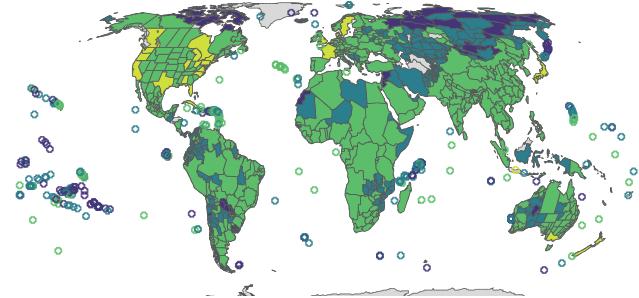




German Centre for Integrative Biodiversity Research (iDiv)
Halle-Jena-Leipzig

sDiv synthesis centre of iDiv



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

**Matthias Grenié, Petr Pyšek, Franz Essl, Patrick Weigelt,
Holger Kreft, Mark van Kleunen, Wayne Dawson, Ingolf Kühn,
Helge Brüelheide, Marten Winter**



GloNAF
Global Naturalized Alien Flora

Neobiota 2022 – Tuesday 13th of September 2022

matthias.grenie@idiv.de



[@LeNematode](https://twitter.com/LeNematode)



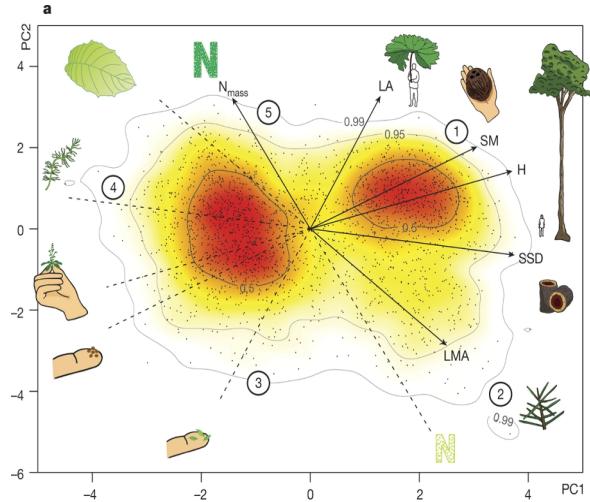
<https://rekyt.github.io/>

iDiv is a research centre of the
DFG Deutsche Forschungsgemeinschaft

Functional Invasion Community Ecology?

Functional Invasion Community Ecology?

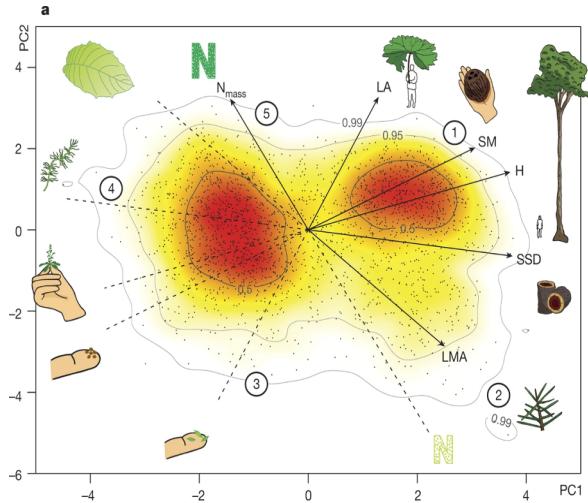
Functional traits let us **gain insight**



Díaz et al. 2016

Functional Invasion Community Ecology?

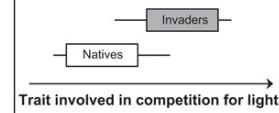
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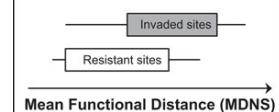
Díaz et al. 2016

Community Ecology focuses on **multiple species** together

Q1: Which species are more invasive?

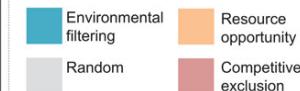


Q2: Which communities are resistant to invasion?



Q3: Which processes drive coexistence between invaders and natives?

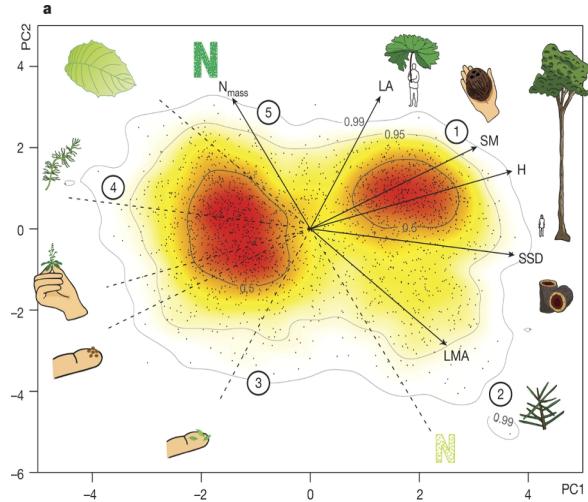
Proportion of sites



Gallien & Carboni 2016

Functional Invasion Community Ecology?

