

Supplementary material

Modelling shifts and contraction of seed zones in two Mexican pine species by using molecular markers

Supplementary Table S1. Descriptive statistics for the 21 climatic variables of the two pine species under study, SD = standard deviation, N = 50.

Variable	<i>Pinus arizonica</i>				<i>Pinus durangensis</i>			
	Mean	Min	Max	SD	Mean	Min	Max	SD
MAT	9.9	8.3	11.2	0.8	10.9	9.2	15.6	1.4
MAP	867.3	683.0	1217.0	144.4	1009.1	729.0	1318.0	173.3
GSP	640.8	541.0	891.0	87.8	723.4	520.0	949.0	127.3
MTCM	4.3	2.3	5.6	0.9	5.2	3.1	9.4	1.4
MMIN	-5.3	-6.8	-4.2	0.7	-4.1	-5.9	0.5	1.4
MTWM	14.9	12.6	16.8	1.1	16.2	13.8	21.1	1.8
MMAX	24.2	22.2	26.0	1.0	25.5	23.4	30.5	2.0
SDAY	158.2	144.0	178.0	6.6	151.6	109.0	167.0	11.4
FDAY	269.2	251.0	279.0	9.3	281.0	257.0	313.0	12.5
FFP	112.7	78.0	134.0	17.8	134.4	89.0	202.0	24.9
DD5	2007.2	1529.0	2387.0	222.6	2336.4	1852.0	3883.0	446.1
AAI	0.05	0.04	0.07	0.01	0.05	0.04	0.07	0.01
GSDD5	1048.0	538.0	1356.0	226.3	1380.4	806.0	2869.0	437.6
D100	63.6	49.0	90.0	11.0	55.8	21.0	82.0	13.5
DD0	33.5	10.0	91.0	21.4	21.7	0.0	66.0	18.2
MMINDD0	933.6	797.0	1193.0	107.4	783.1	230.0	1111.0	175.8
SMRPB	4.7	4.0	6.1	0.7	5.0	4.2	6.8	0.8
SMRSPRPB	12.8	10.9	14.8	1.3	14.3	11.7	22.2	2.5
SPRP	30.8	27.0	42.0	3.3	32.3	22.0	42.0	5.6
SMRP	395.2	318.0	525.0	65.1	455.0	339.0	563.0	75.9
WINP	157.3	94.0	230.0	46.6	199.8	117.0	274.0	44.0

Note= MAT = Mean annual temperature (°C), MAP = Mean annual precipitation (mm), GSP = Growing season precipitation (April-September) (mm), MTCM = Mean temperature in the coldest month (°C), MMIN = Minimum temperature in the coldest month (°C), MTWM = Mean temperature in the warmest month (°C), MMAX = Maximum temperature in the warmest month (°C), SDAY = Julian date of the last freezing date of spring, FDAY = Julian date of the first freezing date of autumn, FFP = Length of the Frost-free period (Days), DD5 = Degree days > 5°C (based on mean monthly temperature, degree-days), AAI = Annual aridity index [dd5/0.5mm], GSDD5 = Degree days > 5°C accumulated within the frost-free period (degree-days), D100 = Julian date when the sum of degree days >5°C reaches 100, DD0 = Degree-days < 0°C (based on mean monthly temperature, degree-days), MMINDD0 = Degree-days < 0°C (based on mean minimum monthly temperature, degree-days), SMRPB = Summer precipitation balance: (Jul+Aug+Sep)/(Apr+May+Jun), SMRSPRPB = Summer Spring precipitation balance: (Jul+Aug)/(Apr+May), SPRP = Spring precipitation (Apr+May) (mm), SMRP = Summer precipitation (Jul+Aug) (mm) and WINP = Winter precipitation (Nov+Dec+Jan+Feb) (mm).

Supplementary Table S2. Descriptive statistics for the 25 soil variables of the two pine species under study, SD = standard deviation, N = 50.

Variable	<i>P. arizonica</i>				<i>P. durangensis</i>			
	Mean	Min	Max	SD	Mean	Min	Max	SD
SAL (dS/m)	0.3	0.1	0.8	0.2	0.3	0.1	1.6	0.3
NO ₃ (kg/ha)	57.5	9.6	164.1	54.8	29.2	9.7	165.2	30.5
P (ppm)	16.2	1.8	56.1	15.5	7.7	1.1	32.3	8.6
OM (%)	9.2	1.2	19.4	5.0	9.9	3.0	20.5	5.1
Sat (%)	68.6	38.0	117.0	18.3	71.4	45.0	99.0	15.4
Sand (%)	62.7	40.4	78.4	8.5	65.0	54.4	74.4	6.1
Silt (%)	26.2	11.8	45.8	7.7	24.0	15.8	33.8	4.8
Clay (%)	11.2	5.7	15.7	2.6	11.0	5.7	19.7	3.7
pH	5.1	4.6	5.6	0.3	5.1	4.6	5.5	0.3
Ca (ppm)	1702.4	708.5	2967.3	595.8	1914.5	471.3	6321.3	1119.0
Mg (ppm)	211.3	61.8	611.0	127.8	309.7	71.5	822.3	210.2
Na (ppm)	64.7	43.5	97.0	16.7	83.2	37.5	401.5	69.8
K (ppm)	573.7	226.0	959.0	194.6	600.9	275.5	1327.5	239.1
Fe (ppm)	61.2	23.0	104.4	15.5	57.4	30.7	75.3	13.7
Zn (ppm)	2.8	0.2	5.4	1.6	2.2	0.2	6.7	1.9
Mn (ppm)	51.2	3.5	90.9	29.3	44.6	2.9	105.0	32.6
Cu (ppm)	0.4	0.2	0.9	0.2	0.4	0.2	0.8	0.2
O.B. (%)	6.9	6.1	7.1	0.4	6.9	6.3	7.1	0.3
H (%)	28.1	20.6	35.9	4.5	29.0	22.1	35.4	4.5
Ca (%)	45.9	35.6	54.2	4.7	43.1	30.1	54.3	6.3
Mg (%)	9.1	5.1	16.6	2.9	11.1	4.5	21.1	3.8
K (%)	8.3	4.7	19.6	3.0	8.1	3.1	24.1	4.3
Na (%)	1.7	0.6	4.0	0.7	1.8	0.7	6.8	1.2
CEC	18.5	7.5	31.7	6.2	22.0	7.0	58.9	10.9
HC (cm/h)	25.7	2.8	50.4	12.4	21.0	2.0	49.8	13.2

Note = SAL = Salinity, NO₃ = Nitrates, P = Phosphorus, OM = Organic material, Sat = Water saturation, Ca = Calcium, Mg = Magnesium, Na = Sodium, K = Potassium, Fe = Iron, Zn = Zinc, Mn = Manganese, Cu = Copper, O.B.CEC = Rel. Proportion of other bases in the cation exchange capacity (CEC; meq/100g soil), HCEC = Relative proportion of hydrogen in CEC, CaCEC = Relative proportion in percentage of Ca in CEC, MgCEC = Relative proportion (%) of Mg in CEC, KCEC = Relative proportion in percentage of K in CEC, NaCEC = Relative proportion (%) of Na in , CEC = cation exchange capacity (CEC; meq/100g soil) and HC = Hydraulic conductivity.

Supplementary Table S3a. Locations of the seed stands under study of the species *Pinus arizonica*.

Species	Stands	Code	Location	Municipality	States	Latitude (N)	Longitude (W)	Elevation (m)	Cluster	Mean distance to the next tree (m)
<i>P. arizonica</i>	17	PA3	P.P Porvenir	Guachochi	Chihuahua	26°44'26.41"	107°15'11.94"	2,587	1	56
	4	AM	El Muertesito	Guadalupe y Calvo	Chihuahua	26°1'37.9"	106°2'38.1"	2,801	1	140
	3	AIC	Rancho el Indio	Guadalupe y Calvo	Chihuahua	26°2'29.6"	106°46'3"	2,721	1	84
	1	AG	Entronque de Gallinas	Guadalupe y Calvo	Chihuahua	26°4'15.2"	106°54'26.4"	2,956	1	116
	6	BT	Bajío del Cochi	Teomohachi	Chihuahua	28°37'22.95"	108°15'54.45"	2,398	1	68
	9	ET	Toril	San Dimas	Durango	24°26'59.57"	105°56'26.03"	2,760	1	76
	14	PA	El Girón	Tepehunes	Durango	25°5'56.19"	105°51'12.85"	2,913	1	71
	8	CA1	La Cebadilla	Balleza	Chihuahua	26°10'10.16"	106°20'54.5"	2,670	2	80
	15	PA1	El Embudo	Balleza	Chihuahua	26°20'5.9"	106°19'34.5"	2,499	2	120
	11	J3	Entronque Jacales	Balleza	Chihuahua	26°21'28.4"	106°24'57.9"	2,588	2	65
	16	PA2	La Ultima Agua	Balleza	Chihuahua	26°21'36.7"	106°20'4.7"	2,700	2	110
	20	PC1	Cebollas (Pinole)	Balleza	Chihuahua	26°32'16.8"	106°28'31.8"	2,657	2	67
	19	PB	El Bigueño	Balleza	Chihuahua	26°33'42.7"	106°25'25"	2,480	2	67
	10	J1	La Tetona	Balleza	Chihuahua	26°36'54.4"	106°32'32.9"	2,569	2	73
	5	AO	Mesa del Ojito	Guadalupe y Calvo	Chihuahua	26°10'22.2"	106°38'6.8"	2,684	2	129
	25	XX	EL Guardaganado	Guanacevi	Durango	26°10'35.76"	106°20'52.16"	3,062	2	82
	24	TG	Tierras de Genaro	Guanacevi	Durango	26°10'49.55"	106°21'8.21"	2,675	2	67
	23	TC	La Torre	Guanacevi	Durango	26°10'57.23"	106°20'28.53"	2,948	2	66
	7	CA	Los Magueyes	Guanacevi	Durango	26°15'9.3"	106°24'10.5"	2,486	2	83
	2	AGLL	Gallina	Guachochi	Chihuahua	26°44'40.34"	107°10'6.09"	2,420	3	69
	13	MJ	Mesa de Joya	Guachochi	Chihuahua	26°48'22.98"	107°2'18.94"	2,724	3	80
	12	MC	Mesa Rancho Mario	Madera	Chihuahua	29°13'11.8"	108°13'11.67"	2,552	3	63
	22	PS	Mesa de Seis	Madera	Chihuahua	29°22'27.42"	108°11'31.33"	2,571	3	58
	18	PACB	Ciénega Blanca	Teomohachi	Chihuahua	28°42'38.63"	108°15'49.49"	2,669	3	64
	21	PCT	Puerto Grande	Teomohachi	Chihuahua	28°43'49.22"	108°17'59.76"	2,629	3	48

Supplementary Table S3b. Locations of the seed stands under study of the species *Pinus durangensis*.

