**Supplementary material**

# Detecting climatically driven phylogenetic and morphological divergence among global spruces (*Picea*)

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**Supplement S1** Index of divergence (D) from the phylogeny-based and morphology-based SEEVA evaluation of spruce species.

**Table S1** Index of divergence (*D*) from the phylogeny-based SEEVA evaluation of spruce species worldwide.

**Table S2** Index of divergence (*D*) from the morphology-based SEEVA evaluation of spruce species worldwide.

**Table S1** Index of divergence (*D*) from the phylogeny-based SEEVA evaluation of spruce species worldwide using elevation, four temperature variables (AMT: annual mean temperature; MTWM: max temperature of warmest month; MTCM: min temperature of coldest month; and TAR: temperature annual range) and four precipitation variables (AP: annual precipitation; PWM: precipitation of wettest month; PDM: precipitation of driest month; and PCQ: precipitation of coldest quarter).

| Phylogeny Node | Number of Samples | | Index of Divergence (*D*) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Temperature Variables | | | | Precipitation Variables | | | |
| | $N_a$ | $N_b$ | Elevation | AMT | MTWM | MTCM | TAR | AP | PWM | PDM | PCQ |
| **1** | 1568 | 1820 | 0.25* | 0.02* | 0.15* | 0.08* | 0.26* | 0.09* | 0.16* | 0.20* | 0.05* |
| **2** | 1502 | 66 | 0.30* | 0.38* | 0.33* | 0.17* | 0.38* | 0.20* | 0.03 | 0.13* | 0.23* |
| **3** | 1497 | 5 | 0.69* | 0.45 | 0.49 | 0.35 | 0.55 | 0.67* | 0.72* | 0.19 | 0.29 |
| **4** | 1438 | 59 | 0.64* | 0.12* | 0.32* | 0.27* | 0.68* | 0.31* | 0.77* | 0.26* | 0.06 |
| **5** | 1435 | 3 | 0.74 | 0.66 | 0.47 | 0.44 | 0.89* | 0.69 | 0.78 | 0.24 | 0.51 |
| **6** | 1293 | 142 | 0.32* | 0.56* | 0.11* | 0.79* | 0.83* | 0.76* | 0.75* | 0.62* | 0.46* |
| **7** | 256 | 1037 | 0.56* | 0.12* | 0.45* | 0.77* | 0.87* | 0.45* | 0.34* | 0.99* | 1.00* |
| **8** | 200 | 56 | 0.68* | 0.12* | 0.04 | 0.03 | 0.07 | 0.24* | 0.41* | 0.01 | 0.00 |
| **9** | 49 | 62 | 0.58* | 0.47* | 0.52* | 0.56* | 0.74* | 0.72* | 0.57* | 0.02* | 0.00 |
| **10** | 51 | 8 | 0.86* | 0.41 | 0.20 | 0.33 | 0.31 | 0.02 | 0.02 | 0.30 | 0.32 |
| **11** | 35 | 31 | 0.14 | 0.02 | 0.27 | 0.17 | 0.04 | 0.22 | 0.15 | 0.59* | 0.26* |
| **12** | 29 | 6 | 0.18 | 0.48 | 0.07 | 0.66* | 0.56 | 0.55 | 0.71* | 0.00 | 0.05 |
| **13** | 6 | 23 | 0.52 | 0.34 | 0.08 | 0.80* | 1.00* | 0.80* | 1.00* | 0.81* | 0.08 |
| **14** | 1100 | 720 | 0.46* | 0.19* | 0.13* | 0.30* | 0.31* | 0.05* | 0.42* | 0.54* | 0.66* |
| **15** | 1089 | 11 | 0.33 | 0.75* | 0.37* | 0.88* | 0.93* | 0.47* | 0.60* | 0.34 | 0.39* |
| **16** | 700 | 389 | 0.22* | 0.08* | 0.07* | 0.03* | 0.02* | 0.27* | 0.27* | 0.44* | 0.05* |
| **17** | 628 | 72 | 0.63* | 0.24* | 0.13* | 0.33* | 0.22* | 0.12* | 0.07* | 0.04* | 0.13* |
| **18** | 590 | 38 | 0.38* | 0.51* | 0.08* | 0.70* | 0.88* | 0.76* | 0.79* | 0.35* | 0.64* |
| **19** | 335 | 255 | 0.65* | 0.22* | 0.04 | 0.57* | 0.47* | 0.24* | 0.09* | 0.13* | 0.30* |
| **20** | 373 | 16 | 0.97* | 0.72* | 0.10 | 0.99* | 0.70* | 0.42* | 0.86* | 0.58* | 0.25 |
| **21** | 174 | 199 | 0.08* | 0.65* | 0.30* | 0.56* | 0.35* | 0.62* | 0.52* | 0.62* | 0.58* |
| **22** | 582 | 138 | 0.82* | 0.41* | 0.26* | 0.40* | 0.33* | 0.54* | 0.24* | 0.81* | 0.82* |
| **23** | 489 | 93 | 0.02 | 0.42* | 0.37* | 0.66* | 0.73* | 0.87* | 0.38* | 1.00* | 0.99* |
| **24** | 285 | 204 | 0.01 | 0.52* | 0.06* | 0.67* | 0.73* | 0.56* | 0.64* | 0.01 | 0.01 |
| **25** | 260 | 25 | 0.02 | 0.04 | 0.53* | 0.03 | 0.26* | 0.42* | 0.42* | 0.14* | 0.63* |
| **26** | 248 | 12 | 0.45* | 0.16 | 0.82* | 0.20 | 0.17 | 0.03 | 0.00 | 0.25* | 0.28* |
| **27** | 165 | 83 | 0.05* | 0.15* | 0.18* | 0.17* | 0.06 | 0.16* | 0.00 | 0.03* | 0.01 |
| **28** | 161 | 4 | 0.00 | 0.34 | 0.53 | 0.65 | 0.67 | 0.95* | 0.17 | 0.99* | 0.99* |
| **29** | 11 | 72 | 0.07 | 0.00 | 0.13 | 0.14 | 0.12 | 0.10 | 0.09 | 0.06 | 0.01 |
| **30** | 78 | 126 | 0.01 | 0.26* | 0.17* | 0.46* | 0.81* | 0.50* | 0.99* | 0.01 | 0.00 |
| **31** | 33 | 45 | 0.24* | 0.30* | 0.40* | 0.15 | 0.14 | 0.13 | 0.07 | 0.04 | 0.01 |