Functional traits let us **gain insight**



Díaz et al. 2016

Community Ecology focuses on **multiple species** together

Q1: Which species are more invasive?
Invaders
Natives

Trait involved in competition for light

Q2: Which communities are resistant to invasion?
Invaded sites
Resistant sites

Mean Functional Distance (MDNS)

Q3: Which processes drive coexistence between invaders and natives?

Proportion of sites



Invaded sites Resistant sites



Gallien & Carboni 2016

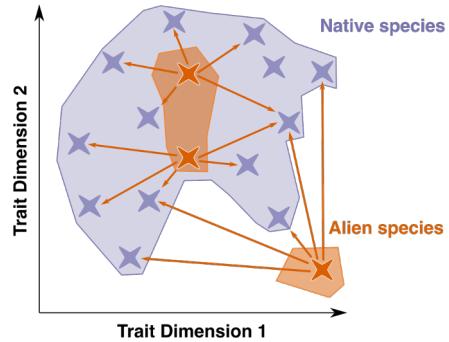
→ Study **community assembly processes** of alien species using functional traits

The problem...

The problem...

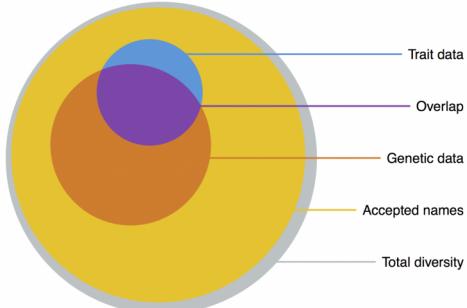
Wanted to study the “**Biotic Resistance Hypothesis**” globally in the **Tropics** with a **functional lens**

Functional Position of Aliens



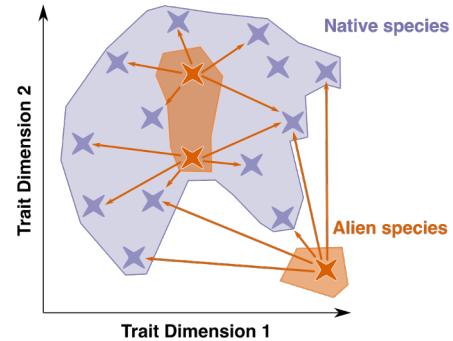
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Cornwell et al. 2019

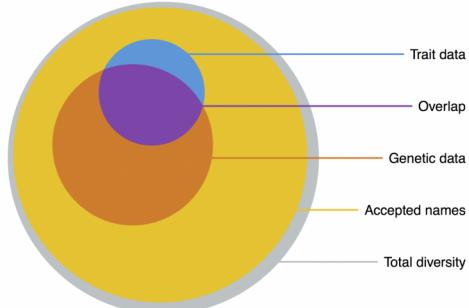
Functional Position of Aliens



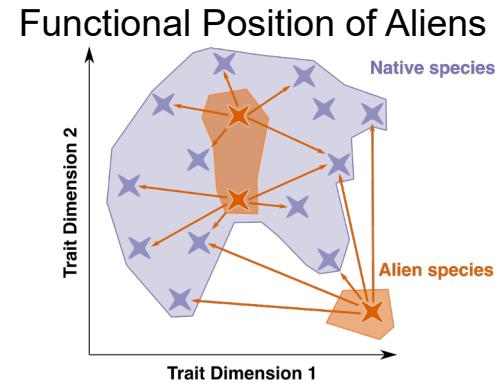
Huge gaps in trait data for alien species

The problem...

Wanted to study the “**Biotic Resistance Hypothesis**” globally in the **Tropics** with a **functional lens**



Cornwell et al. 2019



Huge gaps in trait data for alien species

What do we know of functional traits of alien (plant) species at global scale?

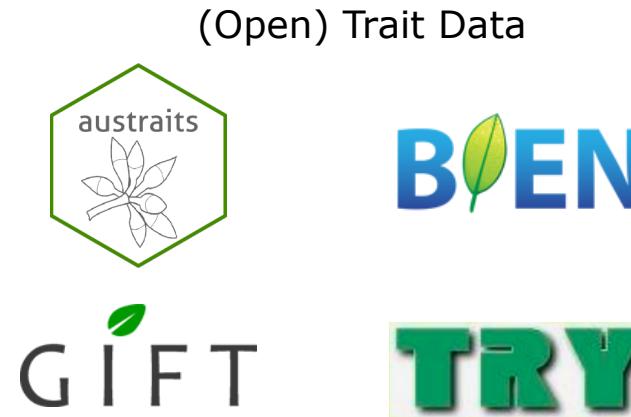
Merging Alien Plant Species Lists and Global Traits