Species	Stands	Code	Location	Municipality	States	Latitude (N)	Longitude (W)	Elevation (m)	Cluster	Mean distance to the next tree (m)
<i>P. durangensis</i>	2	CD	La Cebadilla	Balleza	Chihuahua	26°15'9.3"	106°24'10.5"	2,595	1	57
	18	PD1	Los Ángeles de Arriba	Balleza	Chihuahua	26°25'17.3"	106°31'36.7"	2,768	1	72
	7	EG	Granizo	Guachochi	Chihuahua	26°41'19.86"	107°15'19.99"	2,801	1	55
	24	PPD	Porvenir	Guachochi	Chihuahua	26°46'40.73"	107°15'8.91"	2,450	1	63
	9	H2	Alto del Águila	Guadalupe y Calvo	Chihuahua	25°47'14.8"	106°41'14.4"	2,212	1	66
	6	DP	El Panteón	Guadalupe y Calvo	Chihuahua	26°1'12.6"	106°54'32"	2,635	1	143
	20	PDC	El Pinito	Guadalupe y Calvo	Chihuahua	26°4'40.2"	106°59'20.9"	2,444	1	71
	5	DC	Parque de Beis Bol	Guadalupe y Calvo	Chihuahua	26°5'12.9"	106°47'36.8"	2,217	1	67
	15	MA	Mesa de Carrera	Ocampo	Chihuahua	28°10'30.76"	108°16'1.23"	2,231	1	57
	16	OC	Mesa del Pinole	Ocampo	Chihuahua	28°13'33.37"	108°17'52.19"	2,439	1	56
	25	SMD	Mesa de Escorpiones	Otáez	Durango	24°44'10.32"	105°56'43.7"	2,578	1	102
	1	CC	Cordón del 45	Teomohachi	Chihuahua	28°44'18.43"	108°16'18.57"	2,385	1	56
	19	PD2	Mesa de Arturo	Urique	Chihuahua	27°12'59.21"	107°59'53.4"	2,410	1	99
	3	CHD	Mesa Huicochi (churo)	Urique	Chihuahua	27°25'1.69"	107°57'1.12"	2,647	1	81
	21	PDN	Panteón	Guachochi	Chihuahua	27°15'35.9"	107°27'15.8"	2,381	2	56
	4	CM	Ojito	Madera	Chihuahua	29°1'9.69"	108°19'54.86"	2,441	2	51
	12	LD	La Daga	Madera	Chihuahua	29°29'47.53"	108°18'59.45"	2,381	2	55
	13	LND	Mesa de las Garzas	Madera	Chihuahua	29°35'55.43"	108°26'12.69"	2,516	2	57
	14	LP	La Piedrera	Madera	Chihuahua	29°40'59.13"	108°26'36.78"	2,701	2	115
	11	LCQ	La Cruz Quemada	Urique	Chihuahua	27°12'17.17"	108°0'28.72"	2,543	2	79
	17	PD	Puerto la Trampa	San Dimas	Durango	24°23'8.29"	106°2'56.9"	2,630	3	78
	8	ESF	El Cuadro	San Dimas	Durango	24°26'8.37"	106°3'5.24"	2,219	3	70
	23	PL	La Pista	San Dimas	Durango	24°27'19.26"	106°8'8.06"	2,495	3	115
	10	JP	La Joya	Santiago Papasquiaro	Durango	25°0'10.68"	106°9'47.04"	2,438	3	73
	22	PDS	La Soledad	Santiago Papasquiaro	Durango	25°0'7.41"	106°10'26.42"	2,405	3	90

Supplementary Table S4. Outlier loci by AFLP found for the two *Pinus* species studied by using BayeScan (posterior probability > 0.99, false discovery rates < 0.01), and the measure of genetic differentiation δ ($p < 0.0001$).

Pine species	BayeScan and genetic differentiation δ
<i>P. arizonica</i>	75,76,86,87,91,92,102,147,164,174,186,189,190,194,207,208,209,211,212,214,225,240,257,260,264,268,277,282,286,298,308,311,312,314,318,339,349,351,360,407,424,425
<i>P. durangensis</i>	75,76,86,87,92,117,155,163,180,181,189,190,194,208,209,211,214,215,236,240,257,260,264,265,268,274,277,282,286,298,308,311,312,318,333,335,339,342,349,352,360,381,406,407,416,424,425

Note: δ detected more outlier loci of AFLP than by using BayeScan.

Supplementary Table S5. Descriptive statistics of the climatic variables implemented in the *Pinus arizonica* distribution model; SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
BIO01	Annual Mean Temperature	°C	9.4	24.6	15.1	3.0
BIO02	Mean Diurnal Range (Mean of monthly (max temp - min temp))	°C	11.1	19.7	16.2	2.0
BIO03	Isothermality (BIO2/BIO7) (* 100)	°C	4.3	7.1	5.8	0.4
BIO04	Temperature Seasonality (standard deviation *100)	°C	225.2	762.3	396.0	102.4
BIO05	Max Temperature of Warmest Month	°C	20.8	38.4	28.6	3.1
BIO06	Min Temperature of Coldest Month	°C	-6.9	14.0	0.9	4.1
BIO07	Temperature Annual Range (BIO5-BIO6)	°C	18.7	38.6	27.7	4.2
BIO08	Mean Temperature of Wettest Quarter	°C	13.2	28.4	19.1	2.8
BIO09	Mean Temperature of Driest Quarter	°C	6.5	24.6	14.2	3.4
BIO10	Mean Temperature of Warmest Quarter	°C	13.6	29.0	19.8	2.9
BIO11	Mean Temperature of Coldest Quarter	°C	2.5	20.9	9.8	3.6
BIO12	Annual Precipitation	mm	209.0	1548.0	789.7	231.0
BIO13	Precipitation of Wettest Month	mm	36.0	482.0	195.2	56.9
BIO14	Precipitation of Driest Month	mm	0.0	22.0	8.3	3.8
BIO15	Precipitation Seasonality (Coefficient of Variation)	%	44.0	126.0	94.6	11.0
BIO16	Precipitation of Wettest Quarter	mm	107.0	1200.0	496.5	148.6
BIO17	Precipitation of Driest Quarter	mm	9.0	76.0	37.5	14.3
BIO18	Precipitation of Warmest Quarter	mm	94.0	1012.0	407.0	132.0
BIO19	Precipitation of Coldest Quarter	mm	18.0	272.0	100.1	45.8

NOTE: Variables in bold were selected for the *Pinus arizonica* distribution model.

Supplementary Table S6. Descriptive statistics of the topography variables implemented in the *Pinus arizonica* distribution model. SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
ASP	Aspect	%	-1.0	359.8	183.1	102.5
CUR	Curvature	%	-1.4	1.9	0.0	0.2
PLC	Plan curvature	%	-0.7	0.9	0.0	0.1
PRC	Profile curvature	%	-0.9	0.8	0.0	0.1
SLP	Slope (degrees)	%	0.0	55.6	11.3	7.8
TSI	Terrain shape index	%	-0.9	1.0	0.0	0.1
WI	Wetness index	%	0.0	22.9	12.2	1.7

NOTE: Variables in bold were selected for the *P. arizonica* distribution model.

Supplementary Table S7a. Descriptive statistics of the soil variables implemented in the *Pinus arizonica* distribution model; SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
GEO	Geology_inegi	-	2	27	25.4	4.5
LITHO	Lithostratigraphy_inegi	-	1	37	9.6	2.5
BDRICM	Depth to bedrock (R horizon) up to 200 cm	cm	26	200	96.8	25.6
BDRLOG	Predicted probability of occurrence (0-100%) of R horizon	%	4	100	72.2	11.2
BDTICM	Absolute depth to bedrock	cm	0	9807	141.8	241.6
BLDFIE-sl1	Bulk density (fine earth)	kg/m3	1032	1541	1319.7	73.0
BLDFIE-sl2	Bulk density (fine earth)	kg/m3	994	1514	1271.7	75.1
BLDFIE-sl3	Bulk density (fine earth)	kg/m3	1121	1526	1322.3	60.5
BLDFIE-sl4	Bulk density (fine earth)	kg/m3	1199	1571	1371.3	61.5
BLDFIE-sl5	Bulk density (fine earth)	kg/m3	1254	1639	1433.6	65.1
BLDFIE-sl6	Bulk density (fine earth)	kg/m3	1248	1632	1454.2	61.3
BLDFIE-sl7	Bulk density (fine earth)	kg/m3	1249	1630	1451.9	59.5
CECSOL-sl1	Cation exchange capacity of soil	cmol/kg	14	42	24.1	4.2
CECSOL-sl2	Cation exchange capacity of soil	cmol/kg	13	39	22.6	4.0
CECSOL-sl3	Cation exchange capacity of soil	cmol/kg	12	39	22.3	4.0
CECSOL-sl4	Cation exchange capacity of soil	cmol/kg	12	40	22.4	3.9
CECSOL-sl5	Cation exchange capacity of soil	cmol/kg	12	40	22.7	3.7
CECSOL-sl6	Cation exchange capacity of soil	cmol/kg	13	40	22.9	3.6
CECSOL-sl7	Cation exchange capacity of soil	cmol/kg	13	40	23.1	3.8
CLYPPT-sl1	Clay content (0-2 micro meter) mass fraction	%	31	58	46.9	3.5
CLYPPT-sl2	Clay content (0-2 micro meter) mass fraction	%	32	60	47.0	3.7
CLYPPT-sl3	Clay content (0-2 micro meter) mass fraction	%	32	61	46.8	3.5
CLYPPT-sl4	Clay content (0-2 micro meter) mass fraction	%	34	60	45.9	3.3
CLYPPT-sl5	Clay content (0-2 micro meter) mass fraction	%	34	60	45.2	3.0
CLYPPT-sl6	Clay content (0-2 micro meter) mass fraction	%	34	59	44.9	2.9
CLYPPT-sl7	Clay content (0-2 micro meter) mass fraction	%	32	57	44.0	2.8
CRFVOL-sl1	Coarse fragments volumetric	%	7	37	22.8	3.3
CRFVOL-sl2	Coarse fragments volumetric	%	6	35	21.9	3.1
CRFVOL-sl3	Coarse fragments volumetric	%	7	36	23.0	3.1
CRFVOL-sl4	Coarse fragments volumetric	%	7	37	24.1	3.1
CRFVOL-sl5	Coarse fragments volumetric	%	8	39	25.5	3.1
CRFVOL-sl6	Coarse fragments volumetric	%	10	41	26.7	3.1
CRFVOL-sl7	Coarse fragments volumetric	%	11	41	27.9	3.1
OCSTHA-sd1	Soil organic carbon stock	t ha	0	60	13.7	11.2
OCSTHA-sd2	Soil organic carbon stock	t ha	0	94	14.2	11.6
OCSTHA-sd3	Soil organic carbon stock	t ha	0	133	13.2	11.3
OCSTHA-sd4	Soil organic carbon stock	t ha	0	273	15.8	15.6
OCSTHA-sd5	Soil organic carbon stock	t ha	0	366	5.8	9.2
OCSTHA-sd6	Soil organic carbon stock	t ha	0	160	0.6	4.2

NOTE: Variables in bold were selected for the *P. arizonica* distribution model.

