Appendix A. Detailed description and likelihood function for the Bayesian hierarchical hurdle model.

The likelihood of a given observation of species abundance y_i is given by

$$L(y_i) = \begin{Bmatrix} y_i = 0 : 1 - \pi \\ y_i > 0 : \pi \times Gamma(\alpha, \beta_i) \end{Bmatrix}$$

where π is the probability of occurring in a given forest stand, α is the shape of the gamma distribution, and β_i is the rate parameter, which was allowed to vary for every observation. The probability of species *i* occurring in forest stand *j* (π_{ij}) was modeled as:

$$\text{logit}(\pi_{ij}) = \gamma_{0j} + \gamma_{1j}\text{MPD}_{ij} + \gamma_{2j}\text{MTD}_{ij} + \gamma_{3j}\text{Introduced}_i + \gamma_{4j}\text{MPD}_{ij}\text{: Introduced}_i + \gamma_{5j}\text{MTD}_{ij}\text{: Introduced}_{ij}$$

Similarly, the mean relative abundance of species *i* in forest stand *j* (μ_{ij}) was modeled using a log-link:

$$\log(\mu_{ij}) = \beta_{0j} + \beta_{1j}\text{MPD}_{ij} + \beta_{2j}\text{MTD}_{ij} + \beta_{3j}\text{Introduced}_i + \beta_{4j}\text{MPD}_{ij}\text{: Introduced}_i + \beta_{5j}\text{MTD}_{ij}\text{: Introduced}_i$$

where μ_{ij} is drawn from a gamma distribution with a constant shape, α, and a rate parameter $\nu_{ij} = \alpha/\mu_{ij}$. In this parameterization, the variance of an observation increases in proportion to the square of the mean: $\sigma_{ij}^2 = \mu_{ij}^2/\alpha$. A negative relationship between MPD/MTD and presence/absence or relative cover indicates environmental filtering (e.g., increasing phylogenetic or trait distance leads to lower probability of occurrence or relative abundance). Conversely, a positive relationship between MPD/MTD and either response variable indicates greater success for unique species (e.g., niche partitioning). The interaction coefficients (MPD:Introduced, MTD:Introduced) represent the difference between native and introduced species.

Stand-level coefficients were drawn from a multivariate normal distribution allowing for correlations among random effects. Environmental variables were included as group-level predictors, allowing assessment of the effects of MPD, MTD, and Introduced status across forest age and environmental gradients. For example, the coefficient for relative cover MPD, β_{1j}, was a linear function of light availability, litter depth, soil VWC, and forest age:

$$B_{1j} \sim N(\widehat{\beta_{1j}}, \Sigma)$$

$$\widehat{\beta_{1j}} = \tau_0 + \tau_1 \mathrm{light}_j + \tau_2 \mathrm{litter}_j + \tau_3 VWC_j + \tau_4 age_j$$

where Σ was the covariance matrix for all random effects. This is conceptually similar to a linear regression of forest stand coefficients against environmental predictors.

MPD, MTD, and all environmental variables were standardized for use in the model. We used Wishart distributions as priors for the precision (i.e., inverse covariance) matrices of random effects in both the gamma and logistic models. All model parameters were given priors drawn from a normal distribution ($\mu = 0, \sigma^2 = 4$). The model ran four chains with 500 burn-in iterations each. Chain convergence was assessed using traceplots and density plots of the posterior distributions for all model parameters. We sampled the posterior distribution 500 times, resulting in 500 independent posterior estimates per chain (2000 total). For all parameters, we calculated the posterior median value and the 80% and 95% credible intervals (CI_{80}, CI_{95}). We define statistically significant results when the CI_{95} excludes zero and marginally significant results when the CI_{80} excludes zero.