Merging Alien Plant Species Lists and Global Traits

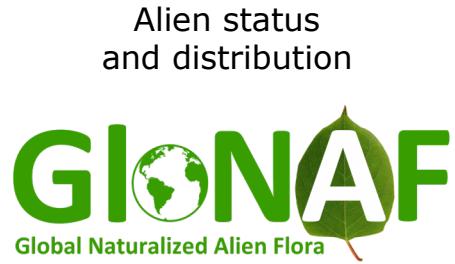
Alien status
and distribution



Merging Alien Plant Species Lists and Global Traits



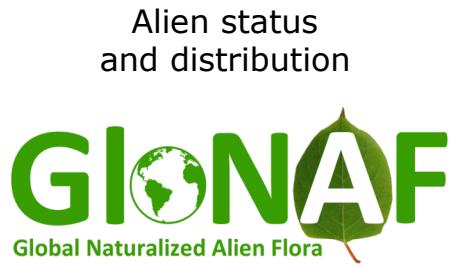
Merging Alien Plant Species Lists and Global Traits



(Open) Trait Data



Merging Alien Plant Species Lists and Global Traits



(Open) Trait Data



Taxonomic Harmonization (Grenié et al. 2022)
+ Trait Harmonization + Trait Categorization

Merging Alien Plant Species Lists and Global Traits



(Open) Trait Data



Taxonomic Harmonization (Grenié et al. 2022)
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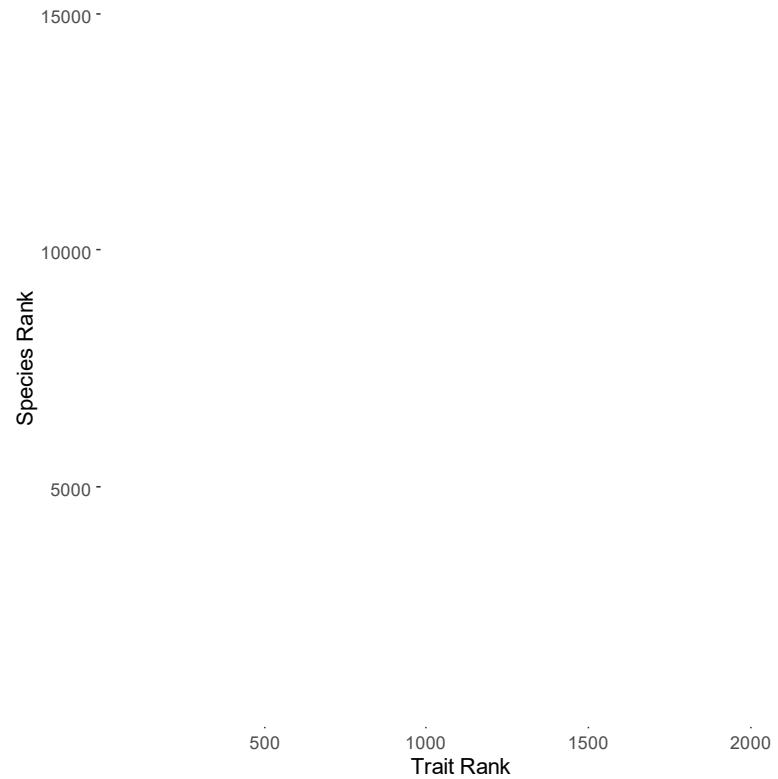
16,538 species from GloNAF
→ **15,490** species with **at least one trait (consolidated data)**

