

## **New Phytologist Supporting Information**

### **Climate refugia: joint inference from fossil records, species distribution models, and phylogeography**

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The following Supporting Information is available for this article:

**Notes S1** Data sources for Figs 2 and 5

#### **Data sources for Fig. 2**

(a) Effective precipitation is based on the PRISM climate data for 1960–1990 (Daly *et al.*, 2002) following the methods in (Gavin & Hu, 2006). *Ascaphus* observations are based on records reported in GBIF ([www.gbif.org](http://www.gbif.org), accessed 01 Dec 2013), Carstens & Richards (2007), and Ritland *et al.* (2000). (b) The UKMO simulation of climate for the Last Glacial Maximum is from the PMIP2 Paleoclimate Model Intercomparison Project (Johns *et al.*, 1997). Anomalies for monthly temperature and precipitation (LGM – present simulations) were smoothed across the coarse 3.75° GCM grid and applied to the modern 4-km gridded PRISM climate data. Ice sheet extent and coastline is from Dyke *et al.* (2003). (c) *Ascaphus* maximum-likelihood tree showing intraspecific and interspecific phylogenetic relationships (Nielson *et al.*, 2001). (d) Lost Trail Pass pollen record taken from Fig. 9 (in part) of Mehringer *et al.* (1977) and redrafted. Used with permission. Copyright Regents of the University of Colorado.

#### **Data sources for Fig. 5**

Background maps are cross-blended hypsometric tinted shaded relief maps available from [naturalearthdata.com](http://naturalearthdata.com). (a) Distribution of European beech is from Pott (1997). Fossil occurrences

are listed in Tzedakis *et al.* (2013), Magri *et al.* (2006), Kaltenrieder *et al.* (2009), and de Lafontaine *et al.* (in press). Hindcasted distribution of beech is generalized from Svenning *et al.* (2008). Potential refugia are modified from Magri *et al.* (2006) using newer results from de Lafontaine *et al.* (2013) and distinguish refugia supported by genetics and/or fossil data. Arrows indicating postglacial migration are from Magri *et al.* (2006). The furthest north potential refugium marked by '?' is based only on macrofossils from early interstadials of the last glacial period (before the LGM) and early Holocene pollen (Magri *et al.*, 2006). (b) Fossil occurrences are from Kaiser *et al.* (2007) for the late Holocene and Herzschuh *et al.* (2006) for the late Glacial. The distribution map, and inferred refugia and migration are from Meng *et al.* (2007). (c) The distribution of Douglas-fir is from Little (1971). Fossil presences (LGM only) are from Gugger & Sugita (2010), with the exception that data from western Washington were not included after careful consideration of the continuous presence Douglas-fir in that area (see Barnosky, 1985; Grigg & Whitlock, 2002). The hindcasted LGM distribution is generalized from Roberts (2013), and show only areas with  $c. > 0.5$  probability of presence. The SDM for Douglas-fir was applied to downscaled paleoclimate simulation from the CCM1 model (Kutzbach *et al.*, 1998).

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