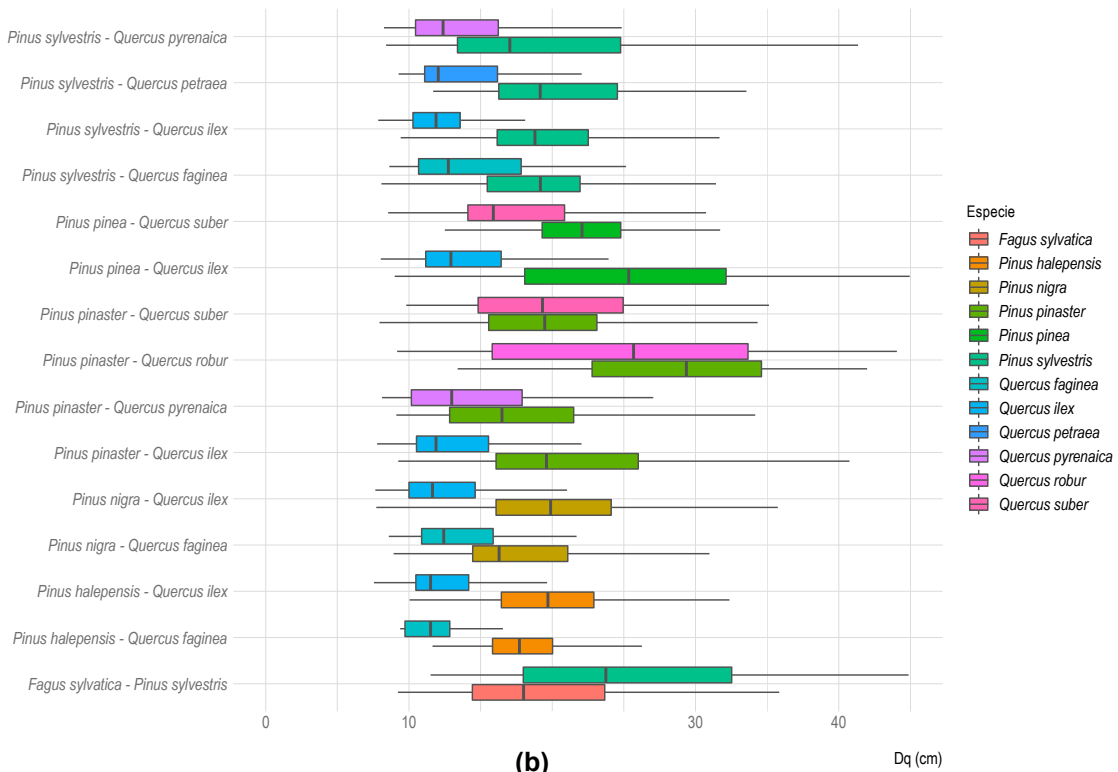
Supplementary Figure S2: Aridity influence in terms of the De Martonne Index (M), on H-D relationship for different stand dominant height (Ho)