Global Trait Matrix

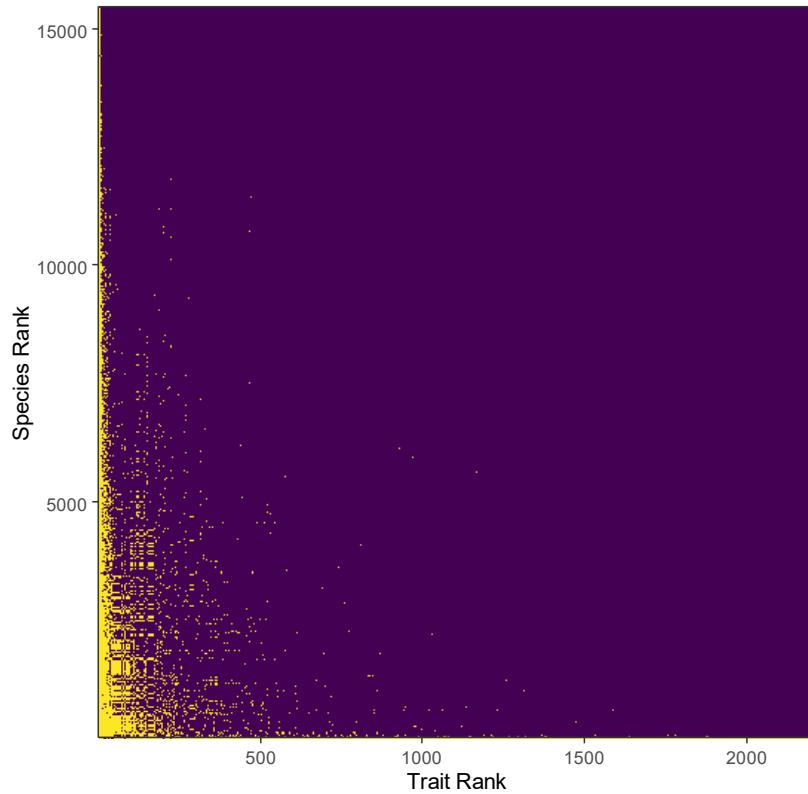
Global Trait Matrix

500 1000 1500 2000
Trait Rank

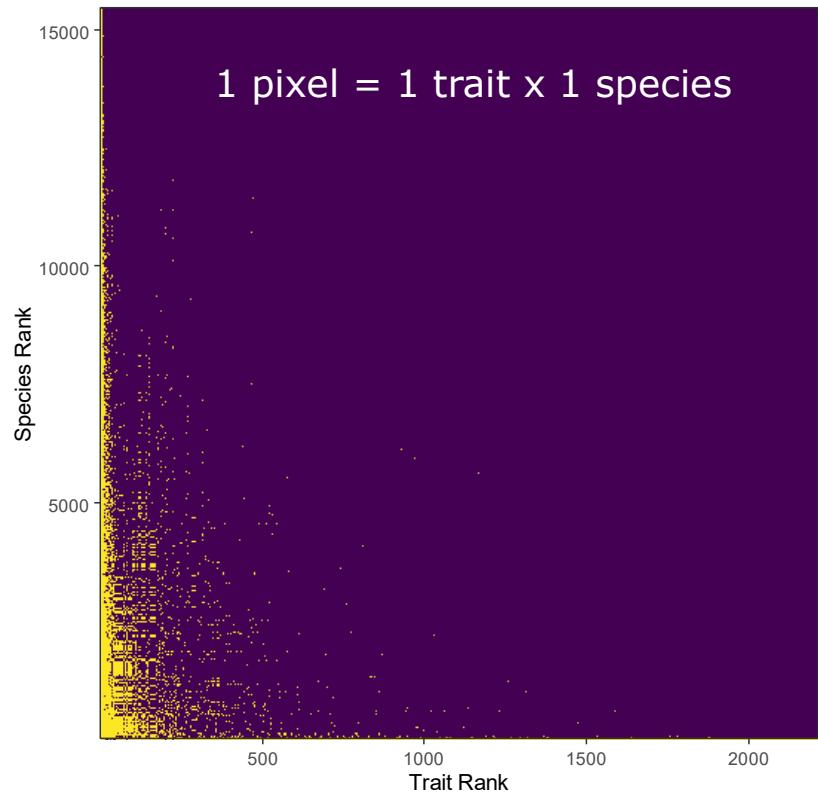
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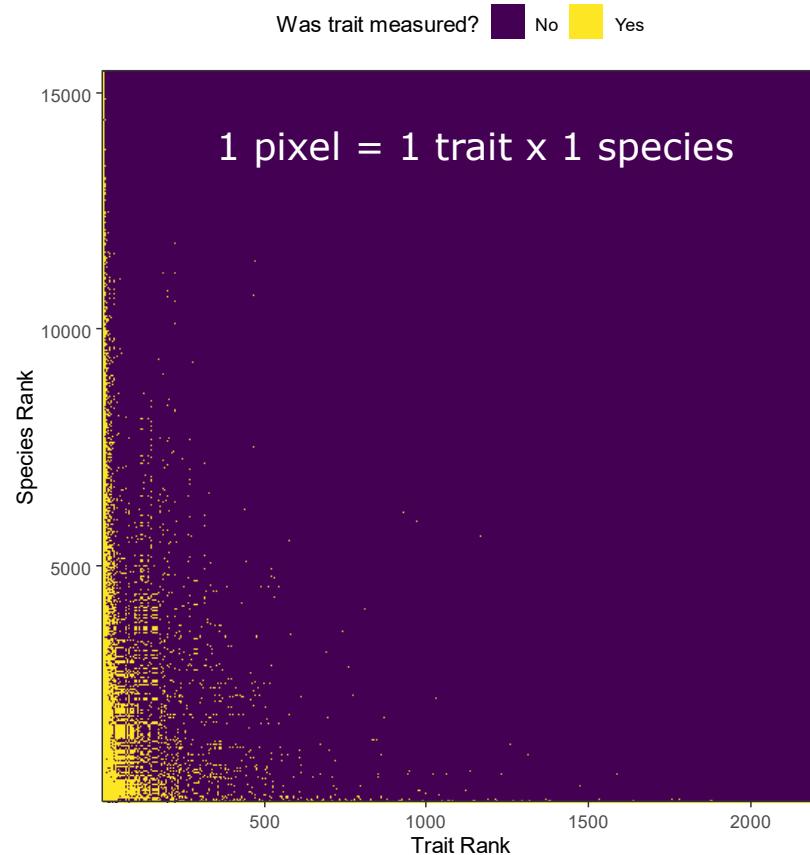
Global Trait Matrix