Nodes correspond to those in Fig. 2. The number of samples for the two sister groups are indicated by $N_a$ and $N_b$. * Indicates a significant difference between sister groups at $P<0.0016$ after Bonferroni correction.

**Table S2** Index of divergence (*D*) from the morphology-based SEEVA evaluation of spruces worldwide using elevation, four temperature variables (AMT: annual mean temperature; MTWM: max temperature of warmest month; MTCM: min temperature of coldest month; and TAR: temperature annual range) and four precipitation variables (AP: annual precipitation; PWM: precipitation of wettest month; PDM: precipitation of driest month; and PCQ: precipitation of coldest quarter).

| Morphology Node | Number of Samples | | Index of Divergence (*D*) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Temperature Variables | | | | Precipitation Variables | | | |
| | $N_a$ | $N_b$ | Elevation | AMT | MTWM | MTCM | TAR | AP | PWM | PDM | PCQ |
| **1** | 2857 | 531 | 0.30* | 0.17* | 0.05* | 0.18* | 0.18* | 0.16* | 0.54* | 0.32* | 0.36* |
| **2** | 2530 | 327 | 0.51* | 0.06* | 0.13* | 0.25* | 0.48* | 0.11* | 0.12* | 0.35* | 0.10* |
| **3** | 2118 | 412 | 0.08* | 0.10* | 0.30* | 0.22* | 0.36* | 0.14* | 0.10* | 0.25* | 0.12* |
| **4** | 42 | 2076 | 0.48* | 0.42* | 0.48* | 0.22* | 0.41* | 0.01 | 0.26* | 0.25* | 0.04 |
| **5** | 25 | 17 | 0.46* | 0.04 | 0.05 | 0.20 | 0.28 | 0.56* | 0.47* | 0.10 | 0.08 |
| **6** | 5 | 12 | 0.28 | 0.39 | 0.39 | 0.44 | 0.02 | 0.76 | 0.14 | 1.00* | 1.00* |
| **7** | 335 | 1741 | 0.14* | 0.20* | 0.13* | 0.37* | 0.54* | 0.22* | 0.26* | 0.41* | 0.31* |
| **8** | 378 | 1363 | 0.21* | 0.17* | 0.10* | 0.46* | 0.49* | 0.22* | 0.46* | 0.32* | 0.30* |
| **9** | 96 | 282 | 0.42* | 0.94* | 0.57* | 0.98* | 1.00* | 0.97* | 0.53* | 0.98* | 0.98* |
| **10** | 93 | 3 | 0.71 | 1.00* | 0.73 | 1.00* | 1.00* | 0.00 | 0.00 | 0.05 | 0.90 |
| **11** | 45 | 237 | 0.43* | 0.72* | 0.10 | 0.71* | 0.65* | 0.16* | 0.52* | 0.04 | 0.05 |
| **12** | 6 | 231 | 0.41 | 0.73* | 0.13 | 1.00* | 0.99* | 1.00* | 0.59 | 0.98* | 0.99* |
