A barrier to global plant invasion ecology: gaps in trait availability for alien species

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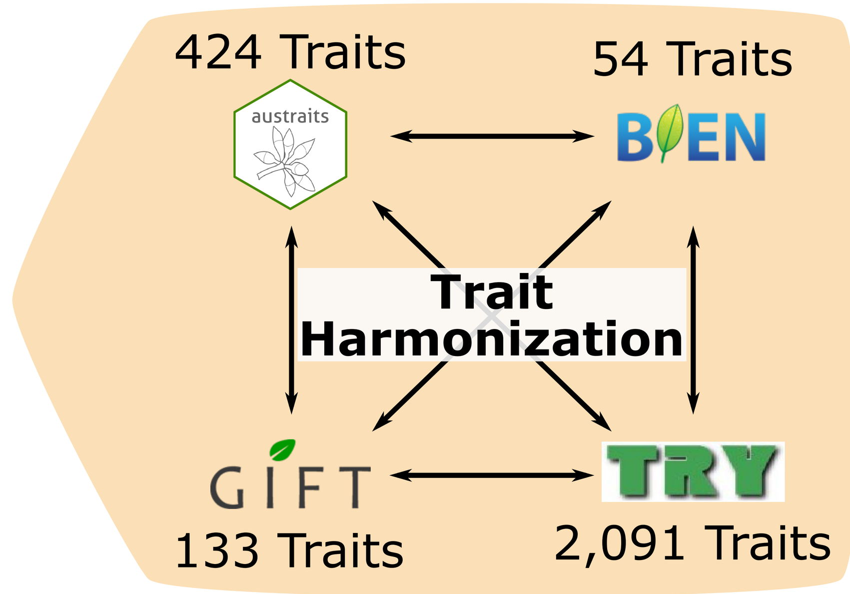
Introduction

Non-native species have strong negative effects on ecosystems, like *Reynoutria japonica*. Functional ecology can help understand them using **functional traits**. However, the extent to which alien species are described by global trait databases is not known.
We assessed the trait coverage of global alien species using global trait databases.

Methods

We assembled the largest trait dataset for alien plant species using global trait databases (AusTraits, BIEN, GIFT, TRY) and manually curated trait correspondence tables, combining them with the GloNAF database of alien species status and distributions.
We performed taxonomic harmonization for all the involved databases to unify the different taxonomies using the TNRS. In total we obtained distribution and alien status for 16,538 species and observed 2,216 different traits.



Because ecologists are seldom interested in isolated trait, we focused on 3 specific **combinations of trait**. These represent commonly used combinations for comparative ecology.

