Supporting information

Table S1 Summary of 268 candidate gene SNPs used for genetic analysis in hindex, including species-specific alleles and their frequency within reference Sitka spruce (QCI) and white spruce (ENA) populations, respectively and the allele frequency differentials (δ) between the two species.

Table S2 Summary of multiple stepwise regressions performed in *R* of distance (drainage distance), and climate variables (mean annual temperature, mean annual precipitation, and continentality) with dependent variables; hybrid index, cold injury, and height.

Fig. S1 Population clustering analyses based on ten replicate *Structure* runs for Sitka spruce, white spruce, and hybrid populations.

Fig. S2 Genetic relationship amongst 31 populations estimated using *Structure* and genotypic data based on 268 SNP loci for $K = 2$ for Sitka spruce (red) and white spruce (green) individuals and their hybrids.

Fig. S3 Genetic relationship between three 'reference' populations (Haida Gwaii, eastern North America and Fort Nelson) estimated using *Structure* and genotypic data based on 120 SNP loci for $K = 2$ and 3 for Sitka spruce (green) and white spruce (red).

Table S1 Summary of 268 candidate gene SNPs used for genetic analysis in *hindex* , including species-specific alleles and their frequency within reference Sitka spruce (QCI) and white spruce (ENA) populations, respectively and the allele frequency differentials (δ) between the two species.

Locus	Sitka spruce allele*	Sitka spruce allele frequency	White spruce allele*	White spruce allele frequency	Allele frequency differential
0_10112.contig2.C2.352	G	0.938	T	0.095	0.842
0_10754.contig2.C1.179	T	1.000	-	1.000	0.000
0_12681.contig2.C2.315	C	1.000	T	0.976	0.024
0_13680.contig2.C1.149	G	1.000	A	0.036	0.964
0_13680.contig2.NC1.68	A	0.979	T	0.012	0.967
0_14976.contig2.NC1.354	A	1.000	G	0.881	0.119
0_15075.contig2.C2.341	G	0.104	A	0.060	0.045
0_16142.contig2.C1.266	G	1.000	A	0.036	0.964
0_17017.contig2.C1.225	G	1.000	A	0.048	0.952
0_17017.contig2.NC1.250	G	1.000	A	0.048	0.952
0_17238.contig2.NC1.122	T	0.979	G	0.286	0.693
100_316_NS	G	0.667	A	0.000	0.667
103_455_NS	A	0.542	T	0.000	0.542
114_248_S	C	0.833	G	0.274	0.560
124_495_S	T	0.750	C	0.190	0.560
125_312_S	T	0.979	C	0.000	0.979
127_273_S	T	0.875	C	0.286	0.589
13_496_NS	C	0.771	T	0.298	0.473
13_632_S	G	0.708	A	0.000	0.708
132_78_S	A	0.979	G	0.262	0.717
133_39_S	G	1.000	A	0.464	0.536
133_418_S	C	0.750	T	0.000	0.750
133_553_NS	T	0.917	C	0.310	0.607
135_122_NS	G	0.438	A	0.167	0.271
14_248_NS	G	0.458	C	0.000	0.458
14_301_NS	T	0.438	G	0.000	0.438
141_349_S	G	1.000	A	0.476	0.524
144_441_S	A	0.854	G	0.012	0.842
162_199_S	T	0.542	A	0.238	0.304
164_465_S	C	0.417	T	0.012	0.405
169_375_NS	C	0.979	A	0.524	0.455
179_114_S	T	0.417	C	0.024	0.393
179_319_NS	T	0.333	C	0.012	0.321
179_699_S	A	0.688	G	0.012	0.676
19_567_S	G	0.438	A	0.012	0.426
191_162_S	C	0.854	T	0.690	0.164
194_470_S	T	0.688	A	0.000	0.688
195_356_NS	G	1.000	C	0.024	0.976
198_447_S	C	1.000	-	1.000	0.000
20_374_NS	C	0.979	G	0.000	0.979
206_435_NS	T	0.875	A	0.369	0.506
208PG02825j	C	0.854	T	0.655	0.199
208PG04280j	A	0.896	G	0.440	0.455
208PG08590a	G	0.771	A	0.262	0.509
208pg10495g	A	1.000	G	0.167	0.833
208pg10524e	G	1.000	C	0.238	0.762
208pg10802g.1	T	0.958	C	0.155	0.804
208pg12875c	C	1.000	T	0.595	0.405
208pg13043k	G	0.979	C	0.310	0.670
208PG13612a	G	0.875	A	0.845	0.030
209_523_S	C	0.854	G	0.238	0.616