Supplementary Table S7b. Descriptive statistics of the soil variables implemented in the *Pinus arizonica* distribution model; SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
ORCDRC-sl1	Soil organic carbon content (fine earth fraction)	g kg	6	152	57.4	18.5
ORCDRC-sl2	Soil organic carbon content (fine earth fraction)	g kg	5	113	26.9	8.1
ORCDRC-sl3	Soil organic carbon content (fine earth fraction)	g kg	5	94	17.8	4.4
ORCDRC-sl4	Soil organic carbon content (fine earth fraction)	g kg	2	92	10.2	3.4
ORCDRC-sl5	Soil organic carbon content (fine earth fraction)	g kg	1	88	7.4	2.9
ORCDRC-sl6	Soil organic carbon content (fine earth fraction)	g kg	0	89	6.7	2.8
ORCDRC-sl7	Soil organic carbon content (fine earth fraction)	g kg	0	89	6.6	2.8
PHIHOX-sl1	Soil pH x 10	H2O	51	85	61.1	4.3
PHIHOX-sl2	Soil pH x 10	H2O	51	85	60.7	4.4
PHIHOX-sl3	Soil pH x 10	H2O	51	85	60.8	4.5
PHIHOX-sl4	Soil pH x 10	H2O	52	86	61.1	4.4
PHIHOX-sl5	Soil pH x 10	H2O	53	87	61.9	4.7
PHIHOX-sl6	Soil pH x 10	H2O	53	87	63.3	4.6
PHIHOX-sl7	Soil pH x 10	H2O	53	88	63.9	4.6
PHIKCL-sl1	Soil pH x 10	KCl	41	75	54.2	5.5
PHIKCL-sl2	Soil pH x 10	KCl	41	74	54.2	5.4
PHIKCL-sl3	Soil pH x 10	KCl	42	74	54.0	5.3
PHIKCL-sl4	Soil pH x 10	KCl	44	74	54.1	5.1
PHIKCL-sl5	Soil pH x 10	KCl	44	75	54.6	5.1
PHIKCL-sl6	Soil pH x 10	KCl	45	75	54.9	5.0
PHIKCL-sl7	Soil pH x 10	KCl	45	76	55.3	5.1
SLTPPT-sl1	Silt content (2-50 micro meter)	%	12	36	26.2	2.9
SLTPPT-sl2	Silt content (2-50 micro meter)	%	12	37	26.4	2.8
SLTPPT-sl3	Silt content (2-50 micro meter)	%	11	36	26.1	2.8
SLTPPT-sl4	Silt content (2-50 micro meter)	%	11	35	25.3	2.9
SLTPPT-sl5	Silt content (2-50 micro meter)	%	11	34	24.7	2.6
SLTPPT-sl6	Silt content (2-50 micro meter)	%	12	33	24.1	2.4
SLTPPT-sl7	Silt content (2-50 micro meter)	%	12	33	24.0	2.3
SNDPPT-sl1	Sand content (50-2000 micro meter)	%	19	41	27.1	2.3
SNDPPT-sl2	Sand content (50-2000 micro meter)	%	20	42	26.7	2.5
SNDPPT-sl3	Sand content (50-2000 micro meter)	%	20	43	27.3	2.7
SNDPPT-sl4	Sand content (50-2000 micro meter)	%	20	43	28.9	2.9
SNDPPT-sl5	Sand content (50-2000 micro meter)	%	21	44	30.2	2.8
SNDPPT-sl6	Sand content (50-2000 micro meter)	%	21	45	31.1	2.7
SNDPPT-sl7	Sand content (50-2000 micro meter)	%	22	44	32.2	2.5

NOTE: Variables in bold were selected for the *P. arizonica* distribution model.

Supplementary Table S8. Descriptive statistics of the climatic variables implemented in the *Pinus durangensis* distribution model; SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
BIO01	Annual Mean Temperature	°C	9.4	24.6	14.9	3.0
BIO02	Mean Diurnal Range (Mean of monthly (max temp - min temp))	°C	11.1	19.6	16.2	2.0
BIO03	Isothermality (BIO2/BIO7) (* 100)	°C	4.9	6.5	5.8	0.3
BIO04	Temperature Seasonality (standard deviation *100)	°C	225.2	650.7	394.8	101.7
BIO05	Max Temperature of Warmest Month	°C	20.8	38.4	28.5	3.1
BIO06	Min Temperature of Coldest Month	°C	-6.9	14.0	0.8	4.1
BIO07	Temperature Annual Range (BIO5-BIO6)	°C	18.7	36.2	27.7	4.2
BIO08	Mean Temperature of Wettest Quarter	°C	13.2	28.2	18.9	2.8
BIO09	Mean Temperature of Driest Quarter	°C	6.5	24.6	14.2	3.4
BIO10	Mean Temperature of Warmest Quarter	°C	13.6	28.9	19.6	2.8
BIO11	Mean Temperature of Coldest Quarter	°C	2.5	20.9	9.7	3.6
BIO12	Annual Precipitation	mm	352.0	1548.0	806.4	220.6
BIO13	Precipitation of Wettest Month	mm	90.0	482.0	200.3	52.3
BIO14	Precipitation of Driest Month	mm	0.0	22.0	8.3	3.8
BIO15	Precipitation Seasonality (Coefficient of Variation)	%	74.0	126.0	95.8	9.3
BIO16	Precipitation of Wettest Quarter	mm	222.0	1200.0	509.5	137.4
BIO17	Precipitation of Driest Quarter	mm	9.0	76.0	37.6	14.4
BIO18	Precipitation of Warmest Quarter	mm	158.0	1012.0	417.5	124.5
BIO19	Precipitation of Coldest Quarter	mm	18.0	272.0	102.6	45.0

NOTE: Variables in bold were selected for the *P. durangensis* distribution model.

Supplementary Table S9. Descriptive statistics of the topography variables implemented in the *Pinus durangensis* distribution model; SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	Sd
ASP	Aspect	%	0.0	359.8	184.1	102.1
CU	Curvature	%	-1.4	1.9	0.0	0.2
PLC	Plan curvature	%	-0.7	0.9	0.0	0.1
PRC	Profile curvature	%	-0.9	0.8	0.0	0.1
SLP	Slope (degrees)	%	0.1	55.6	11.4	7.7
TSI	Terrain shape index	%	-0.9	1.0	0.0	0.1
WI	Wetness index	%	8.5	21.4	12.2	1.6

NOTE: Variables in bold were selected for the *P. durangensis* distribution model.

Supplementary Table S10a. Descriptive statistics of the soil variables implemented in the *Pinus durangensis* distribution model. SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
GEO	Geology_INEGI	-	2	27	26.0	3.4
LITHO	Lithostratigraphy_INEGI	-	1	32	9.6	2.2
BDRICM	Depth to bedrock (R horizon) up to 200 cm	cm	26	181	95.1	23.1
BDRLOG	Predicted probability of occurrence (0-100%) of R horizon	%	32	100	73.1	9.4
BDTICM	Absolute depth to bedrock	cm	0	2424	131.4	162.8
BLDFIE-sl1	Bulk density (fine earth)	kg/m3	1032	1517	1317.3	72.5
BLDFIE-sl2	Bulk density (fine earth)	kg/m3	994	1473	1268.6	74.1
BLDFIE-sl3	Bulk density (fine earth)	kg/m3	1121	1514	1320.0	60.0
BLDFIE-sl4	Bulk density (fine earth)	kg/m3	1199	1571	1369.5	61.5
BLDFIE-sl5	Bulk density (fine earth)	kg/m3	1254	1639	1432.5	65.6
BLDFIE-sl6	Bulk density (fine earth)	kg/m3	1248	1632	1453.1	61.7
BLDFIE-sl7	Bulk density (fine earth)	kg/m3	1249	1630	1450.3	59.7
CECSOL-sl1	Cation exchange capacity of soil	cmol/kg	14	42	24.0	4.2
CECSOL-sl2	Cation exchange capacity of soil	cmol/kg	14	37	22.5	4.0
CECSOL-sl3	Cation exchange capacity of soil	cmol/kg	12	37	22.2	3.9
CECSOL-sl4	Cation exchange capacity of soil	cmol/kg	12	37	22.3	3.8
CECSOL-sl5	Cation exchange capacity of soil	cmol/kg	12	37	22.6	3.7
CECSOL-sl6	Cation exchange capacity of soil	cmol/kg	13	37	22.8	3.6
CECSOL-sl7	Cation exchange capacity of soil	cmol/kg	13	39	23.0	3.8
CLYPPT-sl1	Clay content (0-2 micro meter) mass fraction	%	37	58	47.2	3.1
CLYPPT-sl2	Clay content (0-2 micro meter) mass fraction	%	36	60	47.3	3.3
CLYPPT-sl3	Clay content (0-2 micro meter) mass fraction	%	35	59	47.0	3.2
CLYPPT-sl4	Clay content (0-2 micro meter) mass fraction	%	34	60	46.1	3.1
CLYPPT-sl5	Clay content (0-2 micro meter) mass fraction	%	35	60	45.4	2.8
CLYPPT-sl6	Clay content (0-2 micro meter) mass fraction	%	36	59	45.1	2.7
CLYPPT-sl7	Clay content (0-2 micro meter) mass fraction	%	35	57	44.2	2.6
CRFVOL-sl1	Coarse fragments volumetric	%	12	37	22.9	3.1
CRFVOL-sl2	Coarse fragments volumetric	%	13	35	22.0	2.9
CRFVOL-sl3	Coarse fragments volumetric	%	14	36	23.2	3.0
CRFVOL-sl4	Coarse fragments volumetric	%	15	37	24.3	3.0
CRFVOL-sl5	Coarse fragments volumetric	%	16	39	25.6	3.0
CRFVOL-sl6	Coarse fragments volumetric	%	18	41	26.9	3.0
CRFVOL-sl7	Coarse fragments volumetric	%	18	41	28.0	2.9
OCSTHA-sd1	Soil organic carbon stock	t ha	0	60	13.7	11.2
OCSTHA-sd2	Soil organic carbon stock	t ha	0	94	14.0	11.6
OCSTHA-sd3	Soil organic carbon stock	t ha	0	133	12.9	11.2
OCSTHA-sd4	Soil organic carbon stock	t ha	0	273	15.5	15.5

NOTE: Variables in bold were selected for the *P. durangensis* distribution model.

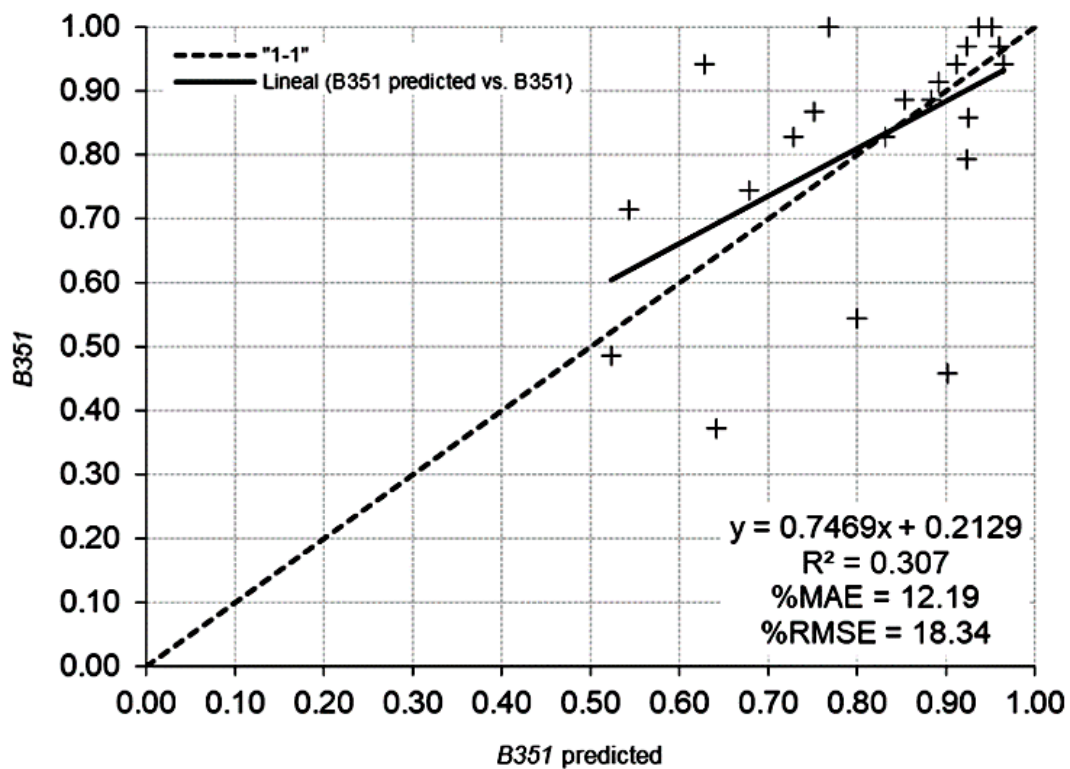
Supplementary Table S10b. Descriptive statistics of the soil variables implemented in the *Pinus durangensis* distribution model; SD= standard deviation.