Mean quadratic diameter (Dg) distribution in conifer-conifer mixed stands

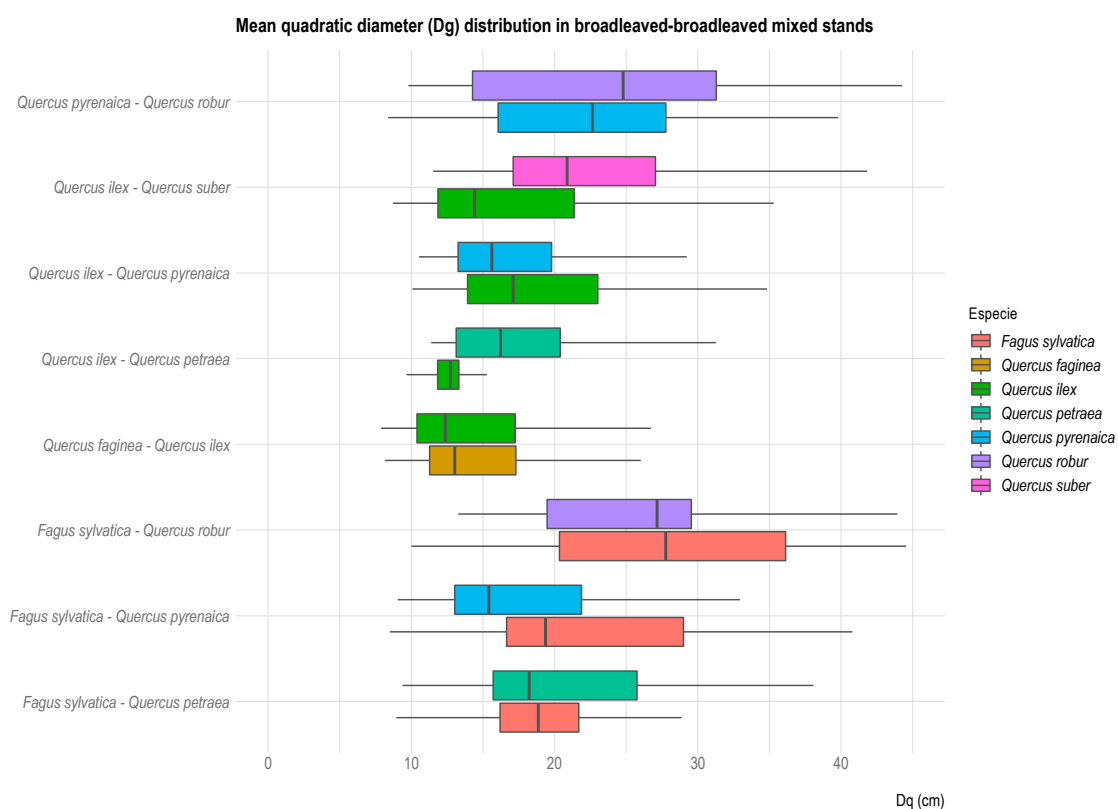


(a)