213_153_S	C	1.000	T	0.274	0.726
213_330_S	C	1.000	T	0.000	1.000
213_468_NS	G	1.000	C	0.262	0.738
213_72_S	T	1.000	G	0.000	1.000
214_180_S	C	0.938	T	0.095	0.842
214_558_S	G	0.938	A	0.095	0.842
215_132_S	A	0.917	G	0.214	0.702
222_305_S	G	0.458	A	0.060	0.399
222_370_S	G	0.042	A	0.036	0.006
242_241_S	C	0.938	T	0.262	0.676
244_118_NS	A	1.000	G	1.000	0.000
245_170_NS	C	0.729	G	0.107	0.622
245_281_S	T	0.750	G	0.060	0.690
245_98_NS	C	0.833	T	0.429	0.405
249_648_S	C	0.563	T	0.012	0.551
252_200_NS	C	0.896	G	0.583	0.313
259_736_NS	A	1.000	G	0.012	0.988
260_264_S	T	1.000	C	0.012	0.988
260_84_S	T	1.000	C	0.012	0.988
27_420_S	A	0.792	T	0.000	0.792
27_711_S	T	0.896	C	0.512	0.384
27_99_S	T	0.042	C	0.024	0.018
273507_S	T	0.667	C	0.381	0.286
288_302_NS	G	0.688	T	0.036	0.652
29_177_S	C	0.479	T	0.000	0.479
29_592_S	G	0.896	T	0.048	0.848
295_78_S	G	0.938	A	0.060	0.878
2iTC2438a	G	0.854	A	0.298	0.557
2pa08pg12519k	A	0.979	G	0.381	0.598
2TC7674e	C	1.000	A	0.667	0.333
30_423_S	G	0.708	A	0.667	0.042
41_150_NS	G	0.792	C	0.107	0.685
45_1067_NS	A	0.979	G	0.976	0.003
46_575_NS	G	0.604	T	0.000	0.604
46_623_NS	T	0.604	G	0.000	0.604
50_135_S	T	1.000	C	0.667	0.333
51_36_S	G	0.938	T	0.012	0.926
68_286_S	T	1.000	C	0.060	0.940
69_753_S	A	0.229	G	0.048	0.182
71_365_NS	A	0.604	T	0.083	0.521
84_261_S	G	0.333	T	0.000	0.333
84_370_NS	T	0.917	G	0.000	0.917
85_279_S	A	1.000	G	0.071	0.929
86_438_S	G	1.000	C	0.071	0.929
89_300_NS	C	0.917	A	0.000	0.917
89_37_NS	G	0.917	A	0.000	0.917
97_489_S	C	0.438	T	0.000	0.438
BB.PF00643.12e	A	0.979	C	0.833	0.146
BB.PF0139.20e	C	0.688	G	0.107	0.580
C13628.contig2.C4.584	G	0.958	C	0.048	0.911
C14881.contig5.C1.273	T	1.000	C	0.214	0.786
C1498.contig1.NC1.839	T	1.000	C	0.167	0.833
C1498.contig1.NC2.1166	G	0.313	A	0.071	0.241
C16679.contig1.C1.315	A	0.771	T	0.452	0.318
C18467.contig1.NC2.168	G	1.000	A	0.000	1.000
C20322.contig1.NC3.296	T	1.000	A	0.179	0.821
C20925.contig1.NC3.450	C	1.000	T	0.702	0.298
C2211.contig1.C5.1435	T	1.000	C	0.679	0.321
C2270.contig1.NC1.384	G	1.000	T	0.048	0.952
C2285.contig1.C2.449	T	1.000	C	0.607	0.393
C2319.contig2.NC1.360	C	1.000	G	0.405	0.595