Abbreviation	Variable	Unit	Min	Max	Mean	SD
OCSTHA-sd5	Soil organic carbon stock	t ha	0	366	5.4	8.9
OCSTHA-sd6	Soil organic carbon stock	t ha	0	160	0.3	3.5
ORCDRC-sl1	Soil organic carbon content (fine earth fraction)	g kg	17	152	58.0	18.0
ORCDRC-sl2	Soil organic carbon content (fine earth fraction)	g kg	10	113	27.1	8.0
ORCDRC-sl3	Soil organic carbon content (fine earth fraction)	g kg	9	94	17.8	4.4
ORCDRC-sl4	Soil organic carbon content (fine earth fraction)	g kg	4	92	10.2	3.4
ORCDRC-sl5	Soil organic carbon content (fine earth fraction)	g kg	2	88	7.4	2.9
ORCDRC-sl6	Soil organic carbon content (fine earth fraction)	g kg	1	89	6.7	2.8
ORCDRC-sl7	Soil organic carbon content (fine earth fraction)	g kg	1	89	6.7	2.8
PHIHOX-sl1	Soil pH x 10	H2O	51	72	60.5	3.0
PHIHOX-sl2	Soil pH x 10	H2O	51	72	60.1	3.1
PHIHOX-sl3	Soil pH x 10	H2O	51	73	60.1	3.1
PHIHOX-sl4	Soil pH x 10	H2O	52	74	60.5	3.1
PHIHOX-sl5	Soil pH x 10	H2O	53	76	61.2	3.4
PHIHOX-sl6	Soil pH x 10	H2O	53	77	62.7	3.6
PHIHOX-sl7	Soil pH x 10	H2O	53	78	63.2	3.5
PHIKCL-sl1	Soil pH x 10	KCl	41	67	53.7	5.0
PHIKCL-sl2	Soil pH x 10	KCl	41	67	53.7	4.9
PHIKCL-sl3	Soil pH x 10	KCl	42	67	53.5	4.7
PHIKCL-sl4	Soil pH x 10	KCl	44	67	53.6	4.6
PHIKCL-sl5	Soil pH x 10	KCl	44	68	54.1	4.5
PHIKCL-sl6	Soil pH x 10	KCl	45	68	54.4	4.4
PHIKCL-sl7	Soil pH x 10	KCl	45	69	54.8	4.5
SLTPPT-sl1	Silt content (2-50 micro meter)	%	18	36	26.1	2.8
SLTPPT-sl2	Silt content (2-50 micro meter)	%	18	37	26.3	2.8
SLTPPT-sl3	Silt content (2-50 micro meter)	%	18	36	26.0	2.8
SLTPPT-sl4	Silt content (2-50 micro meter)	%	17	35	25.3	2.8
SLTPPT-sl5	Silt content (2-50 micro meter)	%	17	32	24.6	2.5
SLTPPT-sl6	Silt content (2-50 micro meter)	%	16	31	24.0	2.4
SLTPPT-sl7	Silt content (2-50 micro meter)	%	17	30	23.9	2.2
SNDPPT-sl1	Sand content (50-2000 micro meter)	%	19	36	26.9	2.1
SNDPPT-sl2	Sand content (50-2000 micro meter)	%	20	37	26.5	2.3
SNDPPT-sl3	Sand content (50-2000 micro meter)	%	20	40	27.1	2.6
SNDPPT-sl4	Sand content (50-2000 micro meter)	%	20	42	28.8	2.8
SNDPPT-sl5	Sand content (50-2000 micro meter)	%	21	42	30.2	2.7
SNDPPT-sl6	Sand content (50-2000 micro meter)	%	21	42	31.1	2.7
SNDPPT-sl7	Sand content (50-2000 micro meter)	%	22	42	32.1	2.4

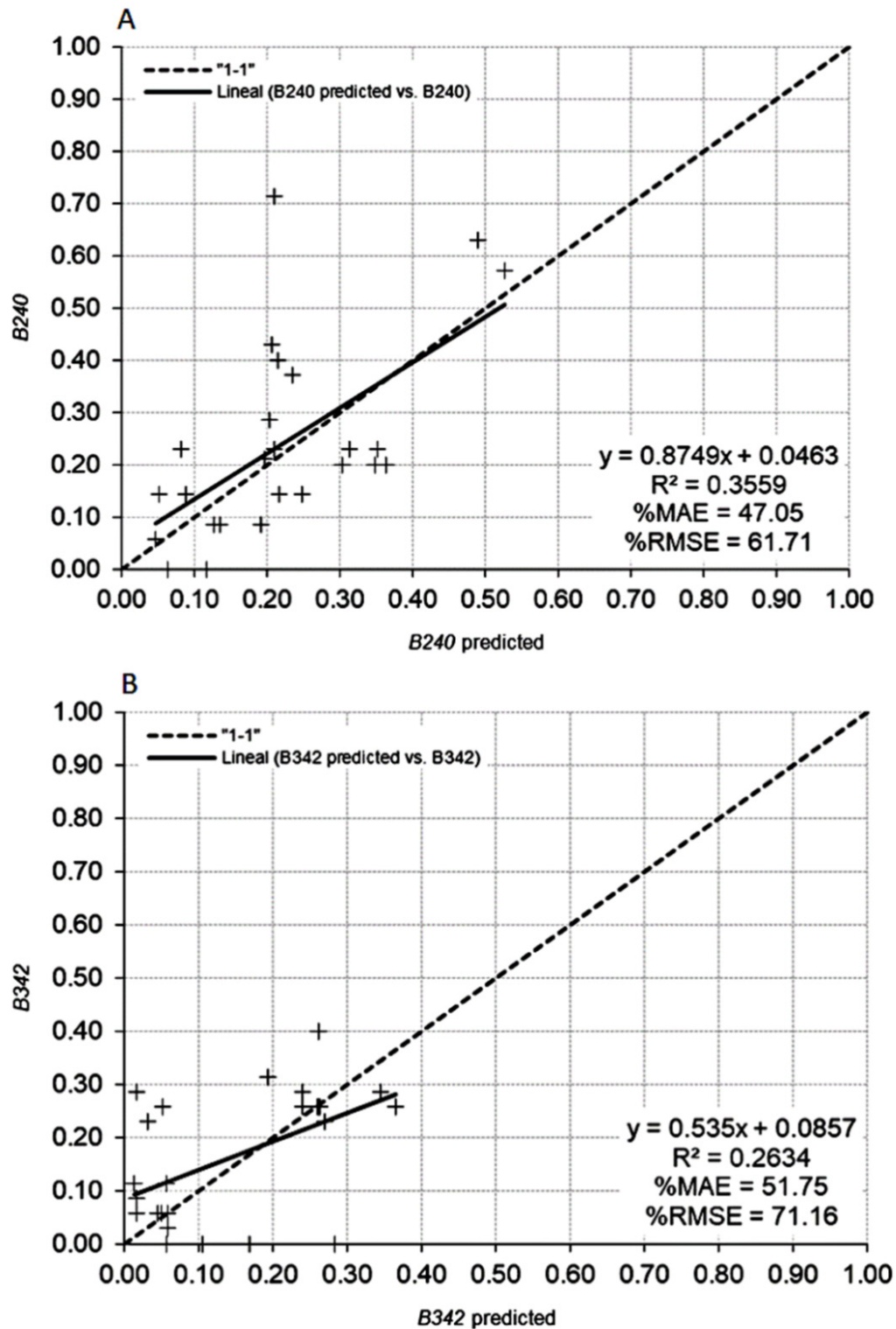
NOTE: Variables in bold were selected for the *P. durangensis* distribution model.

Supplementary Table S11. Statistical description of the relative frequency of the AFLP used in the models.

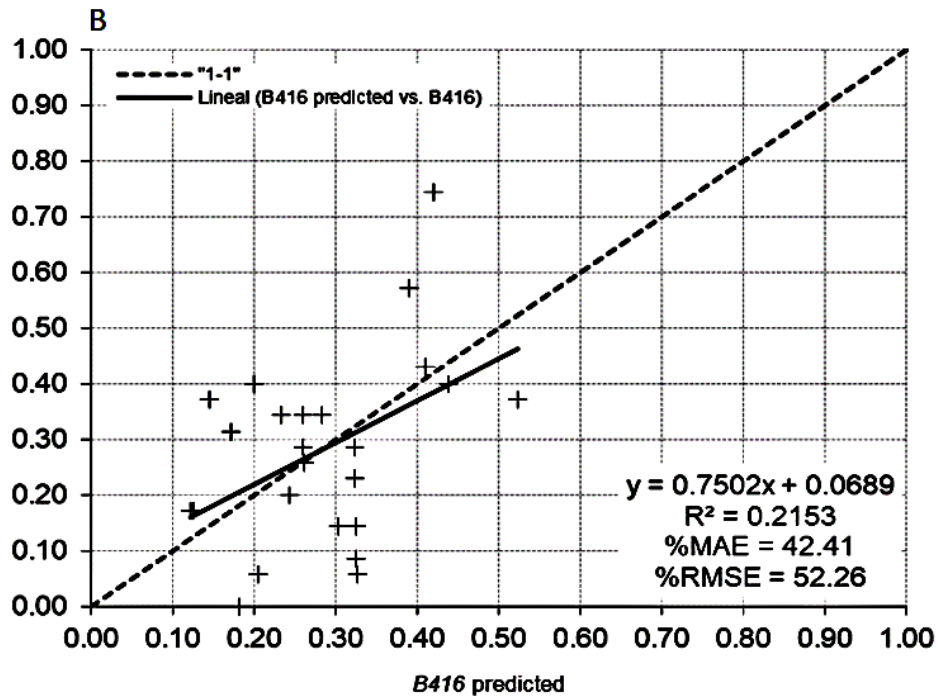
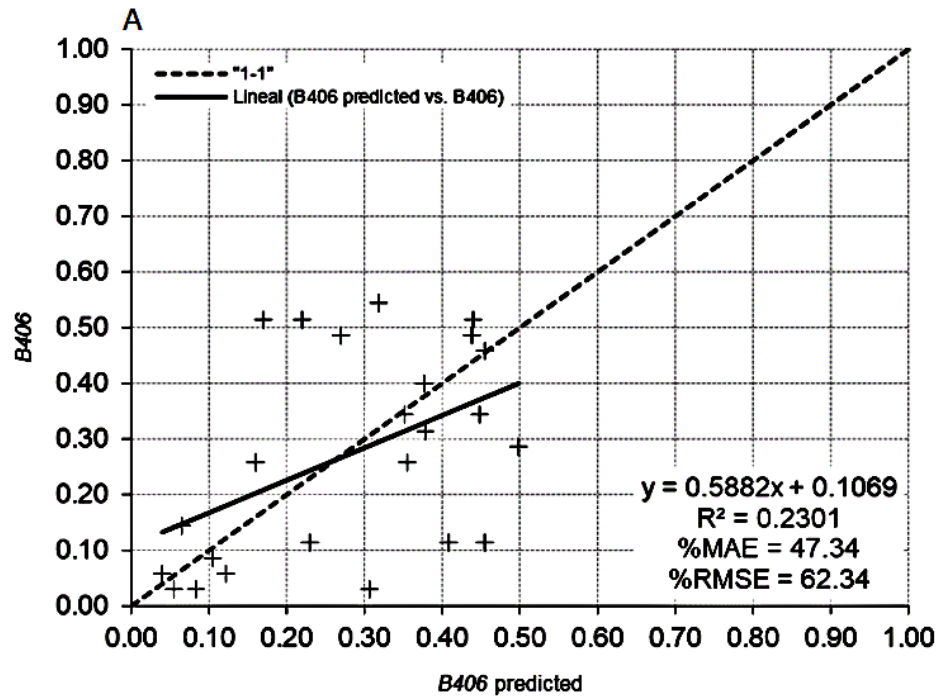
AFLP	Min	Max
351	0.37	1
240	0	0.71
416	0	0.74



Supplementary Figure S1. Graphical representation of predicted values vs observed values for the adaptive AFLP relative frequency distribution model 351, depending on Spring precipitation (mm), for *Pinus arizonica*.