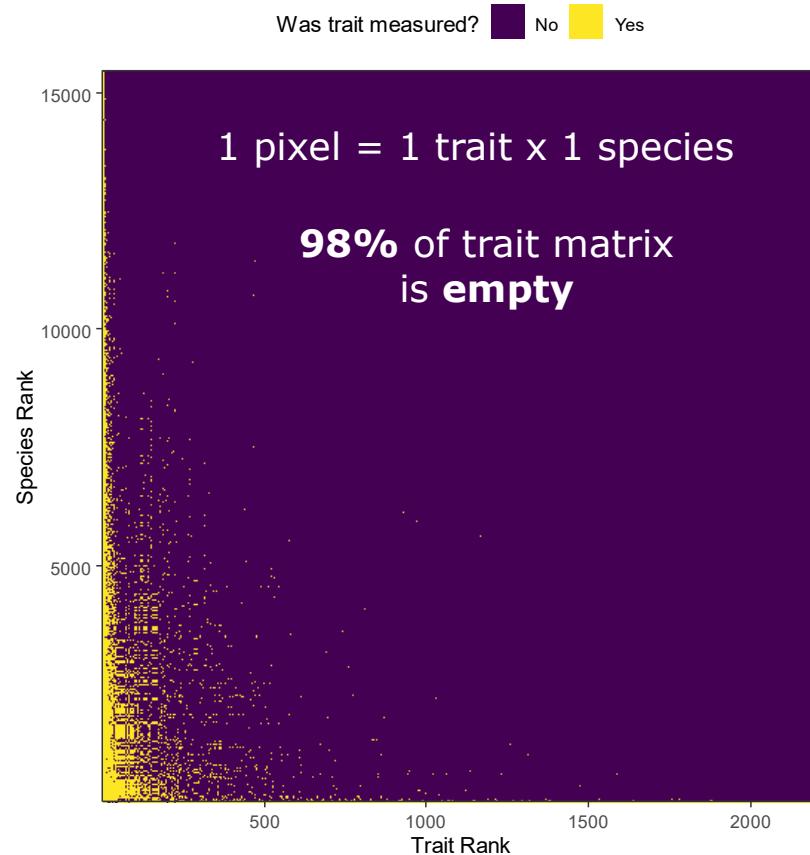
Global Trait Matrix



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Global Trait Matrix