C24607.contig1.NC4.1208	T	1.000	C	0.190	0.810
C3300.contig1.NC4.640	G	0.479	C	0.440	0.039
C4447.contig1.C2.631	T	1.000	C	0.083	0.917
C4545.contig1.C1.200	A	0.729	C	0.655	0.074
C4575.contig1.C2.853	A	0.313	C	0.012	0.301
C4773.contig1.NC1.338	C	1.000	T	0.298	0.702
C4944.contig2.C2.472	A	1.000	C	0.583	0.417
C4944.contig2.C4.573	A	0.979	G	0.357	0.622
C4944.contig2.C5.740	A	0.896	T	0.762	0.134
C5104.contig1.C1.624	G	0.833	A	0.405	0.429
C6522.contig1.NC1.269	T	0.563	A	0.167	0.396
C6814.contig1.NC8.578	C	0.396	A	0.298	0.098
C6847.contig1.C2.1238	T	0.938	C	0.655	0.283
C717.contig2.NC2.162	A	0.083	G	0.000	0.083
C7807.contig1.C1.230	A	1.000	G	0.643	0.357
C8159.contig1.NC7.1499	G	0.438	A	0.262	0.176
C9634.contig2.NC2.1086	G	1.000	C	0.774	0.226
C996.contig1.NC1.663	C	0.750	T	0.238	0.512
C996.contig1.NC4.945	A	0.833	G	0.238	0.595
CL1458Contig1.contig2.C2.311	A	0.958	G	0.012	0.946
CL1458Contig1.contig2.C3.377	T	1.000	-	1.000	0.000
CO481261.contig1.NC7.671	G	0.083	A	0.048	0.036
CO484662.contig1.C1.269	C	0.104	T	0.095	0.009
P03539.4	T	0.958	C	0.798	0.161
p09832.2	A	0.979	G	0.702	0.277
P15825.2	T	0.979	C	0.405	0.574
P4800.3	C	1.000	T	0.357	0.643
P6937.1	C	0.688	T	0.357	0.330
P7108.2	G	0.917	A	0.238	0.679
P9580.1	G	1.000	A	0.417	0.583
PTC9341	C	0.979	T	0.476	0.503
SNP_GQ0013.BR.1_E01.Contig1.114	G	0.979	A	0.036	0.943
SNP_GQ0014.BR_A18.Contig1.666	T	1.000	G	0.048	0.952
SNP_GQ0021.B3.r_E11.Contig1.558	T	0.979	G	0.548	0.432
SNP_GQ0021.BR.1_O06.Contig1.333	A	1.000	C	0.452	0.548
SNP_GQ0031.TB_K19.Contig2.238	C	1.000	G	0.655	0.345
SNP_GQ0043.TB_G16.Contig2.1226	A	1.000	T	0.429	0.571
SNP_GQ0044.B3.r_K18.Contig1.396	T	1.000	C	0.214	0.786
SNP_GQ0044.B3.r_N02.Contig1.846	T	0.875	G	0.786	0.089
SNP_GQ0046.B3_H01.Contig1.506	T	0.958	G	0.333	0.625
SNP_GQ0048.B3.r_I01.Contig1.195	T	1.000	C	0.607	0.393
SNP_GQ00612.B3_G14.Contig1.819	C	1.000	A	0.476	0.524
SNP_GQ00612.B3_J14.Contig1.472	G	1.000	A	0.369	0.631
SNP_GQ0072.B3.r_I18.Contig1.409	T	0.979	C	0.750	0.229
SNP_GQ0074.B3.r_L04.Contig1.773	C	0.958	T	0.095	0.863
SNP_GQ0178.B7_E07.Contig1.180	C	1.000	G	0.262	0.738
SNP_GQ02010.B3.r_E06.Contig1.52(	C	1.000	T	0.381	0.619
SS_CO483349.contig3.496	G	0.688	A	0.131	0.557
WS.2.0.GQ0011.B3.r.O22.2.439	C	0.958	T	0.060	0.899
WS.2.0.GQ0013.BR.1.F05.1.445	G	0.979	A	0.619	0.360
WS.2.0.GQ0013.BR.1.F24.1.457	A	0.979	C	0.107	0.872
WS.2.0.GQ0013.BR.1.H07.1.1246	C	0.979	T	0.274	0.705
WS.2.0.GQ0014.B3.r.K03.1.350	G	0.979	T	0.429	0.551
WS.2.0.GQ0015.BR.F19.1.1238	G	0.958	A	0.548	0.411
WS.2.0.GQ0021.BR.1.G04.1.641	C	1.000	T	0.238	0.762
WS.2.0.GQ0021.BR.1.I14.1.917	T	1.000	C	0.726	0.274
WS.2.0.GQ0023.B3.r.A10.1.304	A	0.688	G	0.369	0.318
WS.2.0.GQ0024.B3.r.O14.1.374	C	0.979	A	0.202	0.777
WS.2.0.GQ0024.BR.K09.4.220	G	1.000	A	0.500	0.500
WS.2.0.GQ0025.BR.I12.1.575	T	0.896	C	0.726	0.170
WS.2.0.GQ0025.BR.J23.1.1534	G	0.938	A	0.583	0.354