Supplementary Figure S2. Graphic representation of predicted values vs observed values for the distribution model of *P. durangensis*, A: relative frequency of adaptive AFLP 240 depending on the winter precipitation and B: relative frequency of adaptive AFLP 342 depending on the maximum temperature in the warmest month.

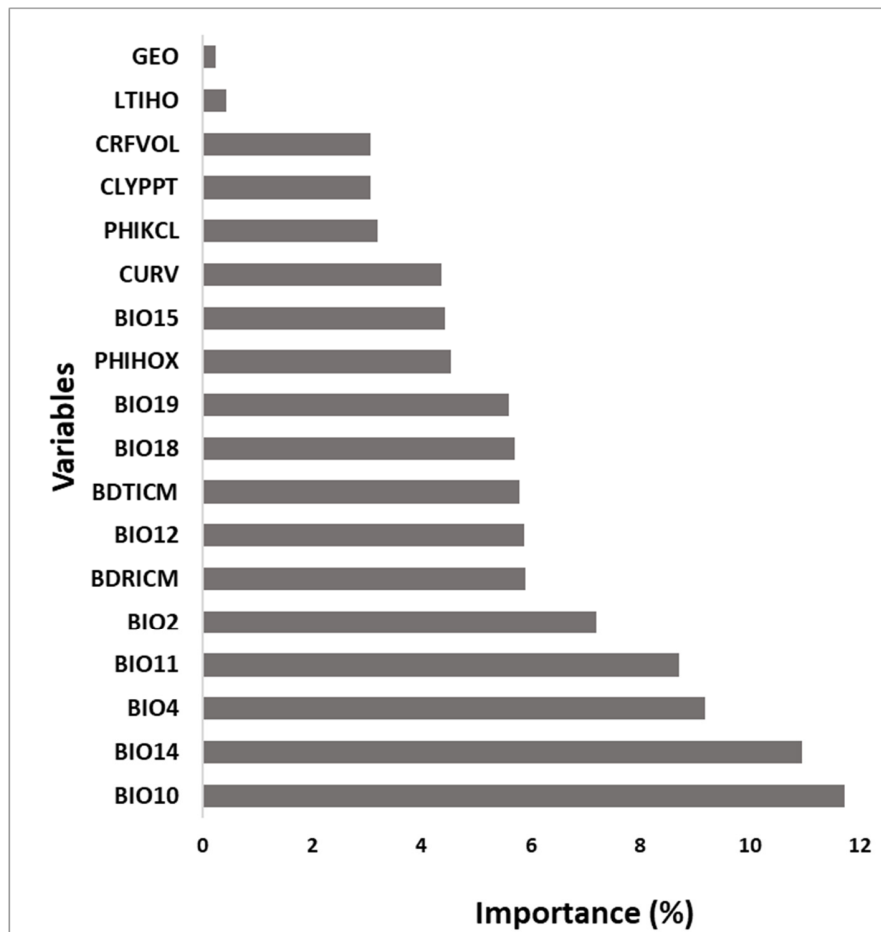


Supplementary Figure S3. Graphical representation of predicted values vs observed values for the distribution model of *P. durangensis*, A: relative frequency of adaptive AFLP 406 depending on the aridity index and B: relative frequency of adaptive AFLP 416 depending on Spring precipitation (mm).

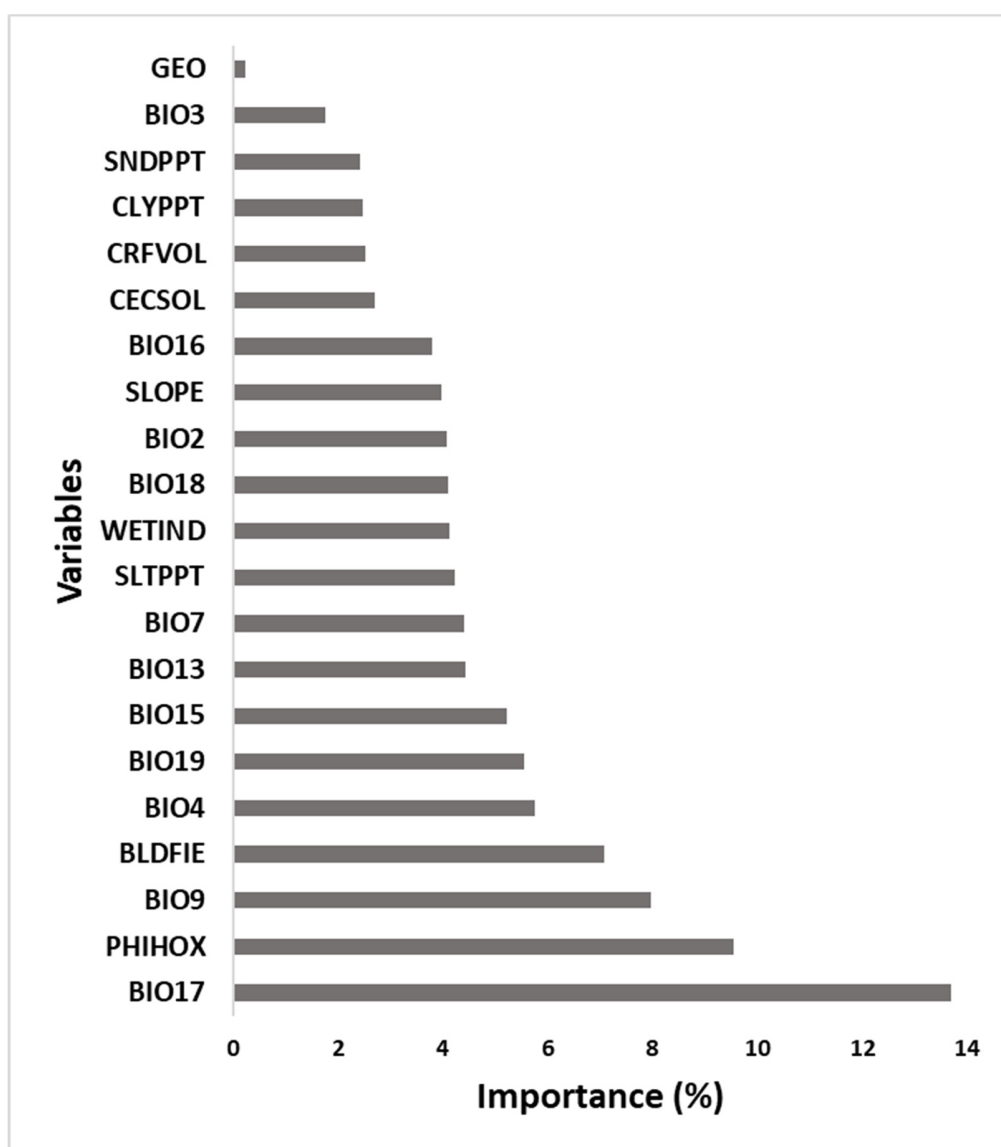
Supplementary Table S12. Results of RDA analysis and variance partitioning for *Pinus arizonica*.

Partition	R.squared	Adj.R.squared
[a+b] = X1	0.095	0.0552
[b+c] = X2	0.251	0.144
[a+b+c] = X1+X2	0.322	0.187
Individual fractions		
[a] = X1 X2		0.042
[b]		0.013
[c] = X2 X1		0.132
[d] = Residuals		0.813

NOTE: X1= soil variables and X2 = climatic variables.



Supplementary Figure S4. Important variables for the *Pinus arizonica* distribution model selected by partial least squares (PLS) and the random forest algorithm.

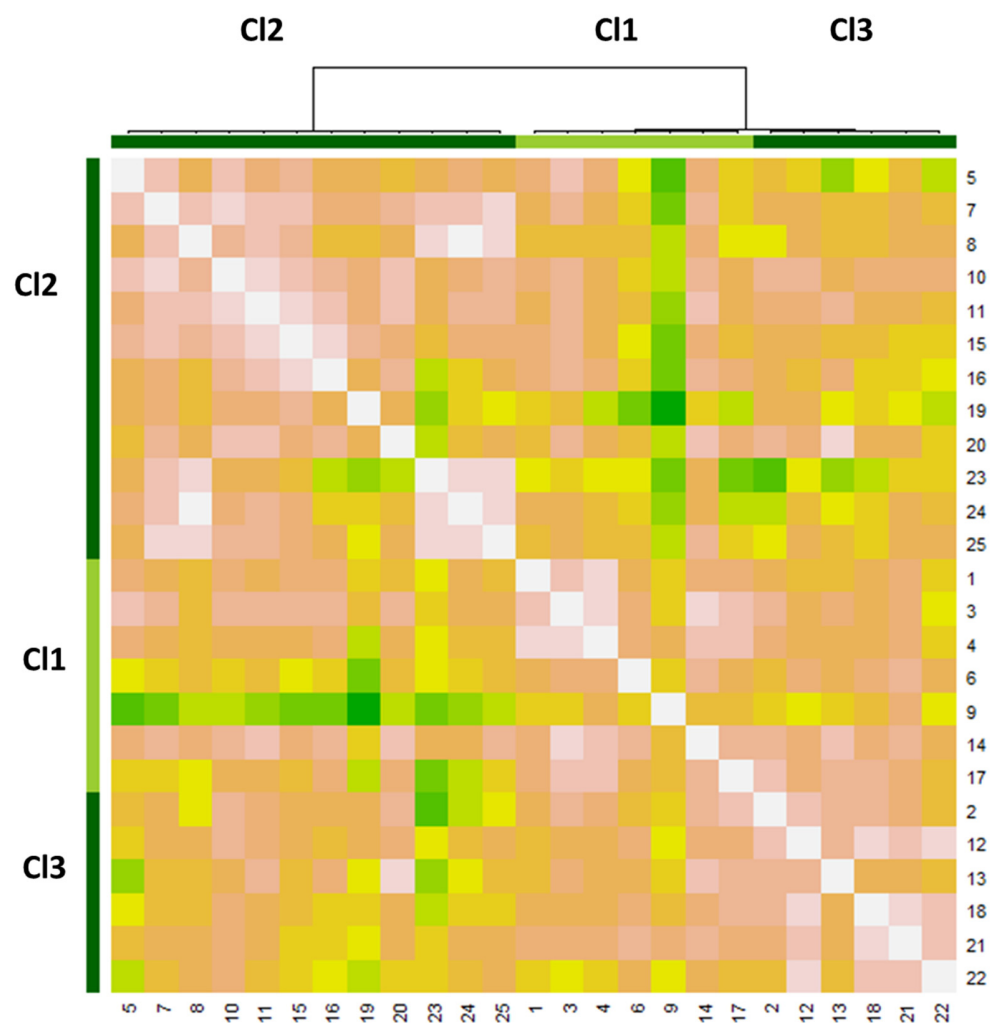


Supplementary Figure S5. Important variables for the *Pinus durangensis* distribution model selected by partial least squares (PLS) and the random forest algorithm.