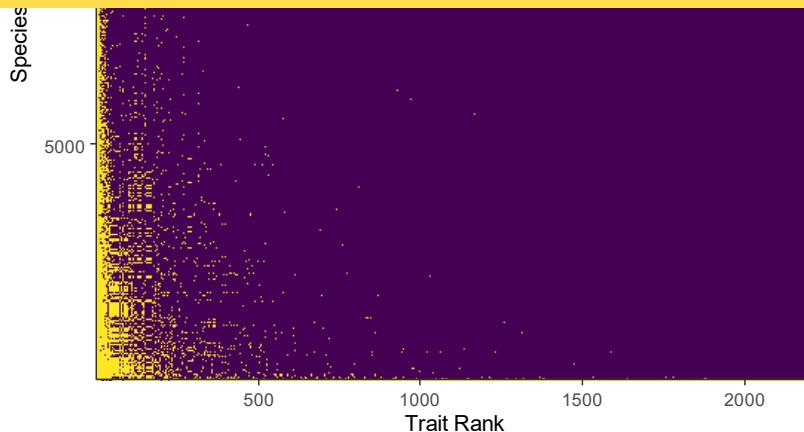


Global Trait Matrix

Was trait measured? No Yes

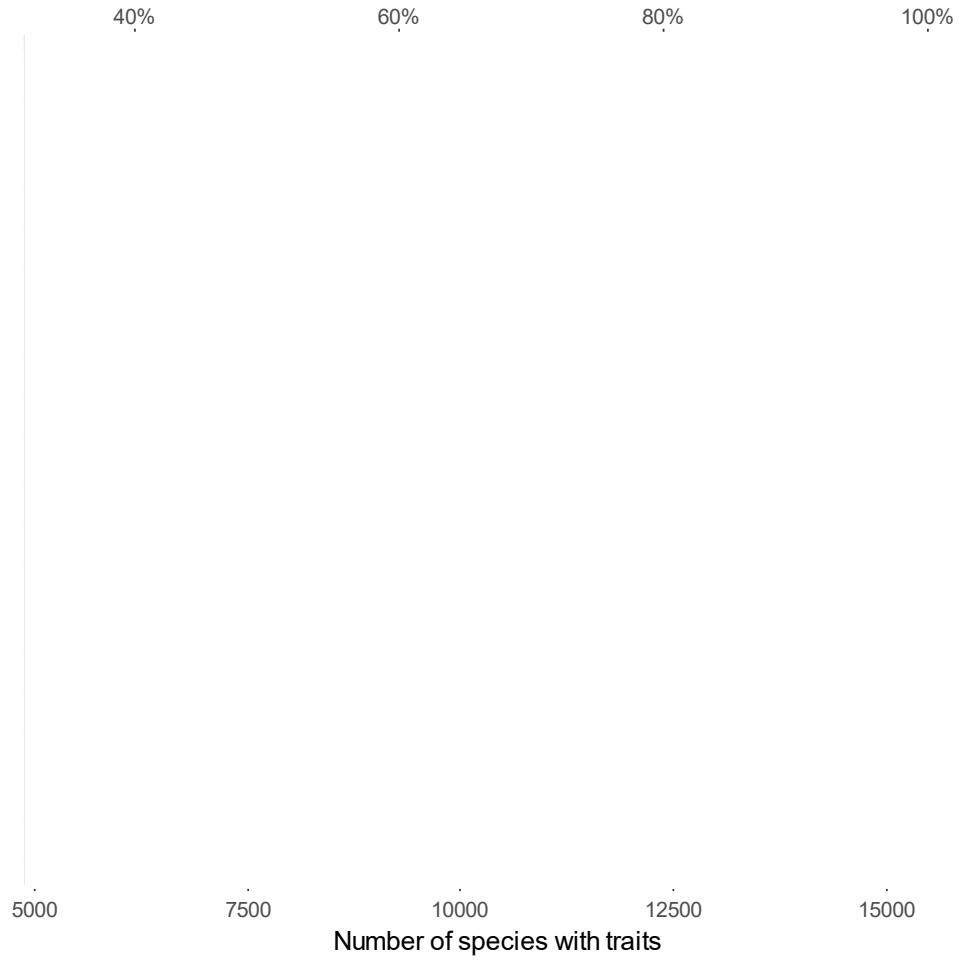


We are lacking much of