WS.2.0.GQ0031.B3.r.N13.1.1210	C	0.979	G	0.071	0.908
WS.2.0.GQ0031.TB.F08.2.1213	C	1.000	T	0.310	0.690
WS.2.0.GQ0032.TB.K21.1.136	T	0.875	C	0.524	0.351
WS.2.0.GQ0033.TB.D14.1.699	C	0.979	G	0.143	0.836
WS.2.0.GQ0034.B3.r.M12.1.702	T	0.979	A	0.440	0.539
WS.2.0.GQ0041.BR.J16.4.199	C	1.000	A	0.369	0.631
WS.2.0.GQ00410.B3.P11.1.1618	T	0.875	C	0.060	0.815
WS.2.0.GQ00411.B3.J14.1.1171	A	1.000	G	0.429	0.571
WS.2.0.GQ00412.B3.E01.1.1202	C	0.979	G	0.357	0.622
WS.2.0.GQ00412.B3.K07.1.1479	G	1.000	A	0.619	0.381
WS.2.0.GQ00412.B3.M21.1.371	G	0.708	A	0.369	0.339
WS.2.0.GQ00412.B3.P24.3.109	A	0.917	G	0.452	0.464
WS.2.0.GQ0043.BR.J01.2.228	C	0.938	T	0.774	0.164
WS.2.0.GQ0044.B3.r.L23.1.678	G	0.875	A	0.155	0.720
WS.2.0.GQ0045.B3.G10.1.344	T	0.813	C	0.107	0.705
WS.2.0.GQ0045.B3.I14.1.573	T	1.000	C	0.214	0.786
WS.2.0.GQ0045.B3.N03.1.416	C	0.979	T	0.619	0.360
WS.2.0.GQ0045.B3.N10.1.1522	G	1.000	A	0.357	0.643
WS.2.0.GQ0045.B3.P14.1.834	T	0.979	G	0.024	0.955
WS.2.0.GQ0046.B3.C03.1.551	A	0.750	T	0.476	0.274
WS.2.0.GQ0047.B3.F06.1.894	C	0.833	A	0.202	0.631
WS.2.0.GQ0049.B3.A02.1.657	G	0.958	A	0.369	0.589
WS.2.0.GQ0061.B3.r.G16.3.334	A	1.000	G	0.286	0.714
WS.2.0.GQ00611.B3.H11.1.1029	A	1.000	G	0.429	0.571
WS.2.0.GQ00611.B3.J20.1.130	G	1.000	A	0.571	0.429
WS.2.0.GQ00611.B3.L10.2.622	A	1.000	G	0.179	0.821
WS.2.0.GQ00612.B3.L21.1.172	G	1.000	A	0.321	0.679
WS.2.0.GQ0064.B3.r.I13.1.1236	A	0.875	G	0.036	0.839
WS.2.0.GQ0064.TB.H03.2.370	C	1.000	T	0.012	0.988
WS.2.0.GQ0072.B3.r.P11.1.1000	T	0.604	C	0.095	0.509
WS.2.0.GQ0073.TB.L02.2.233	T	1.000	G	0.369	0.631
WS.2.0.GQ0073.TB.M05.1.1123	A	0.979	C	0.548	0.432
WS.2.0.GQ0085.B3.r.O08.1.222	T	1.000	C	0.381	0.619
WS.2.0.GQ0131.B3.E24.1.1764	G	1.000	A	0.524	0.476
WS.2.0.GQ0133.B7.1.D11.1.1584	T	1.000	C	0.500	0.500
WS.2.0.GQ0134.B7.1.L07.1.1358	A	0.979	G	0.048	0.932
WS.2.0.GQ0161.TB.B13.1.1161	G	1.000	T	0.702	0.298
WS.2.0.GQ0163.TB.B18.1.1080	A	0.958	C	0.131	0.827
WS.2.0.GQ0165.B3.F11.2.34	T	0.750	C	0.381	0.369
WS.2.0.GQ0168.B3.J12.1.1192	C	1.000	T	0.405	0.595
WS.2.0.GQ0168.B3.N16.1.556	A	1.000	G	0.393	0.607
WS.2.0.GQ0173.TB.A04.4.594	T	0.917	C	0.631	0.286
WS.2.0.GQ0175.B7.K18.1.223	C	1.000	A	0.690	0.310
WS.2.0.GQ0177.B7.K12.1.501	G	1.000	A	0.214	0.786
WS.2.0.GQ0178.B7.A11.1.460	G	1.000	A	0.143	0.857
WS.2.0.GQ0187.T24.A06.1.1353	A	1.000	G	0.357	0.643
WS.2.0.GQ0193.B3.r.A11.3.420	A	0.979	G	0.619	0.360
WS.2.0.GQ0195.B3.D14.1.174	C	0.896	T	0.250	0.646
WS.2.0.GQ0197.B3.G24.1.764	A	1.000	T	0.369	0.631
WS.2.0.GQ0198.B3.P03.1.170	C	0.854	T	0.500	0.354
WS.2.0.GQ02010.B3.r.N03.1.1528	A	1.000	G	0.619	0.381
WS.2.0.GQ02010.B7.H23.1.251	C	0.646	T	0.167	0.479
WS.2.0.GQ02011.B3.r.B09.2.447	T	1.000	C	0.679	0.321
WS.2.0.GQ02013.TB.O16.1.231	G	1.000	A	0.619	0.381
WS.2.0.GQ02014.B3.r.H08.1.644	A	1.000	T	0.440	0.560
WS.2.0.GQ02015.TB.B10.1.1440	C	0.875	T	0.571	0.304
WS.2.0.GQ02016.B3.r.F09.1.1121	G	0.396	A	0.262	0.134
WS.2.0.GQ0202.B3.O09.3.261	A	1.000	G	0.452	0.548
WS.2.0.GQ0204.B3.H10.1.662	G	0.958	A	0.095	0.863
WS.2.0.GQ0204.B3.P14.2.925	G	0.438	A	0.190	0.247
WS.2.0.GQ0206.B3.P13.1.173	C	1.000	A	0.274	0.726