Leaf-Height-Seed Mass

3 traits - Westoby et al. 1998

Aboveground Traits

6 traits - Díaz et al. 2016

Root Traits

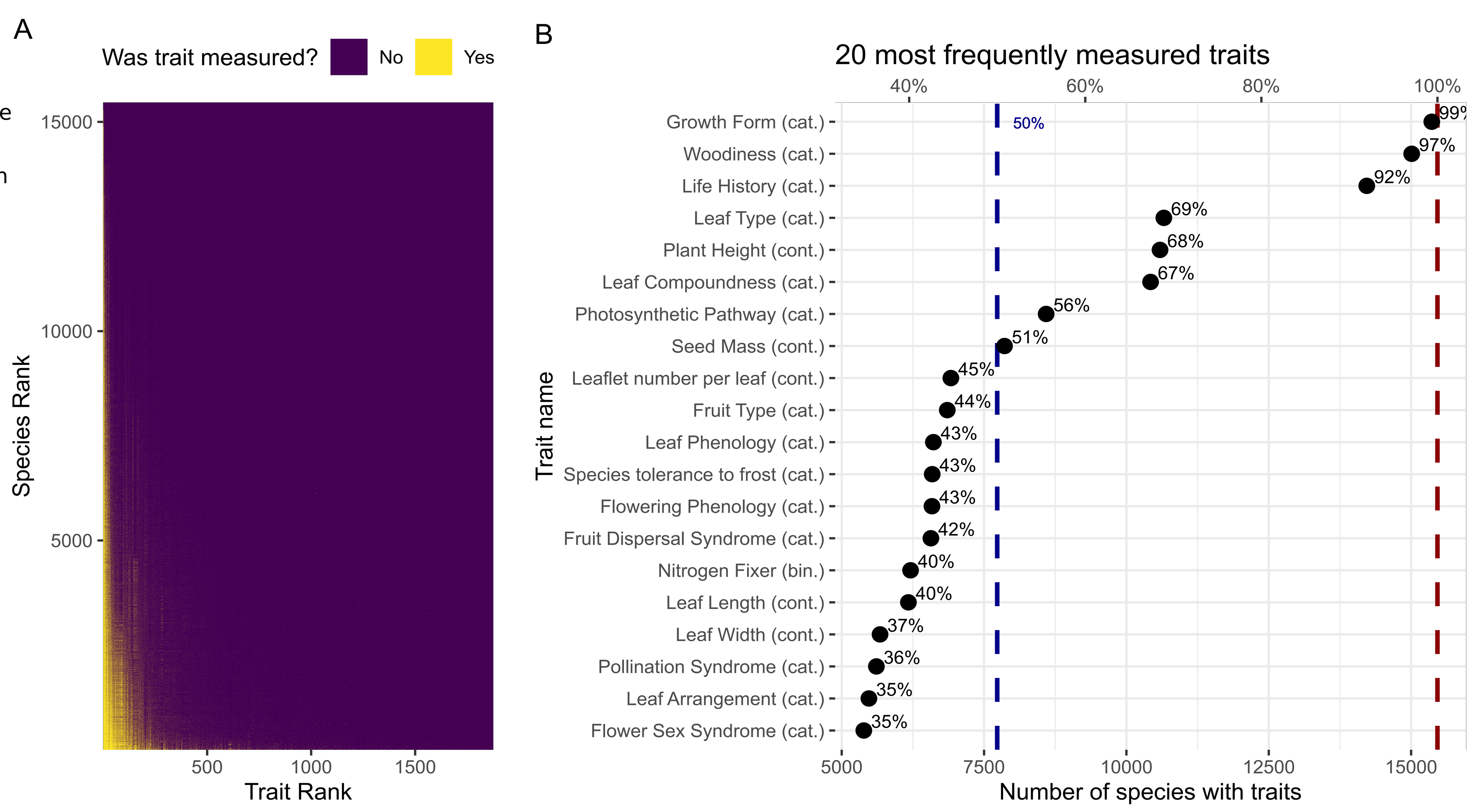
4 traits - Bergmann et al. 2020

Results

We found that the species-by-trait matrix (16,538 species x 2,216 traits) was **empty at 98%** (**Figure 1A**). 1,717 species (~10%) had >100 different traits measured, while **50%** of the species have **>20 traits** measured.