alien plant species traits

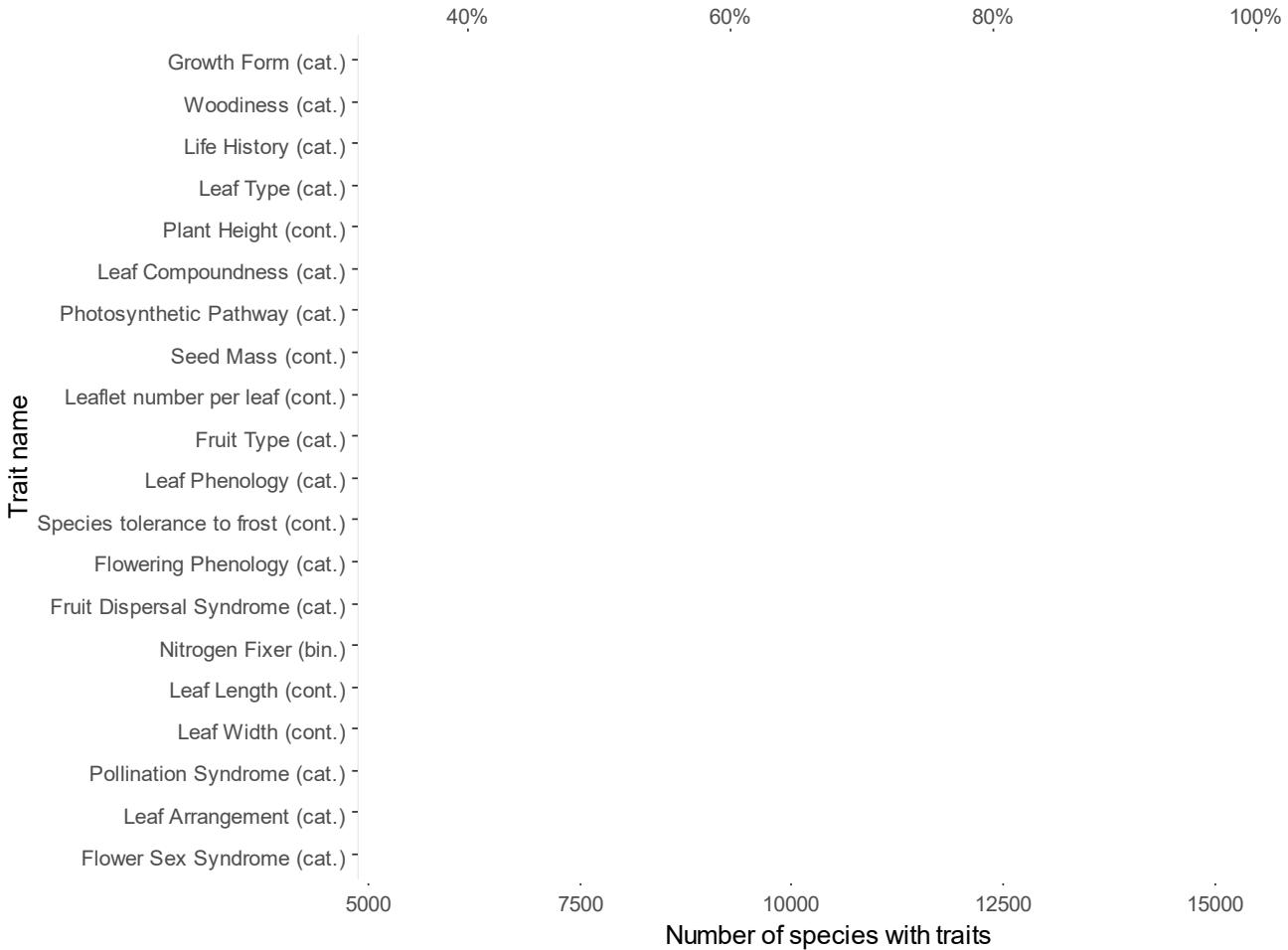


20 most frequently measured traits

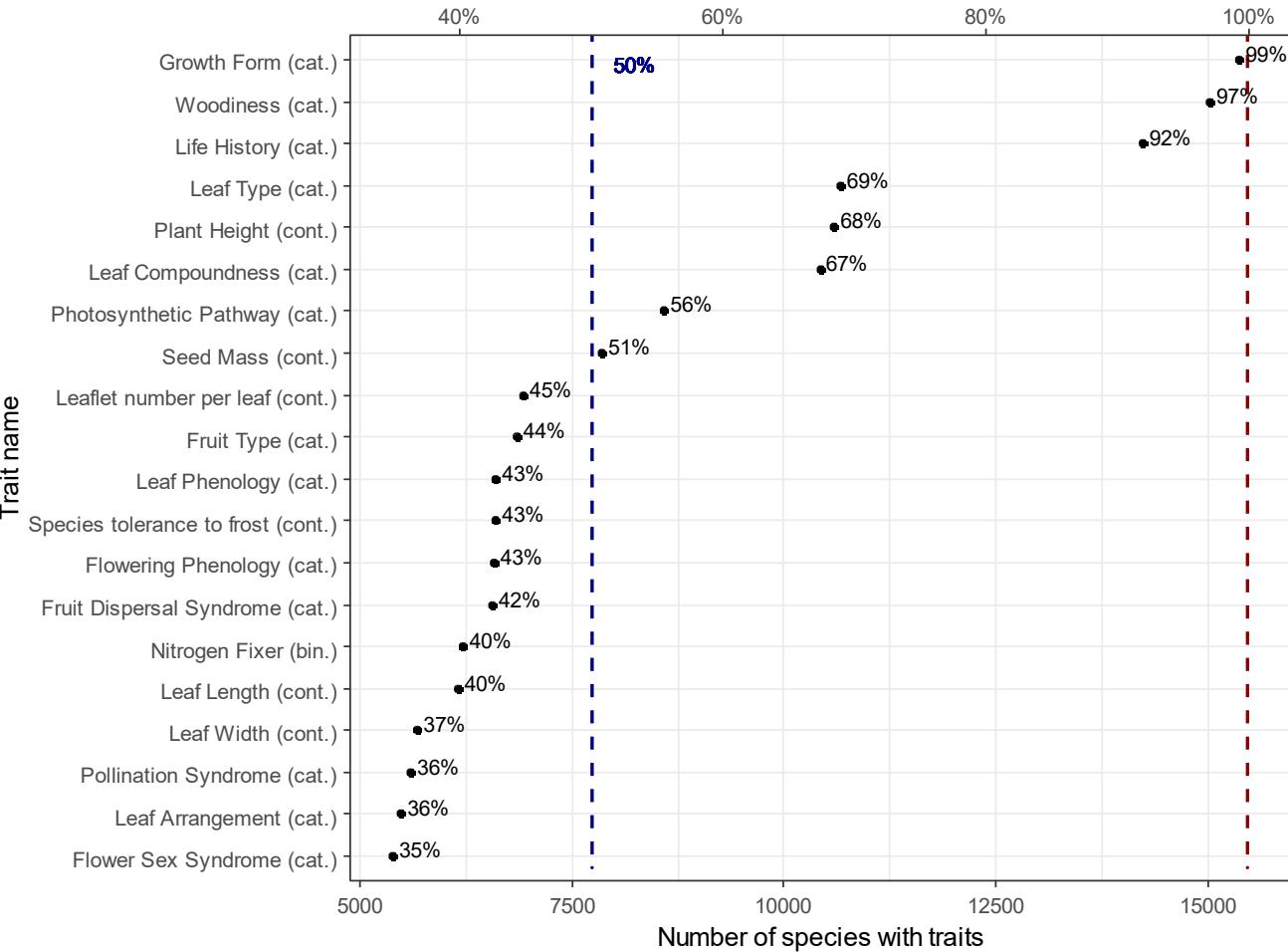