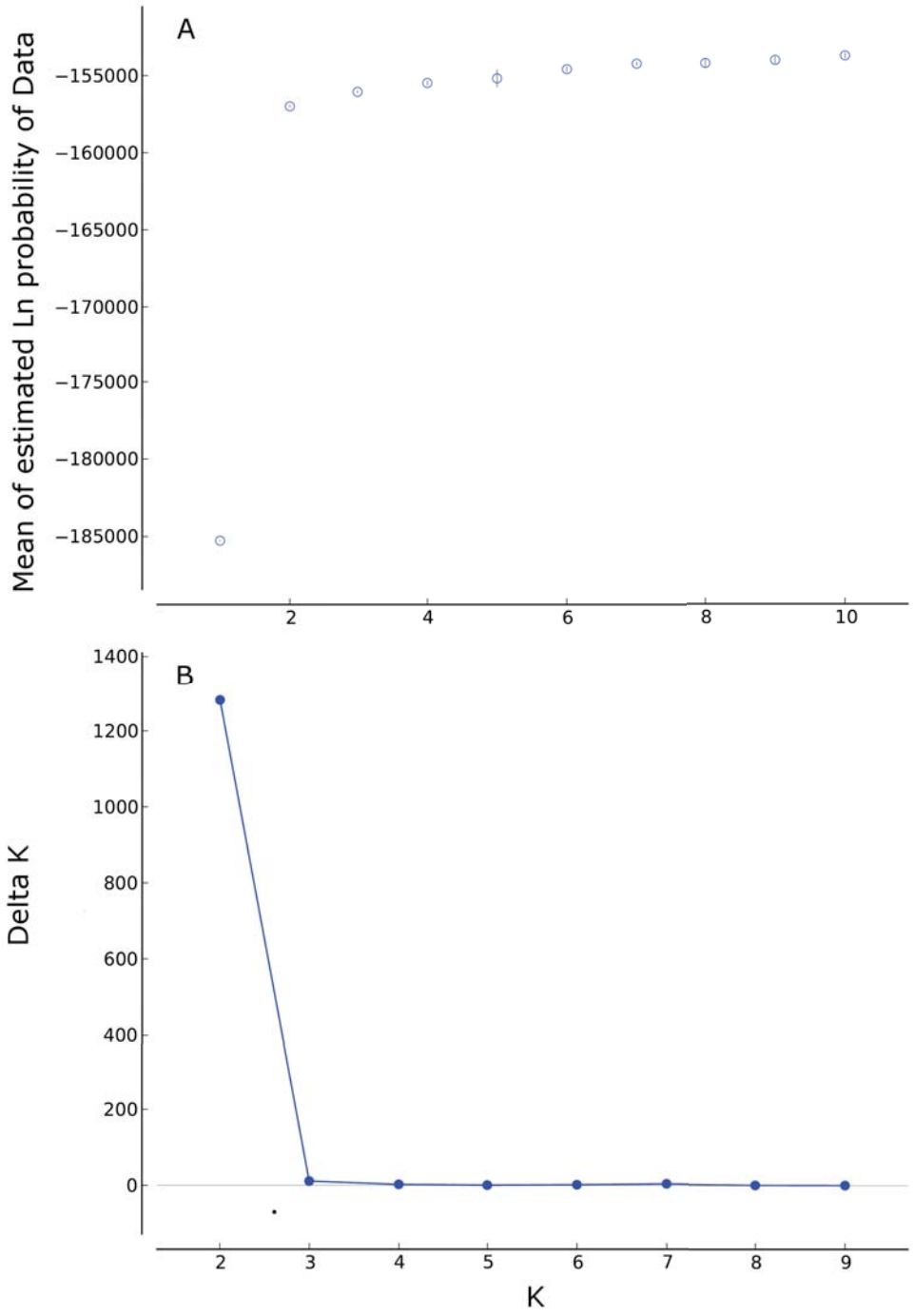
WS.2.0.GQ0208.B3.P21.1.535	A	1.000	G	0.155	0.845
WS.2.0.GQ0222.B7.B17.1.379	T	0.708	G	0.286	0.423
WS.2.0.GQ0222.B7.P03.4.50	A	0.979	G	0.393	0.586
WS.2.0.GQ0226.B7.D08.1.418	G	0.896	A	0.452	0.443
WS.2.0.GQ0226.B7.D16.1.397	A	1.000	T	0.357	0.643
WS.2.0.GQ02511.B3.A11.2.431	A	0.979	T	0.464	0.515
WS.2.0.GQ0253.B7.G03.1.1020	G	0.375	A	0.298	0.077
WS.2.0.GQ0255.B3.P02.1.233	C	0.917	T	0.369	0.548
WS.2.0.GQ0258.B3.B12.1.786	A	1.000	G	0.262	0.738
WS.2.0.GQ02801.B7.O14.1.512	G	0.896	T	0.226	0.670
WS.2.0.GQ02805.B7.J24.2.535	A	0.792	G	0.429	0.363
WS.2.0.GQ02807.B7.A19.1.869	G	1.000	A	1.000	0.000
WS.2.0.GQ02808.B7.O03.2.818	A	0.542	G	0.500	0.042
WS.2.0.GQ02815.B7.M19.1.534	A	1.000	G	0.417	0.583
WS.2.0.GQ02819.B7.K02.2.592	G	1.000	A	0.548	0.452
WS.2.0.GQ02823.SP6.H05.1.827	T	0.979	C	0.262	0.717
WS.2.0.GQ02827.B7.B09.1.298	C	1.000	T	0.321	0.679