Mean quadratic diameter (Dg) distribution in broadleaved-conifer mixed stands

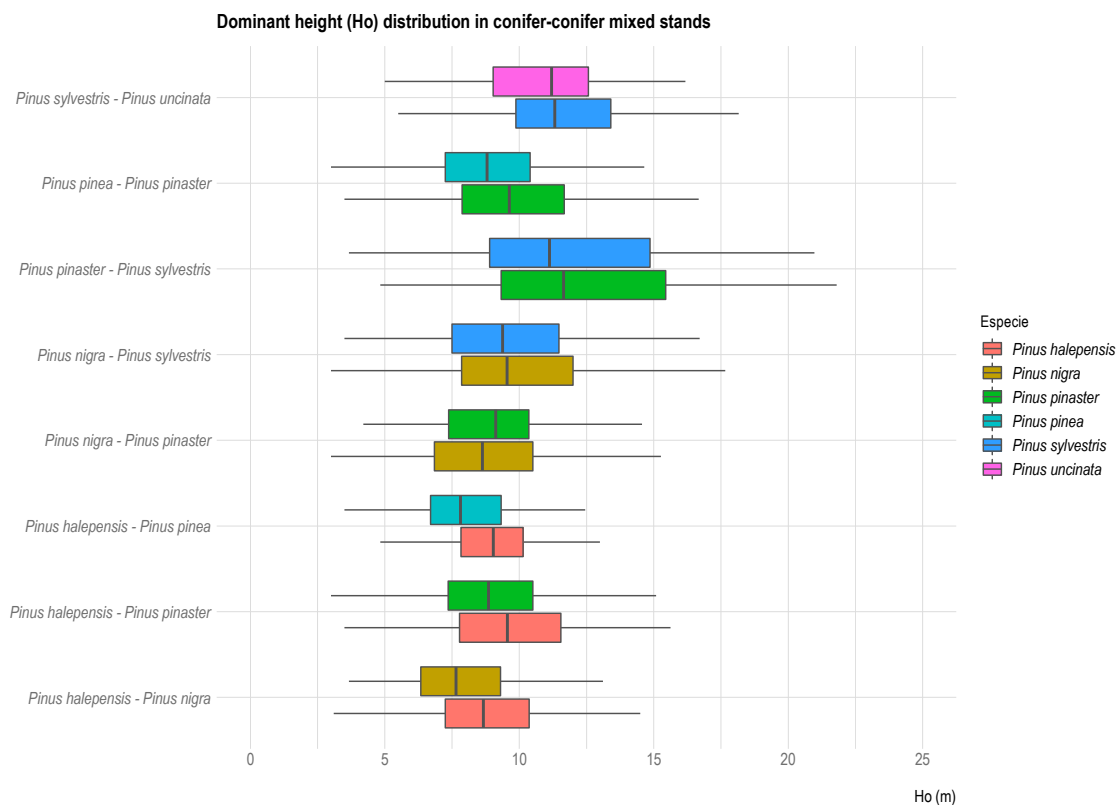


(b)

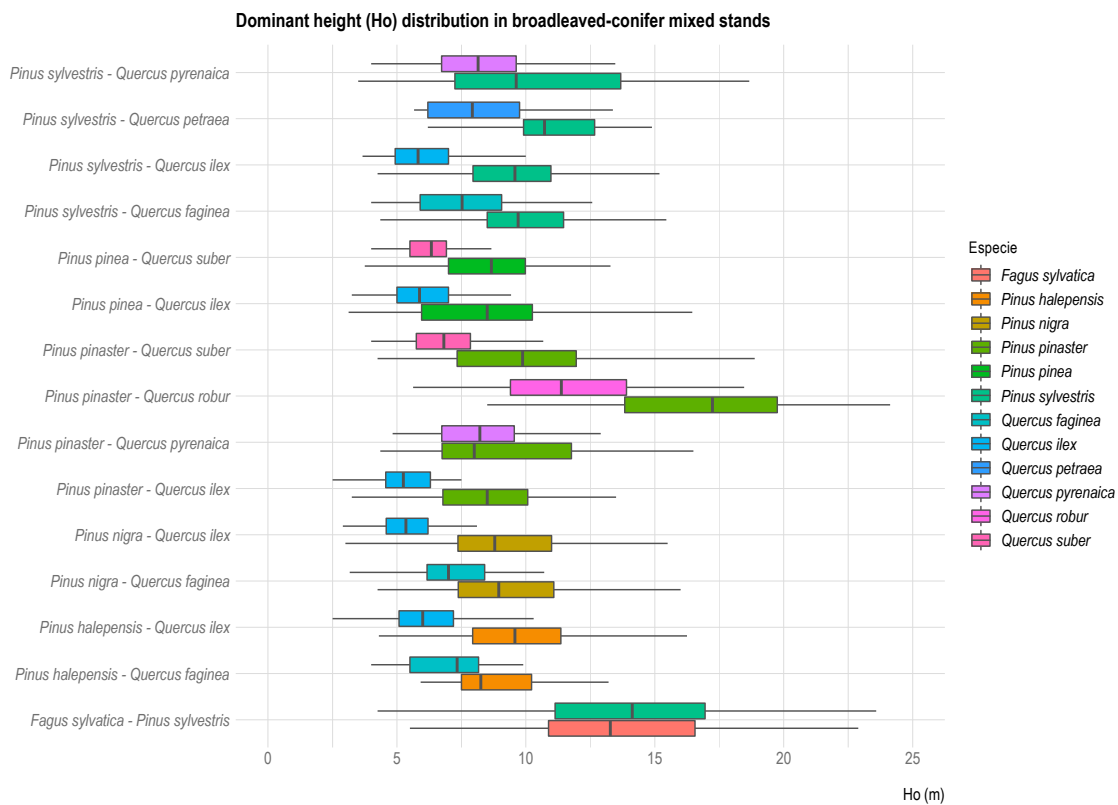


(c)