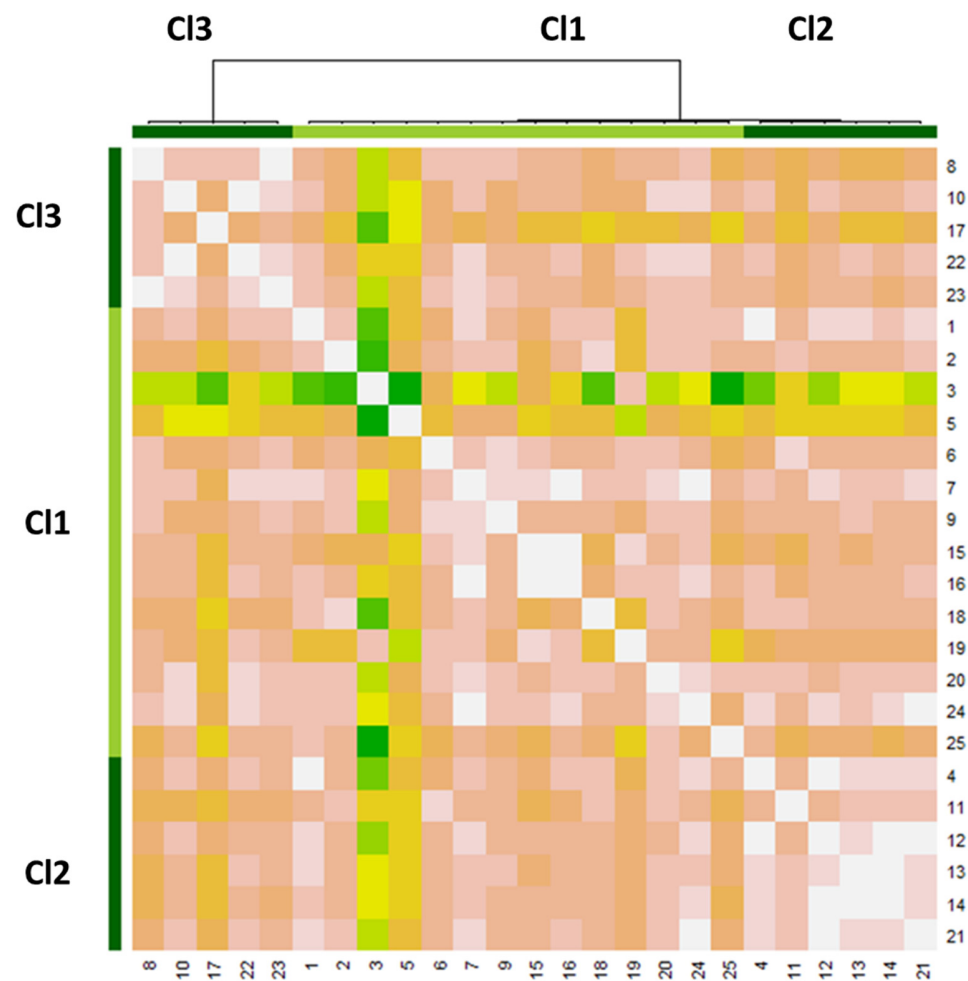
Supplementary Table S13. Comparison between seed zone sizes estimated with species distribution models (SDM) and areas reported in forest management programs (FMP) for *Pinus arizonica* and *P. durangensis*. Values only for a portion of their southern (S), central (C) and northern (N) distribution regions.

Cover area (ha) estimated by the species distribution model (SDM)					Data from the forest management programs (FMP)	Difference between SDM and FMP in 2019 (%)
<i>P. arizonica</i>	UMAFOR (U) and Ejidos (E)*	1990	2019	2030	2019	
	U 1005	95,202	50,238	28,588	54,000	-7.0
	E. Chiqueros	5,135	5,084	5,065	7,047	-27.9
	E. El Zorrillo	5,759	4,552	4,094	6,172	-26.2
	E. Ciénega Prieta	1,318	966.2	833	11	8603.6
	E. Cañada Verde	3,678	2,923	2,637	3,115	-6.2
	E. EL Largo	54,679	20,319	7,286	22,154	-8.3
	La Norteña	2,845	883	139	658	34.1
	E. El Oso	1,388	834	625	252	231.4
	E. Socorro	208	108	69	100	7.9
Sum		170,212	84,941	49,336	93,509	
Mean		18,912	10,618	5,482	10,390	2.2
<i>P. durangensis</i>	U 1005	218,228	191,671	178,885	226,000	-15.2
	U 1010	126,843	101,639	92,079	99,979	1.7
	E. El Largo	173,819	162,500	158,207	72,740	123.4
	E. La Norteña	6,037	5,886	5,829	2,889	103.7
	E. El Oso	5,204	4,500	4,233	1,760	155.7
Sum		530,131	466,196	439,233	403,368	
Mean		106,026	93,239	87,846	80,674	15.6

*Note: UMAFOR = Regional forest management unit; Ejidos = Mexican communal type of land property. (UMAFORES 0802, 1001, 1005 and 1010 data were obtained from the following sources: Ramos et al., 2015; Rodríguez, 2017; Rodríguez, 2019; Unión de Permisarios de la Unidad de Administración Forestal La Flor Durango A. C. 2019 and Unidad de Administración Forestal Santiago Papasquiaro A.C. 2019).



Supplementary Figure S6. Three clusters (CI) of *Pinus arizonica* seed stands. Heat map to visualize the data and to identify clusters of similar environmental conditions based on the Affinity Propagation (AP) clustering, with the quantile = 0.01. This analysis indicates that the 25 stands can be subdivided into three clusters displayed as bright orange squares across the diagonal. The stand's number is shown in Table S3a.



Supplementary Figure S7. Three clusters (CI) of *Pinus durangensis* stands. (A) Heat map to visualize the data and to identify clusters of similar environmental conditions based on the Affinity Propagation (AP) clustering, with the quantile = 0.2. This analysis indicates that the 25 stands can be subdivided into three clusters displayed as bright orange squares across the diagonal. The stand's number is shown in Table S3b.

Supplementary Table S14. Pair-wise *PhiPT* values of *Pinus arizonica* of three clusters of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		Cluster 1	Cluster 2	Cluster 3
all AFLP	Cluster 1	0.000	0.003	0.462
	Cluster 2	0.002	0.000	0.164
	Cluster 3	0.000	0.001	0.000
AFLP outlier	Cluster 1	0.000	0.011	0.010
	Cluster 2	0.004	0.000	0.457
	Cluster 3	0.004	0.000	0.000

PhiPT values above the diagonal. Probability, $P(\text{rand} \geq \text{data})$ based on 9999 permutations is shown below the diagonal.

Supplementary Table S15. Pair-wise *PhiPT* values of *Pinus arizonica* seed stands in Cluster 1 of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		AG	AIC	AM	BT	ET	PA	PA3
all AFLP	AG	0.000	0.425	0.382	0.381	0.427	0.230	0.040
	AIC	0.000	0.000	0.151	0.432	0.507	0.212	0.005
	AM	0.002	0.008	0.000	0.288	0.115	0.433	0.105
	BT	0.002	0.000	0.004	0.000	0.136	0.252	0.013
	ET	0.001	0.000	0.009	0.008	0.000	0.335	0.436
	PA	0.005	0.006	0.000	0.005	0.004	0.000	0.168
	PA3	0.011	0.019	0.010	0.018	0.000	0.008	0.000
AFLP outlier	AG	0.000	0.331	0.425	0.473	0.001	0.437	0.013
	AIC	0.004	0.000	0.459	0.462	0.037	0.439	0.060
	AM	0.000	0.000	0.000	0.444	0.005	0.440	0.010
	BT	0.000	0.000	0.000	0.000	0.011	0.453	0.020
	ET	0.041	0.024	0.039	0.030	0.000	0.034	0.451
	PA	0.000	0.000	0.001	0.000	0.025	0.000	0.072
	PA3	0.026	0.020	0.032	0.025	0.000	0.019	0.000

PhiPT values above the diagonal. Probability, $P(\text{rand} \geq \text{data})$ based on 9999 permutations is shown below the diagonal.

Supplementary Table S16. Pair-wise *PhiPT* values of *Pinus arizonica* seed stands in Cluster 2 of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		AO	CA	CA1	J1	J3	PA1	PA2	PB	PC1	TC	TG	XX
all AFLP	AO	0.000	0.282	0.457	0.475	0.208	0.467	0.089	0.259	0.000	0.451	0.401	0.460
	CA	0.004	0.000	0.491	0.114	0.437	0.452	0.355	0.440	0.000	0.206	0.397	0.431
	CA1	0.000	0.000	0.000	0.428	0.222	0.412	0.481	0.502	0.000	0.490	0.468	0.492
	J1	0.000	0.009	0.002	0.000	0.367	0.438	0.162	0.473	0.000	0.469	0.439	0.512
	J3	0.005	0.001	0.006	0.003	0.000	0.443	0.067	0.423	0.000	0.034	0.421	0.264
	PA1	0.000	0.000	0.000	0.001	0.001	0.000	0.480	0.461	0.000	0.339	0.486	0.331
	PA2	0.010	0.003	0.000	0.008	0.014	0.000	0.000	0.432	0.000	0.181	0.040	0.060
	PB	0.004	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.263	0.464	0.411
	PC1	0.035	0.041	0.026	0.032	0.042	0.033	0.045	0.037	0.000	0.000	0.000	0.000
	TC	0.000	0.007	0.000	0.001	0.016	0.003	0.008	0.005	0.042	0.000	0.146	0.283
	TG	0.001	0.002	0.000	0.001	0.001	0.000	0.018	0.000	0.048	0.010	0.000	0.459
	XX	0.000	0.000	0.000	0.000	0.005	0.003	0.014	0.002	0.041	0.005	0.001	0.000
AFLP outlier	AO	0.000	0.177	0.435	0.401	0.141	0.118	0.426	0.050	0.000	0.165	0.092	0.418
	CA	0.010	0.000	0.457	0.329	0.441	0.412	0.315	0.400	0.000	0.423	0.432	0.416
	CA1	0.000	0.000	0.000	0.193	0.211	0.268	0.280	0.173	0.000	0.455	0.410	0.428
	J1	0.001	0.005	0.010	0.000	0.439	0.445	0.263	0.448	0.000	0.064	0.018	0.441
	J3	0.013	0.000	0.010	0.000	0.000	0.424	0.398	0.467	0.000	0.155	0.065	0.433
	PA1	0.014	0.000	0.007	0.000	0.000	0.000	0.314	0.380	0.000	0.236	0.035	0.401
	PA2	0.000	0.005	0.007	0.007	0.003	0.005	0.000	0.110	0.000	0.256	0.353	0.395
	PB	0.020	0.002	0.011	0.000	0.000	0.003	0.016	0.000	0.000	0.143	0.019	0.473
	PC1	0.093	0.102	0.078	0.083	0.103	0.104	0.107	0.076	0.000	0.000	0.000	0.000
	TC	0.010	0.000	0.000	0.020	0.014	0.009	0.008	0.013	0.091	0.000	0.432	0.353
	TG	0.017	0.001	0.000	0.031	0.023	0.029	0.004	0.030	0.107	0.000	0.000	0.131
	XX	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.102	0.004	0.016	0.000

PhiPT values above the diagonal. Probability, $P(\text{rand} \geq \text{data})$ based on 9999 permutations is shown below the diagonal.