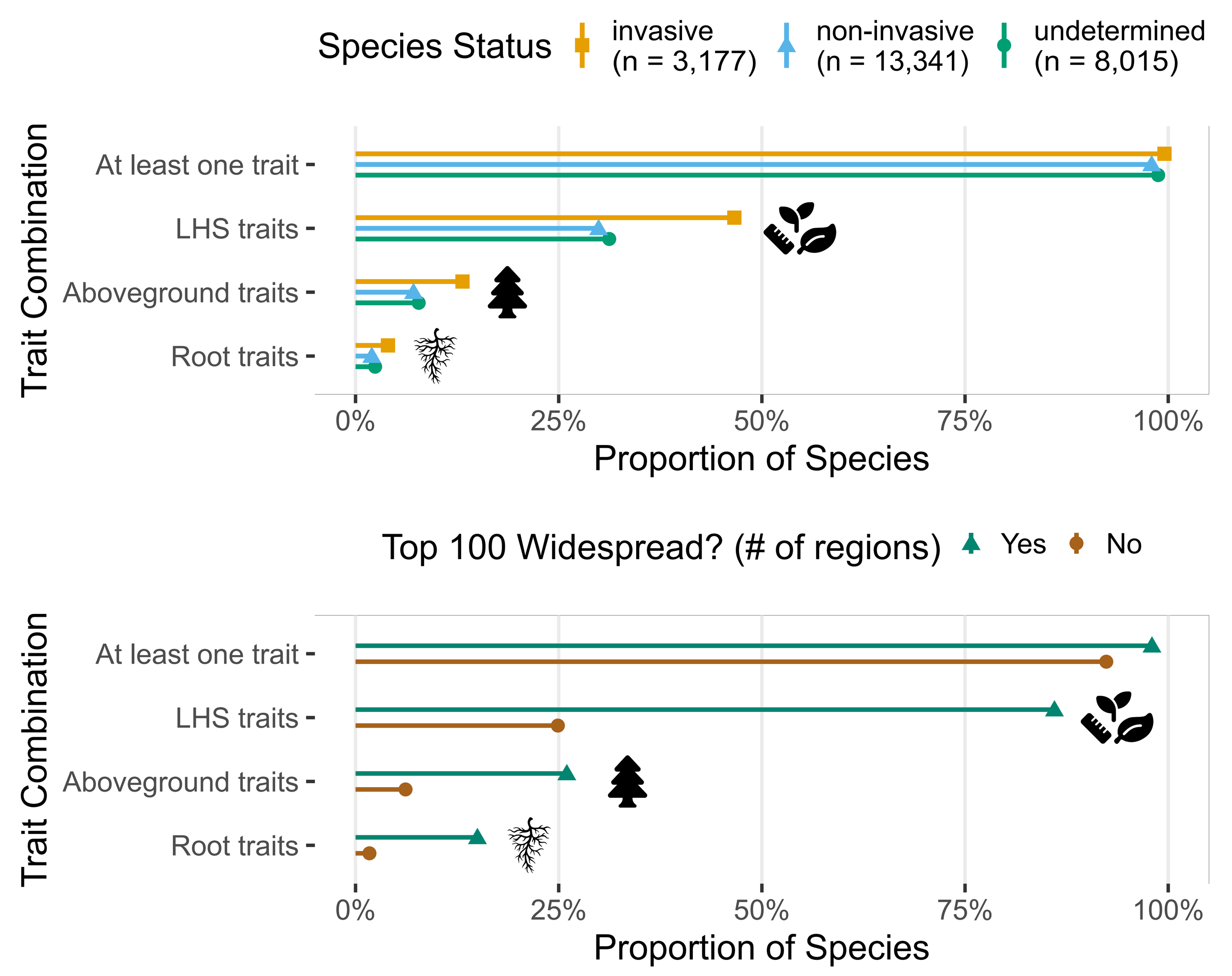
We also looked at the 20 most frequently measured traits (**Figure 1B**). Most of them were **categorical**. **Plant height** and **seed mass** were the most available continuous traits at respectively **68%** and **51%** of the species. There were **only 8 traits** available for **over 50%** of the species.

Figure 1 Raw trait distribution
A Visualization of the trait matrix
B Species proportion for the 20 most measured traits



We measured the proportion of species with a given trait combination in function of their alien status as well as their widespreadness.
We found that **invasive and widespread species** had a consistenly **higher proportion of known trait combinations** than non-invasive and non widespread species. This result hold whatever the considered trait combination.

Figure 2 Trait combination proportions (**top**) by alien status (**bottom**) and range size



We mapped the proportion of alien species in each region with target trait combinations (**Figure 3**). All regions of the world showed **>80% coverage** with **>0 trait**.

However, for other trait combinations, the proportion dropped. The median was **<60%** for **LHS**. The **Tropics** showed vast regions with **<40% coverage**. **Other combinations** showed **<20% coverage** almost everywhere.