| **13** | 89 | 142 | 0.38* | 0.14* | 0.51* | 0.00 | 0.00 | 0.71* | 0.97* | 0.08* | 0.25* |
| **14** | 1043 | 320 | 0.93* | 0.08* | 0.37* | 0.69* | 0.81* | 0.74* | 0.44* | 0.98* | 0.95* |
| **15** | 6 | 1037 | 0.66* | 0.31 | 0.47 | 0.29 | 0.85* | 0.59 | 0.86* | 0.25 | 0.26 |
| **16** | 244 | 76 | 0.04 | 0.76* | 0.08 | 0.84* | 0.83* | 0.91* | 0.83* | 0.16* | 0.13* |
| **17** | 56 | 188 | 0.65* | 0.18* | 0.28* | 0.04 | 0.00 | 0.05* | 0.91* | 0.00 | 0.00 |
| **18** | 126 | 62 | 0.03 | 0.02 | 0.17* | 0.14* | 0.70* | 0.01 | 0.29* | 0.00 | 0.00 |
| **19** | 27 | 49 | 0.07 | 0.31* | 0.63* | 0.66* | 0.40* | 0.01 | 0.05 | 0.72* | 0.93* |
| **20** | 11 | 16 | 0.43 | 0.00 | 0.08 | 0.00 | 0.55* | 0.45 | 0.16 | 0.08 | 0.14 |
| **21** | 39 | 373 | 0.35* | 0.17* | 0.01 | 0.46* | 0.39* | 0.34* | 0.13 | 0.49* | 0.06 |
| **22** | 31 | 8 | 0.78* | 0.40 | 0.09 | 0.77* | 0.46 | 0.41 | 0.77* | 0.32 | 0.35 |
| **23** | 199 | 174 | 0.08* | 0.65* | 0.30* | 0.56* | 0.35* | 0.62* | 0.52* | 0.62* | 0.58* |
| **24** | 72 | 255 | 0.28* | 0.09 | 0.06 | 0.11* | 0.07* | 0.18* | 0.13* | 0.00 | 0.33* |
| **25** | 283 | 248 | 0.35* | 0.26* | 0.25* | 0.46* | 0.21* | 0.28* | 0.02* | 0.43* | 0.36* |
| **26** | 89 | 194 | 0.98* | 0.06 | 0.21* | 0.12* | 0.32* | 0.65* | 0.21* | 0.78* | 0.70* |
| **27** | 38 | 51 | 0.93* | 0.60* | 0.14 | 0.82* | 0.95* | 0.16 | 0.01 | 0.42* | 0.50* |
| **28** | 33 | 161 | 0.00 | 0.31* | 0.03 | 0.33* | 0.43* | 0.09 | 0.33* | 0.00 | 0.00 |
| **29** | 11 | 237 | 0.66* | 0.09 | 0.32 | 0.30 | 0.04 | 0.07 | 0.02 | 0.62* | 0.60* |
| **30** | 23 | 214 | 0.41* | 0.21 | 0.13 | 0.01 | 0.26* | 0.47* | 0.93* | 1.00* | 0.70* |
| **31** | 72 | 142 | 0.70* | 0.26* | 0.11* | 0.15* | 0.13* | 0.45* | 0.13* | 0.66* | 1.00* |
| **32** | 138 | 4 | 1.00* | 0.59 | 0.61 | 0.01 | 0.60 | 0.02 | 0.00 | 0.01 | 1.00 |

Nodes correspond to those in Figure 3. The number of samples for the two sister groups are indicated by $N_a$ and $N_b$.

* Indicates a significant difference between sister groups at $P<0.0016$ after Bonferroni correction.