Supplementary Table S17. Pair-wise *PhiPT* values of *Pinus arizonica* seed stands in Cluster 3 of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		AGLL	MC	MJ	PACB	PCT	PS
all AFLP	AGLL	0.000	0.481	0.473	0.490	0.475	0.390
	MC	0.000	0.000	0.425	0.488	0.430	0.461
	MJ	0.000	0.000	0.000	0.452	0.432	0.491
	PACB	0.000	0.000	0.000	0.000	0.467	0.458
	PCT	0.000	0.000	0.000	0.000	0.000	0.274
	PS	0.001	0.001	0.000	0.000	0.005	0.000
AFLP outlier	AGLL	0.000	0.000	0.057	0.002	0.000	0.113
	MC	0.052	0.000	0.037	0.085	0.046	0.002
	MJ	0.019	0.021	0.000	0.064	0.049	0.190
	PACB	0.048	0.018	0.019	0.000	0.327	0.050
	PCT	0.072	0.023	0.022	0.004	0.000	0.007
	PS	0.017	0.045	0.011	0.025	0.042	0.000

PhiPT values above the diagonal. Probability, $P(\text{rand} \geq \text{data})$ based on 9999 permutations is shown below the diagonal.

Supplementary Table S18. Pair-wise *PhiPT* values of *Pinus durangensis* of three clusters of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		Cluster 1	Cluster 2	Cluster 3
all AFLP	Cluster 1	0.000	0.212	0.450
	Cluster 2	0.001	0.000	0.327
	Cluster 3	0.000	0.000	0.000
AFLP outlier	Cluster 1	0.000	0.448	0.012
	Cluster 2	0.000	0.000	0.445
	Cluster 3	0.004	0.000	0.000

PhiPT values above the diagonal. Probability, $P(\text{rand} \geq \text{data})$ based on 9999 permutations is shown below the diagonal.

Supplementary Table S19. Pair-wise *PhiPT* values of *Pinus durangensis* seed stands in Cluster 1 of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		CC	CD	CHD	DC	DP	EG	H2	MA	OC	PD1	PD2	PDC	PPD	SMD
all AFLP	CC	0.000	0.114	0.284	0.169	0.130	0.287	0.430	0.122	0.453	0.056	0.259	0.069	0.366	0.290
	CD	0.009	0.000	0.033	0.114	0.251	0.373	0.456	0.461	0.022	0.004	0.451	0.005	0.408	0.010
	CHD	0.004	0.015	0.000	0.253	0.422	0.430	0.330	0.212	0.435	0.014	0.441	0.030	0.230	0.469
	DC	0.006	0.010	0.005	0.000	0.461	0.114	0.463	0.451	0.166	0.148	0.406	0.288	0.475	0.466
	DP	0.007	0.005	0.002	0.000	0.000	0.428	0.484	0.331	0.468	0.241	0.416	0.477	0.134	0.143
	EG	0.004	0.003	0.000	0.010	0.002	0.000	0.493	0.456	0.444	0.001	0.495	0.027	0.474	0.120
	H2	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.484	0.466	0.495	0.337	0.481	0.496	0.402
	MA	0.007	0.000	0.006	0.000	0.003	0.000	0.000	0.000	0.070	0.003	0.468	0.065	0.213	0.115
	OC	0.000	0.016	0.000	0.007	0.000	0.000	0.000	0.010	0.000	0.012	0.458	0.018	0.143	0.370
	PD1	0.013	0.024	0.020	0.009	0.005	0.029	0.000	0.020	0.019	0.000	0.014	0.197	0.050	0.018
	PD2	0.005	0.001	0.000	0.001	0.000	0.000	0.003	0.000	0.000	0.019	0.000	0.132	0.491	0.249
	PDC	0.009	0.019	0.014	0.003	0.000	0.015	0.000	0.009	0.015	0.007	0.008	0.000	0.026	0.019
	PPD	0.003	0.002	0.006	0.000	0.008	0.000	0.000	0.006	0.009	0.015	0.000	0.015	0.000	0.419
	SMD	0.005	0.022	0.000	0.000	0.009	0.011	0.002	0.009	0.003	0.021	0.005	0.018	0.000	0.000
AFLP outlier	CC	0.000	0.001	0.000	0.423	0.001	0.000	0.015	0.431	0.012	0.002	0.406	0.000	0.173	0.015
	CD	0.057	0.000	0.356	0.001	0.002	0.127	0.175	0.001	0.422	0.167	0.439	0.000	0.053	0.437
	CHD	0.055	0.004	0.000	0.001	0.015	0.068	0.450	0.004	0.410	0.445	0.244	0.000	0.111	0.305
	DC	0.000	0.051	0.047	0.000	0.000	0.001	0.037	0.424	0.037	0.013	0.208	0.000	0.428	0.019
	DP	0.041	0.035	0.024	0.046	0.000	0.362	0.001	0.027	0.008	0.001	0.013	0.104	0.003	0.007
	EG	0.045	0.014	0.018	0.042	0.003	0.000	0.011	0.103	0.429	0.123	0.150	0.000	0.048	0.153
	H2	0.034	0.012	0.000	0.027	0.041	0.031	0.000	0.054	0.414	0.400	0.459	0.000	0.265	0.212
	MA	0.000	0.041	0.034	0.000	0.019	0.014	0.021	0.000	0.108	0.017	0.430	0.000	0.435	0.029
	OC	0.031	0.000	0.000	0.025	0.026	0.001	0.000	0.014	0.000	0.435	0.411	0.000	0.461	0.421
	PD1	0.045	0.012	0.000	0.034	0.034	0.014	0.002	0.027	0.000	0.000	0.336	0.000	0.194	0.428
	PD2	0.002	0.000	0.008	0.009	0.024	0.011	0.000	0.000	0.000	0.004	0.000	0.000	0.471	0.417
	PDC	0.098	0.095	0.086	0.105	0.014	0.064	0.102	0.072	0.083	0.092	0.082	0.000	0.000	0.000
	PPD	0.010	0.020	0.014	0.000	0.026	0.018	0.007	0.000	0.000	0.009	0.000	0.066	0.000	0.185
	SMD	0.031	0.000	0.005	0.029	0.028	0.012	0.009	0.024	0.002	0.000	0.000	0.084	0.010	0.000

PhiPT values above the diagonal. Probability, P(rand >= data) based on 9999 permutations is shown below the diagonal.

Supplementary Table S20. Pair-wise *PhiPT* values of *Pinus durangensis* seed stands in Cluster 2 of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

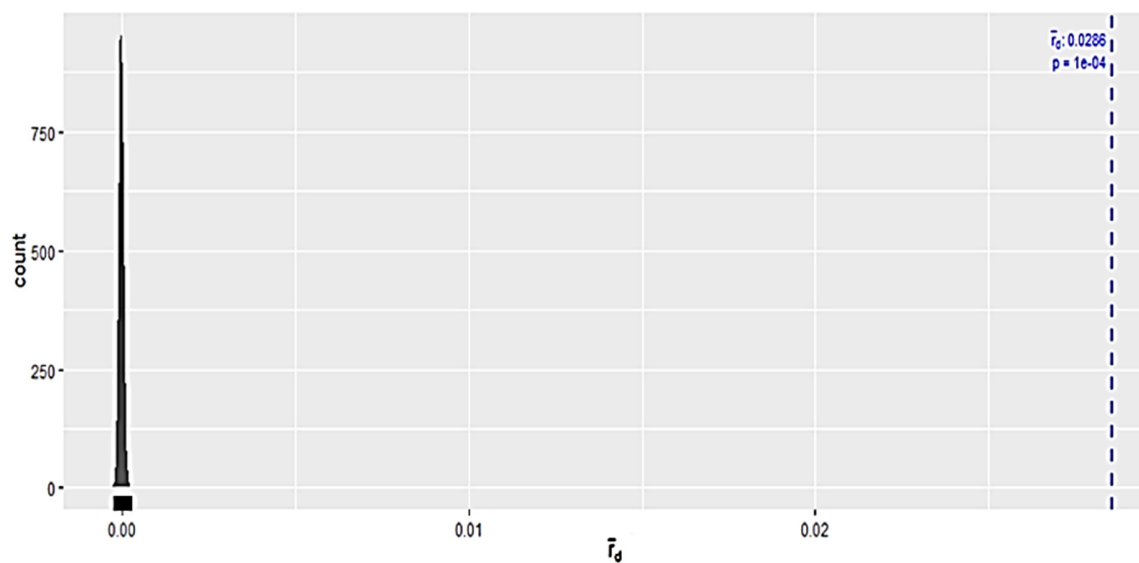
		CM	LCQ	LD	LND	LP	PDN
all AFLP	CM	0.000	0.000	0.003	0.002	0.011	0.454
	LCQ	0.022	0.000	0.463	0.414	0.270	0.000
	LD	0.019	0.000	0.000	0.486	0.034	0.018
	LND	0.020	0.002	0.000	0.000	0.149	0.007
	LP	0.017	0.004	0.014	0.009	0.000	0.011
	PDN	0.000	0.024	0.015	0.018	0.018	0.000
AFLP outlier	CM	0.000	0.000	0.000	0.004	0.000	0.428
	LCQ	0.057	0.000	0.451	0.459	0.282	0.000
	LD	0.048	0.000	0.000	0.448	0.330	0.000
	LND	0.029	0.000	0.000	0.000	0.066	0.004
	LP	0.045	0.006	0.004	0.017	0.000	0.001
	PDN	0.000	0.065	0.058	0.030	0.045	0.000

PhiPT values above the diagonal. Probability, P(rand >= data) based on 9999 permutations is shown below the diagonal.