WS.2.0.GQ02830.B7.N19.1.816	T	1.000	C	0.345	0.655
WS.2.0.GQ02903.B7.B21.1.1399	G	0.979	A	0.155	0.824
WS.2.0.GQ02905.B7.P10.1.849	T	0.625	C	0.226	0.399
WS.2.0.GQ03101.B7.A12.1.268	G	1.000	A	0.345	0.655
WS.2.0.GQ03101.B7.M09.1.229	A	0.979	G	0.571	0.408
WS.2.0.GQ03105.B7.N08.1.636	C	1.000	T	0.202	0.798
WS.2.0.GQ03108.B7.H08.1.831	G	0.958	A	0.405	0.554
WS.2.0.GQ03115.B7.P17.1.1218	G	0.896	A	0.405	0.491
WS.2.0.GQ03118.B7.C03.1.798	G	1.000	A	0.250	0.750
WS.2.0.GQ03125.B7.D11.2.871	A	0.896	G	0.179	0.717
WS.2.0.GQ03126.B7.M13.1.633	A	1.000	G	0.488	0.512
WS.2.0.GQ03226.B7.M05.1.485	G	0.917	T	0.083	0.833
WS.2.0.GQ03409.B7.H11.1.187	G	0.917	A	0.321	0.595
WS.2.0.GQ03516.B7.I16.1.170	G	0.813	T	0.440	0.372
WS.2.0.GQ03614.B7.C22.1.141	A	0.875	G	0.619	0.256
WS00841.B21_O11.contig1.NC1.149	A	0.333	G	0.131	0.202
WS01026.B21_I20.contig1.C1.288	T	1.000	C	0.607	0.393