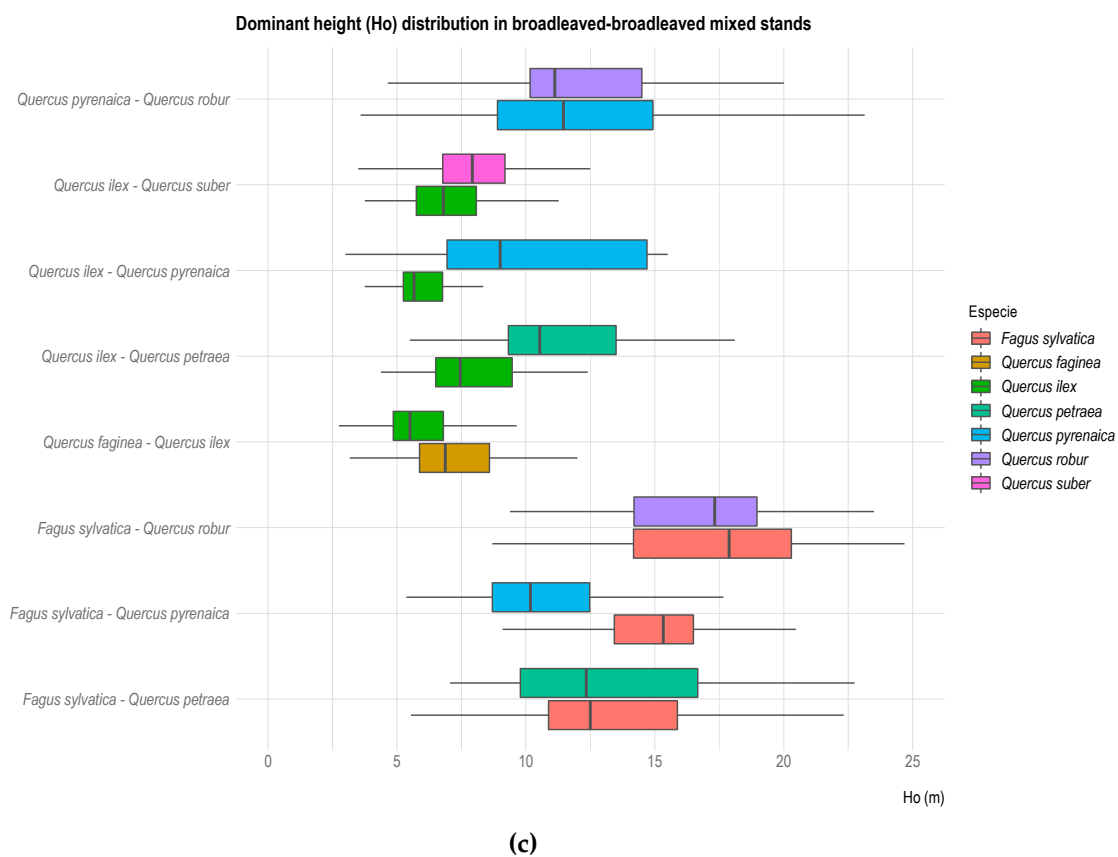
Supplementary Figure S3: Mean values of mean quadratic diameter by species (Dgi) for the selected SNFI plots for the different conifer-conifer (a), conifer-broadleaved (b) and broadleaved-broadleaved (c) mixtures analyzed



(a)



(b)



Supplementary Figure S4: Mean values of dominant height by species (Ho_i) for the selected SNFI plots for the different conifer-conifer (a), conifer-broadleaved (b) and broadleaved-broadleaved (c) mixtures analyzed