Hundreds of tree species can coexist within a single hectare of wet tropical forests, in apparent contradiction of the competitive exclusion principle1,12. One important mechanism that has been proposed to explain species coexistence in tropical forests is niche differentiation at varying spatial scales13,14. At the finer end of the spectrum, the effects of micro-topographical variation are largely unknown, even though it has the potential to explain a substantial component of species distributions. Early life stages are likely most sensitive to niche processes15, and the availability of suitable environmental conditions may provide an initial and lasting advantage. One axis of niche-differentiation among tropical forest trees that varies across macro and micro scales is soil water. As a result, differential seedling survival along water-availability gradients might substantially shape the distributions of adults and facilitate species coexistence.

Water availability on hilltops is often limited16, and the capacity of episodic droughts to restrict the upper elevational distribution of tropical trees is well established2,4,6–9. Here, at the drier end of the spectrum, slower growing speciesare generally more dominant, and this is reflected in their higher than average wood densities17,18. This suggests that wood density should increase with elevation, with fast-growing lower wood density species at an advantage at lower elevation, wetter and nutrient-rich sites. We find no studies explicitly testing a within-site elevation relationship with wood density, although many provide analysis on these components2,4,8,19,20. Nevertheless, under this ecologically compelling model of species distributions, higher wood densities are predicted to be associated with higher elevations.

The extent to which micro-topography interacts with episodic water inundation to constrain species distributions in *terra firme* forest remains largely unexplored. Recent research has shown that species differ in seedling responses to ephemeral water inundation events3, although it is uncertain whether such differences relate to species partitioning10. Moreover, there is little information on how differential responses to micro-topographical variation contributes to species distributions at larger spatial scales. Discovering what limits species at lower elevations prone to waterlogging in tropical forests could help explain niche partitioning across the entire soil water gradient.

We phylogenetically constrained our study to a single family, the Dipterocarpaceae, to reduce uncertainties that could be introduced by including more species from more families. Large-scale (macro-topographical) adult distributions of species (n = 16) and general trends in the wood density distribution (n = 36). We additionally quantified water inundation sensitivities of the 16 dipterocarp species using 2048 seedlings in a fully randomised experiment within the alluvial habitat of Sepilok Forest Reserve, Sabah (Fig. 1a, b & d).

We evaluated both large-scale (macro-topographical) adult distributions and micro-topographical niche segregation among seedlings of 16 species of Dipterocarpaceae, and the extent to which seedling sensitivities to waterlogging reflect adult distributions. We phylogenetically constrained our study to a single family, the Dipterocarpaceae, to reduce uncertainties that could be introduced by including more species from more families. We additionally quantified seedling water inundation sensitivities of 16 dipterocarp species in a fully randomised experiment within the alluvial habitat of Sepilok Forest Reserve, Sabah (Fig. 1a, b & d). Alluvial habitats characteristic of large valleys and riverine areas in lowland dipterocarp forests are common throughout Borneo21–24, and we expect our sites to be representative of much of Borneo’s rainforests. Seedling responses and wood density were used to predict the larger scale (macro-topographical) adult distributions on elevational scales of tens of metres.