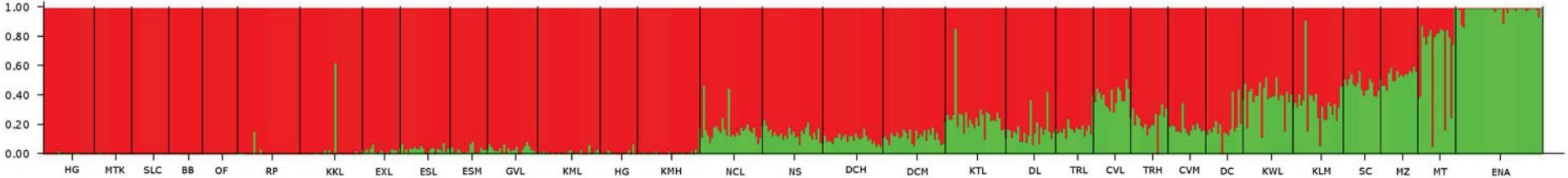
*Species-specific alleles for candidate gene SNPs: A, adenine; C, cytosine; G, guanine; T, thymine

Table S2 - Summary of multiple stepwise regressions performed in *R* of distance (drainage distance), and climate variables (mean annual temperature, mean annual precipitation, and continentality) with dependent variables; hybrid index, cold injury, and height. Summary of predictor variables used within the best fit model is provided, along with Akaike's Information Criterion (AIC), R^2, F-value, and p-value.

Dependent variable	Predictor variable(s)	AIC	R^2	F-value	p-value
Hybrid Index	DD + TD + MAT + MA	#####	0.68	365.90	<0.0001
Cold Injury -8 (ºC)	DD	4118.80	0.07	52.57	<0.0001
Cold Injury -18 (ºC)	DD + TD	3543.14	0.08	30.64	<0.0001
Ten Year Height (mn	DD + TD	5916.63	0.00	2.52	0.08

DD, drainage distance; MAT, mean annual temperature; MAP, mean annual precipitation; TD, continentality


