

---

# Drivers of woody alien invasions across spatial scales in the Hawaiian Islands

Dylan Craven\*<sup>1</sup>, Jonathan Chase<sup>2,3</sup>, and Tiffany Knight<sup>2,3,4</sup>

<sup>1</sup>University of Gottingen – Gottingen, Germany

<sup>2</sup>German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig – Leipzig, Germany

<sup>3</sup>Martin Luther University Halle-Wittenberg – Halle (Saale), Germany

<sup>4</sup>Helmholtz Centre for Environmental Research - UFZ – Halle (Saale), Germany

## Abstract

Islands harbor a disproportionate amount of global plant diversity, emerging as a result of isolation and dynamic geophysical processes. However, isolation also facilitates alien invasions of islands, potentially changing community structure, displacing endemic species, and threatening the provisioning of vital ecosystem services. It is therefore critical to deepen current understanding of the factors that allow alien species to successfully establish in and dominate native forests on islands. Here we assess shifts in the relative importance of abiotic and biotic drivers, and their interactions, on the establishment and dominance of alien species across spatial scales in the Hawaiian archipelago. We used a database of more than 450 forest plots to examine patterns of woody plant invasions at local (< 1 ha) and regional scales (10,000 ha). We calculated phylogenetic distinctiveness (PD) of woody alien species as the mean phylogenetic distance to the nearest native species. We also gathered wood density and seed mass data for alien species to explain variation in their establishment and dominance. At each spatial scale, we fit phylogenetic multilevel Bayesian models to examine variation in establishment and dominance of alien species as a function of biotic (e.g., PD, wood density, and seed mass) and abiotic factors (e.g., precipitation, potential evapotranspiration (PET), soil age, and the human influence index (HII)) and their interactions. At the regional scale, we found that the probability of establishment increased with PET and that phylogenetically unique alien species were more likely to establish in areas with young soils or low precipitation, while those with heavy seeds established well in areas with high precipitation. At the local scale, the establishment of alien species was positively associated with PET, soil age, and HII. However, alien species exhibited different rates of establishment along gradients in precipitation, PET, and soil age that were strongly modulated by species' phylogenetic uniqueness, wood density, and seed mass. Local dominance of alien species also was strongly context dependent; all biotic factors exhibited significant interactions with HII. Our results show that where woody alien species occur or where they are dominant is contingent upon the joint effects of abiotic and biotic filtering.

**Keywords:** biological invasions, spatial scales, forests, functional traits

---

\*Speaker