Appendix F: Plot standard deviation model selection and posteriors

In this appendix, we describe our model selection strategy for the random plot effects in our models, and show posteriors for plot standard deviation σ_p for all species aggregated, incense-cedar, white fir, Douglas-fir, ponderosa pine, sugar pine, black oak, and tanoak.

Selection strategy for random effects

The plot random effect standard deviation cannot overlap zero and we therefore cannot use a 95% credible interval overlap criterion. Instead, we consider the shape and location of the posterior, interpreting it as not meaningful when zero has substantial support. In addition, random effects cannot be treated equivalently to fixed effects in the selection strategy because they are variance components. The forward-selection strategy is not optimal for selecting random effects because one prefers to test the random effects with a "beyond optimal" model which includes all possible fixed effects (Zuur et al. 2009), which is not feasible here. Therefore we use the following procedure to select random plot effects:

1) Fit models with only plot effects. This model should demonstrate which random effects should definitely not be selected, because if there are no other variables and the plot standard deviation posterior has high support at zero, there is little evidence in the data that any variation is accounted for with this effect. Therefore, if plot effect standard deviations have support at zero, we do not include plot effects in future models for fixed effect selection.

2) Otherwise, include plot effects which could potentially be significant and proceed with fixed effect model selection as described in the main text.

3) After selecting fixed effects, check the plot random effect standard deviation again in the final models to confirm that it has remained distinct and separated from zero.

Results of selection for our survival models

We first show posteriors from the model with random plot effects and no explanatory variables (from step 1). Tanoak is the only species in our models which clearly has little support for a plot random effect (Fig. F1), so we do not include it in further model selection. All other species have plot random effect posteriors which are separated from zero (Fig. F1) and therefore plot effects are included for those species throughout the model selection process.

For these species, after selecting fixed effects, we check the plot random effect standard deviation again to see if the variation initially attributed to plot has now been attributed to fixed effects (from step 3, Fig. F2). For all species aggregated, incense-cedar, Douglas-fir, and ponderosa pine, the plot standard deviation posteriors are still clearly separated from zero. Sugar pine's plot random effect has become more ambiguous. Black oak and white fir now have bimodal plot standard deviation posteriors (the MCMC consistently alternates between two possible values). For black oak, 'pairs' plots in R of the MCMC chains show that the plot random effect is compensating for the size effect - when the plot random effect node is close to zero, then the size parameters β^{DBH} and β^{DBH^2} also have smaller (close to zero) values. However, the more favored model (with the higher density) is the one with a nonzero plot effect and strong size dependence. For white fir, no tradeoffs are obvious in the 'pairs' plot but we also recall that the mode at zero disappears when a prior with zero weight at zero is used (Appendix C). White fir and black oak plot standard deviations are likely to be significant if the secondary node at zero is an artifact of the MCMC sampler.

Note that variation in incense-cedar is higher than all species aggregated, Douglas-fir, and