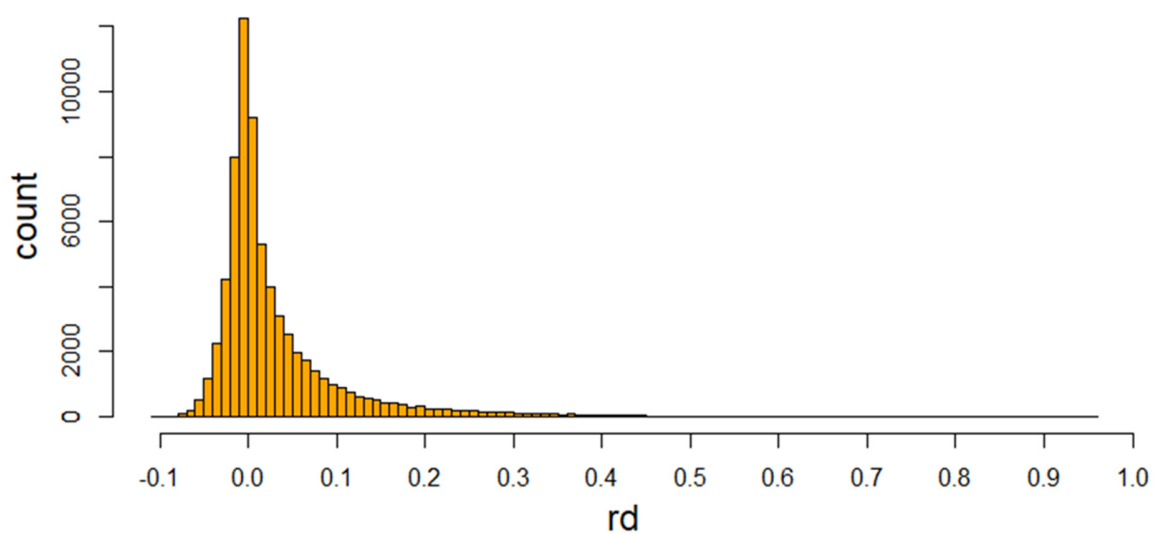
Supplementary Table S21. Pair-wise *PhiPT* values of *Pinus durangensis* seed stands in Cluster 3 of similar climate and soil conditions using the 376 AFLP and the outlier loci by AFLP.

		ESF	JP	PD	PDS	PL
all AFLP	ESF	0.000	0.267	0.468	0.383	0.178
	JP	0.005	0.000	0.221	0.049	0.498
	PD	0.000	0.006	0.000	0.422	0.448
	PDS	0.002	0.014	0.000	0.000	0.070
	PL	0.008	0.000	0.000	0.013	0.000
AFLP outlier	ESF	0.000	0.420	0.068	0.347	0.071
	JP	0.000	0.000	0.163	0.466	0.032
	PD	0.019	0.011	0.000	0.113	0.002
	PDS	0.004	0.000	0.014	0.000	0.101
	PL	0.020	0.025	0.052	0.016	0.000

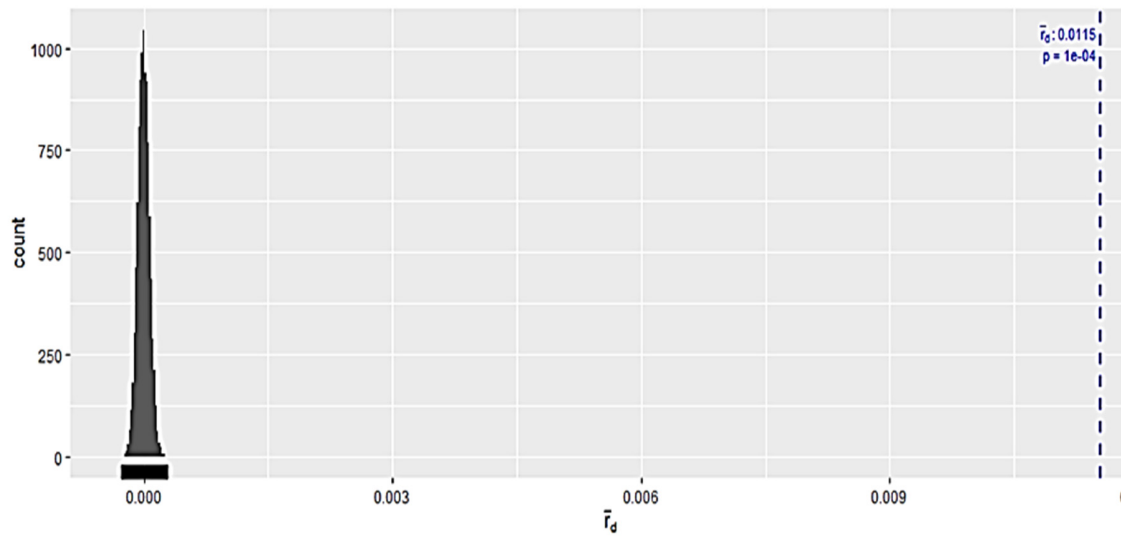
PhiPT values above the diagonal. Probability, P(rand >= data) based on 9999 permutations is shown below the diagonal.



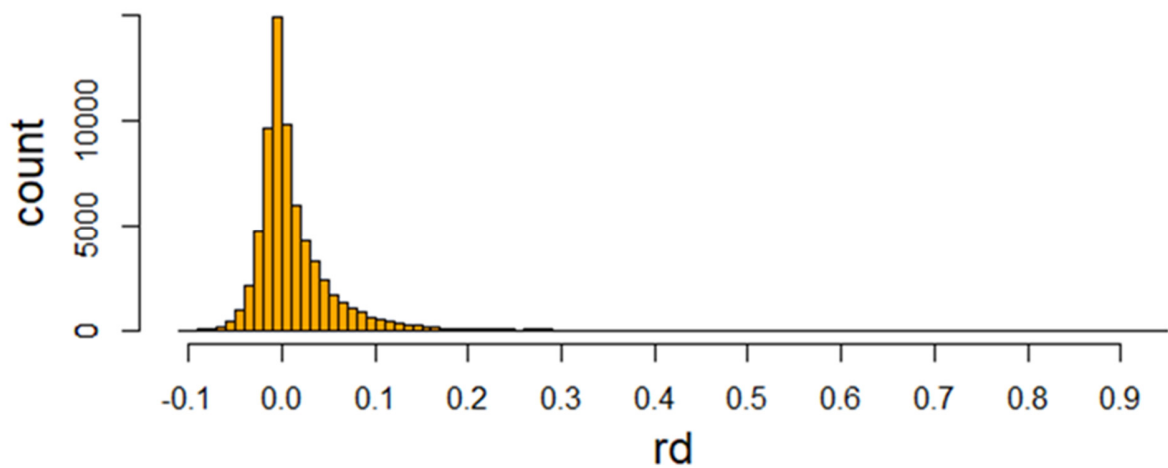
Supplementary Figure S8. Pattern of linkage disequilibrium for the 25 seed stands of *Pinus arizonica*; \bar{r}_d = value of the Standardized Index of Association that accounts for the number of AFLP loci sampled and p = p-value for value of the Standardized Index of Association.



Supplementary Figure S9. Histogram of pairwise values of the Standardized Index of Association (r_d) overall loci of *Pinus arizonica*.



Supplementary Figure S10. Pattern of linkage disequilibrium for the 25 seed stands of *Pinus durangensis*; \bar{r}_d = value of the Standardized Index of Association that accounts for the number of AFLP loci sampled and p = p-value for value of the Standardized Index of Association.



Supplementary Figure S11. Histogram of pairwise values of the Standardized Index of Association (r_d) overall loci of *Pinus durangensis*.

Supplementary Table S22. Linkage disequilibrium pattern for the 25 seed stands of *Pinus arizonica* and *Pinus durangensis*, using the 376 AFLP and the outlier loci detected.

Species	AFLP	Cluster	\bar{r}_d	p
<i>Pinus arizonica</i>	all AFLP	Cluster 1	0.019	0.001
		Cluster 2	0.039	0.001
		Cluster 3	0.008	0.001
		Mean	0.022	0.001
		Overall	0.029	0.001
	AFLP outlier	Cluster 1	0.044	0.001
		Cluster 2	0.073	0.001
		Cluster 3	0.042	0.001
		Mean	0.053	0.001
		Overall	0.055	0.001
<i>Pinus durangensis</i>	all AFLP	Cluster 1	0.014	0.001
		Cluster 2	0.01	0.001
		Cluster 3	0.008	0.001
		Mean	0.011	0.001
		Overall	0.012	0.001
	AFLP outlier	Cluster 1	0.050	0.001
		Cluster 2	0.040	0.001
		Cluster 3	0.035	0.001
		Mean	0.042	0.001
		Overall	0.044	0.001

\bar{r}_d = value of the Standardized Index of Association that accounts for the number of AFLP loci sampled and p = p-value for value of the Standardized Index of Association.

Supplementary Table S23. Three indices of genetic diversity of the 25 seed stands of *Pinus arizonica* calculated for each cluster of seed stands defined by similar climate and soil conditions (Figure 6) and overall.

Stands	DW	dg	% Poly	Cluster
AG	0.097	1.411	0.799	1
AIC	0.074	1.3	0.693	1
AM	0.097	1.363	0.791	1
BT	0.071	1.306	0.641	1
ET	0.079	1.291	0.671	1
PA	0.081	1.314	0.682	1
PA3	0.109	1.33	0.728	1
Mean	0.087	1.331	0.715	
AO	0.08	1.327	0.716	2
CA	0.069	1.305	0.663	2
CA1	0.124	1.387	0.813	2
J1	0.086	1.329	0.704	2
J3	0.116	1.332	0.772	2
PA1	0.116	1.336	0.778	2
PA2	0.113	1.352	0.78	2
PB	0.104	1.363	0.734	2
PC1	0.247	1.339	0.799	2
TC	0.057	1.25	0.578	2
TG	0.082	1.314	0.682	2
XX	0.067	1.267	0.627	2
Mean	0.105	1.325	0.721	
MC	0.058	1.286	0.6	3
AGLL	0.104	1.338	0.726	3
MJ	0.076	1.31	0.695	3
PACB	0.082	1.303	0.698	3
PCT	0.071	1.278	0.627	3
PS	0.09	1.328	0.726	3
Mean	0.080	1.307	0.679	
Overall	0.094	1.322	0.709	

NOTE: DW, low weighted frequency marker value; dg, mean genetic diversity; %Poly, percent polymorphism; no statistically significant difference.

Supplementary Table S24. Three indices of genetic diversity of the 25 seed stands of *Pinus durangensis* calculated for each cluster of seed stands defined by similar climate and soil conditions (Figure 7) and overall.

Stands	DW	dg	% Poly	Cluster
CC	0.097	1.325	0.756	1
CD	0.095	1.310	0.720	1
CHD	0.093	1.334	0.761	1
DC	0.128	1.350	0.810	1
DP	0.073	1.339	0.726	1
EG	0.075	1.303	0.687	1
H2	0.108	1.342	0.761	1
MA	0.124	1.414	0.873	1
OC	0.088	1.320	0.701	1
PD1	0.121	1.334	0.778	1
PD2	0.107	1.362	0.778	1
PDC	0.043	1.257	0.570	1
PPD	0.096	1.367	0.797	1
SMD	0.092	1.317	0.717	1
Mean	0.096	1.334	0.745	
CM	0.077	1.314	0.654	2
LCQ	0.132	1.367	0.816	2
LD	0.102	1.328	0.731	2
LND	0.097	1.343	0.723	2
LP	0.077	1.310	0.704	2
PDN	0.065	1.289	0.679	2
Mean	0.092	1.325	0.718	
ESF	0.080	1.279	0.679	3
JP	0.085	1.320	0.723	3
PD	0.107	1.307	0.701	3
PDS	0.090	1.328	0.712	3
PL	0.105	1.320	0.753	3
Mean	0.093	1.311	0.714	
Overall	0.094	1.327	0.732	

NOTE: DW, low weighted frequency marker value; dg, mean genetic diversity; %Poly, percent polymorphism; no statistically significant difference.