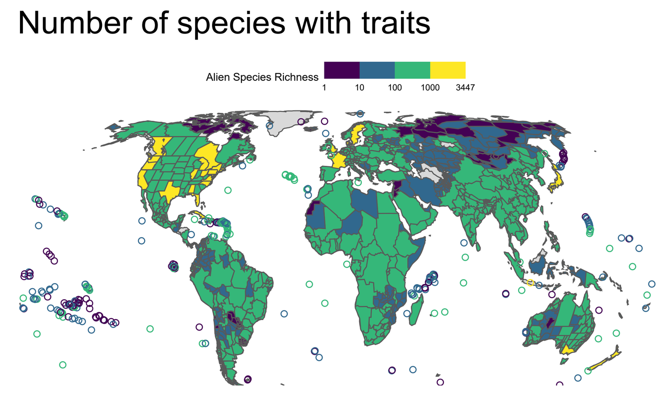
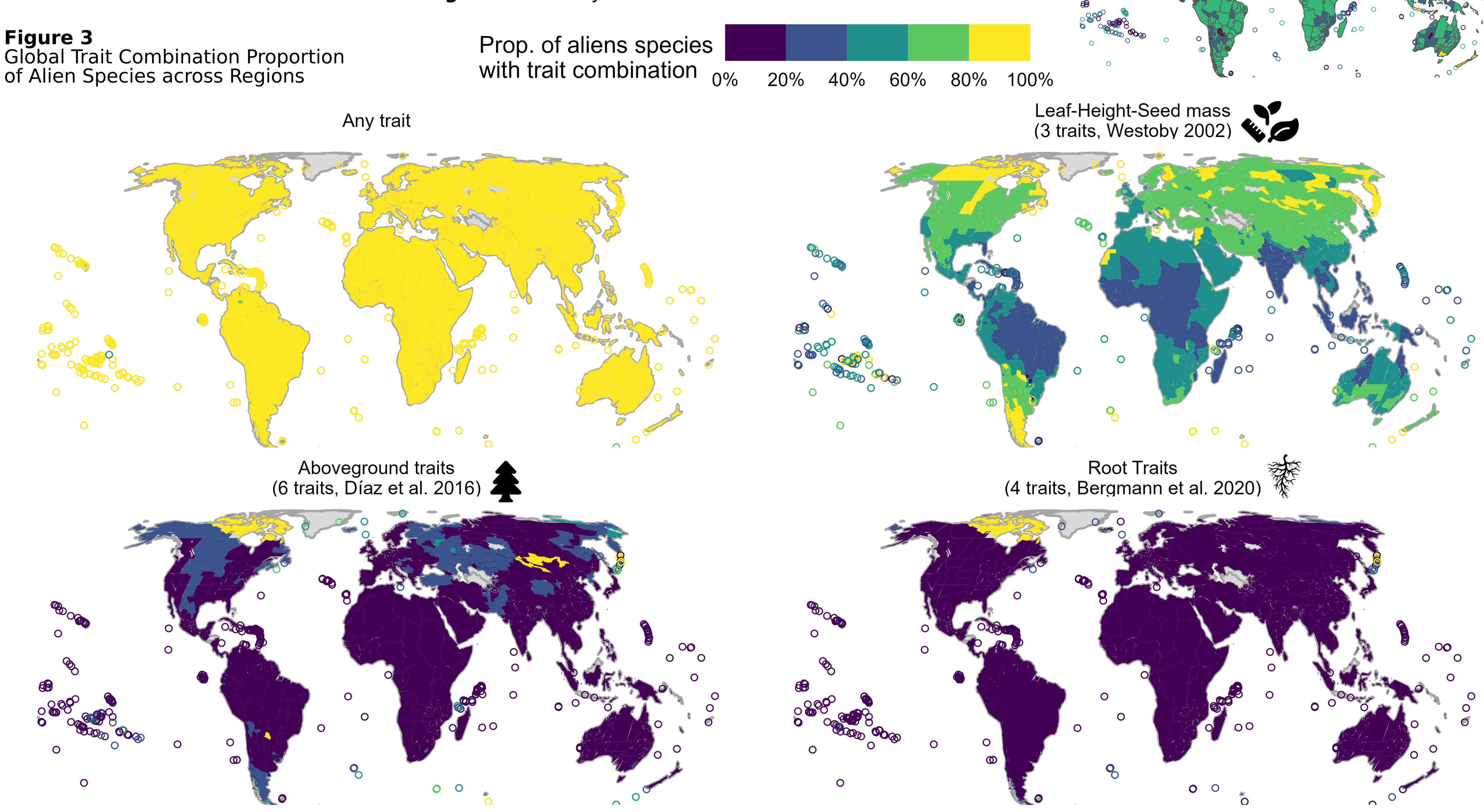


Figure 3 Global Trait Combination Proportion of Alien Species across Regions



Take-Home Messages

- **Global trait databases** show overall l**ow coverage** of **alien species**.
- **Many traits are measured** (over 1,875 have been measured at least once) but as soon as we **combine them the coverage drops** dramatically.
- We're currently building a **model** to **quantify** the factors that explain **trait knowledge** per species (invasiveness, range size, GDP across range size, etc.).
- This doesn't mean the data do not exist, rather that they are **not deposited in global databases**. We should increase the awareness about data consolidation.
- We would need a **global coordinated effort** to increase the trait coverage at global scale: data mobilization from the community, literature search, or targeted field campaign.

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