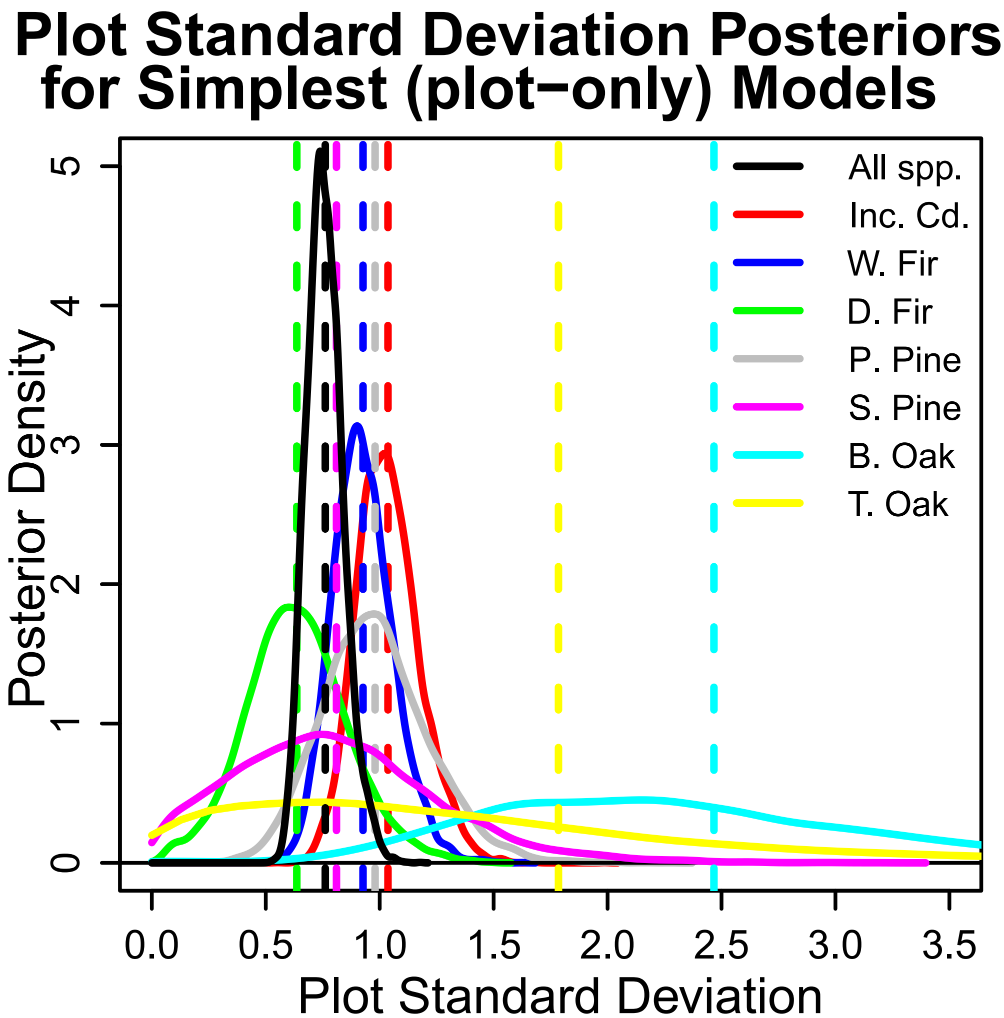

Figure F1: Posterior distributions of the plot random effect standard deviations, for plot-only models. Means are shown as a vertical dashed line.

ponderosa pine. One possible reason for incense-cedar's higher variation could be that it is the most abundant species at our site. It is found on almost the same number of plots as white fir, which is next most abundant, and yet has greater plot variation. It may be that much of the recruitment and gap dynamics are occurring within this most abundant species. We also note that spatial influences on mortality can be more elegantly handled in mapped plots, where the hierarchical model can directly incorporate spatial autocorrelation (Finley et al. 2011).

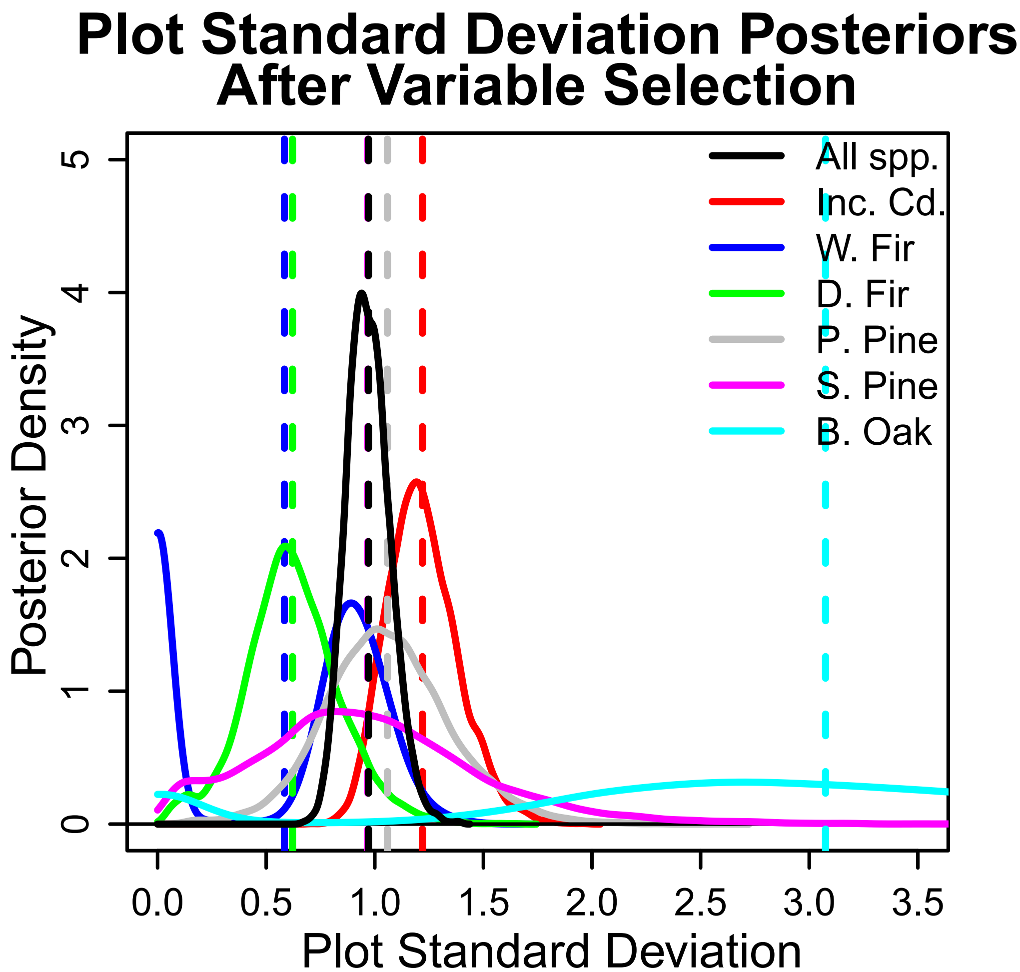

Figure F2: Posterior distributions of the plot random effect standard deviations for models with model-selected fixed effects. Means are shown as a vertical dashed line.

References

Finley, A. O., S. Banerjee, and D. W. MacFarlane. 2011. A Hierarchical Model for Quantifying Forest Variables Over Large Heterogeneous Landscapes With Uncertain Forest Areas. Journal of the American Statistical Association **106**:31–48.

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