A
Mean of estimated Ln probability of Data
−155000
−160000
−165000
−170000
−175000
−180000
−185000
2
4
6
8
10
B
Delta K
1400
1200
1000
800
600
400
200
0
2
3
4
5
6
7
8
9
K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0.80
0.60
0.40
0.20
0.00
HG
MTK
SLC
BB
OF
RP
KKL
EXL
ESL
ESM
GVL
KML
HG
KMH
NCL
NS
DCH
DCM
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DL
TRL
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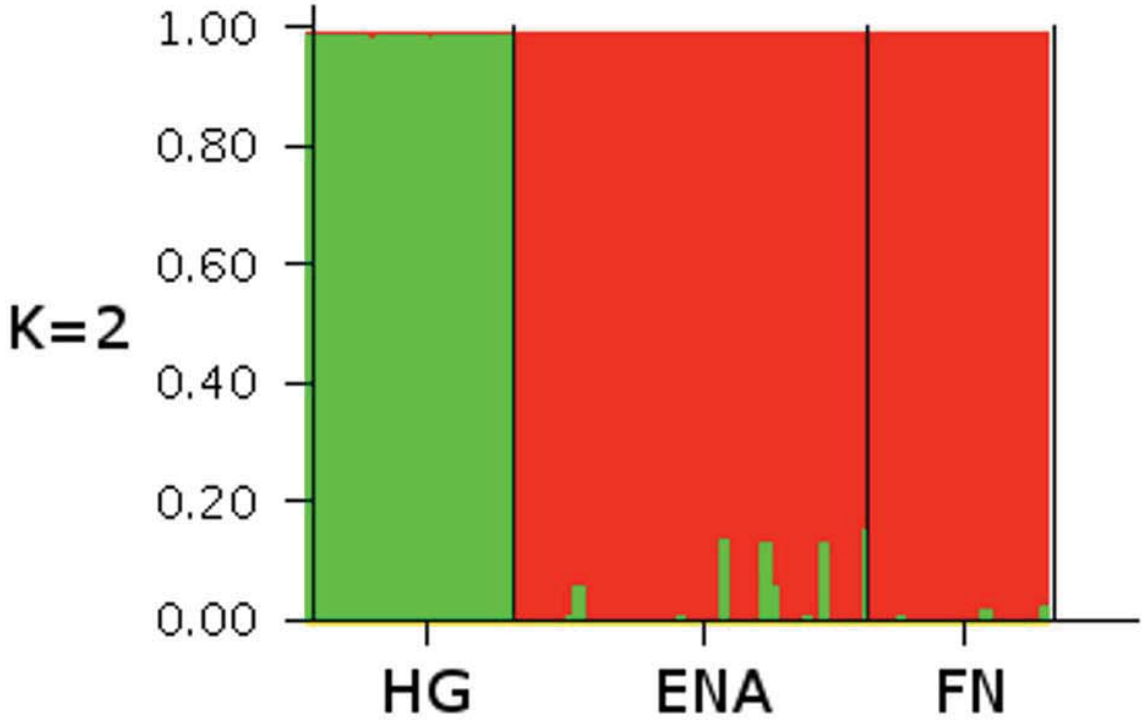
TRH
CVM
DC
KWL
KLM
SC
MZ
MT
ENA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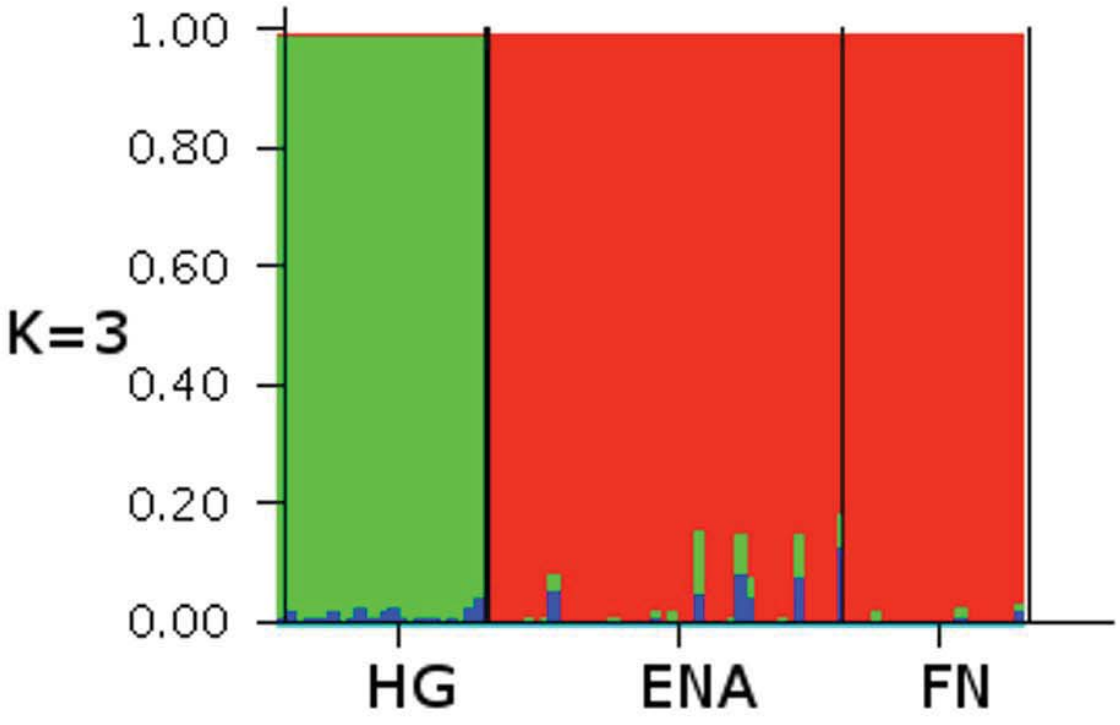
0.20
0.00
HG
ENA
FN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0.40
0.20
0.00
HG
ENA
FN