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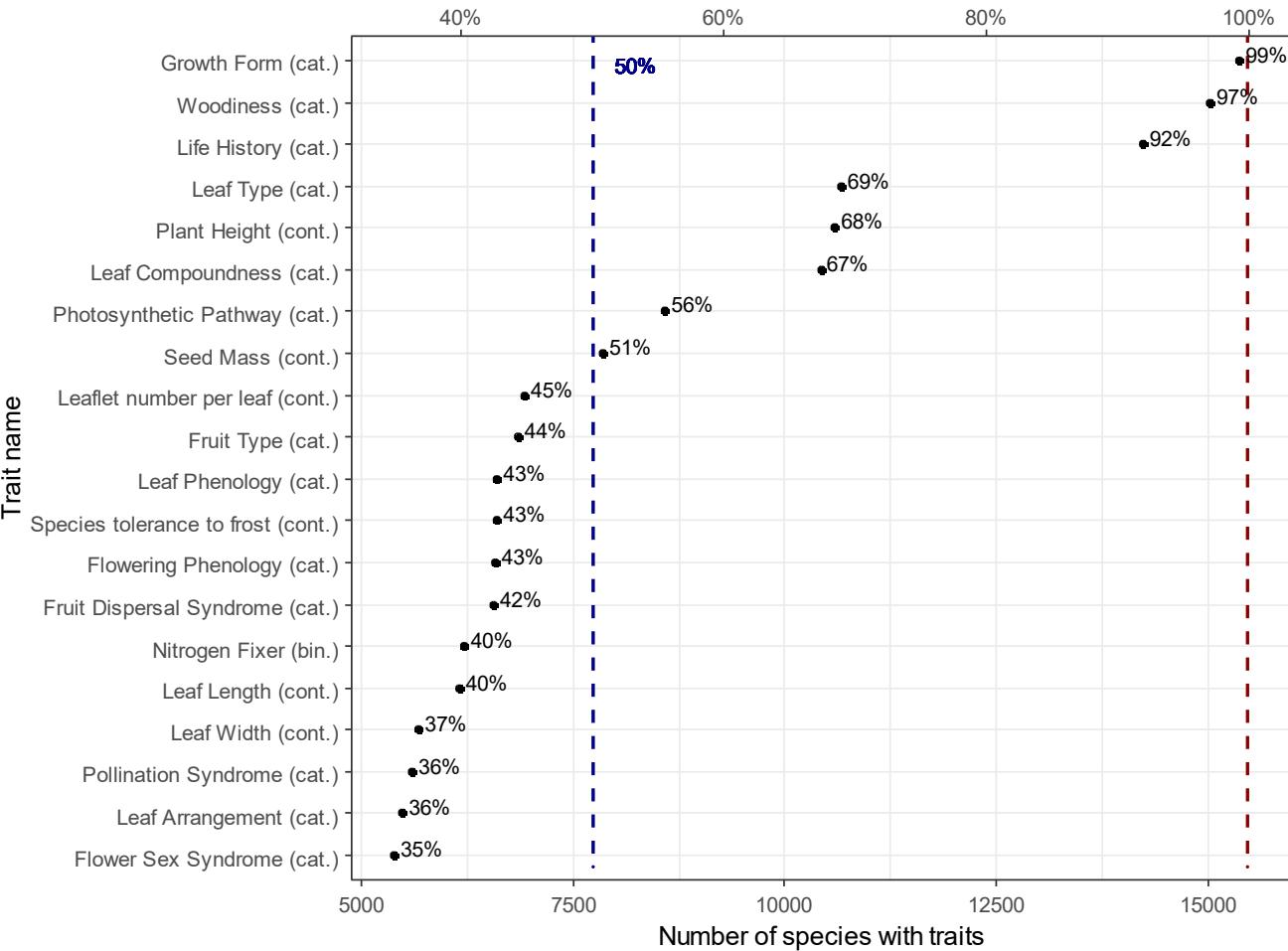
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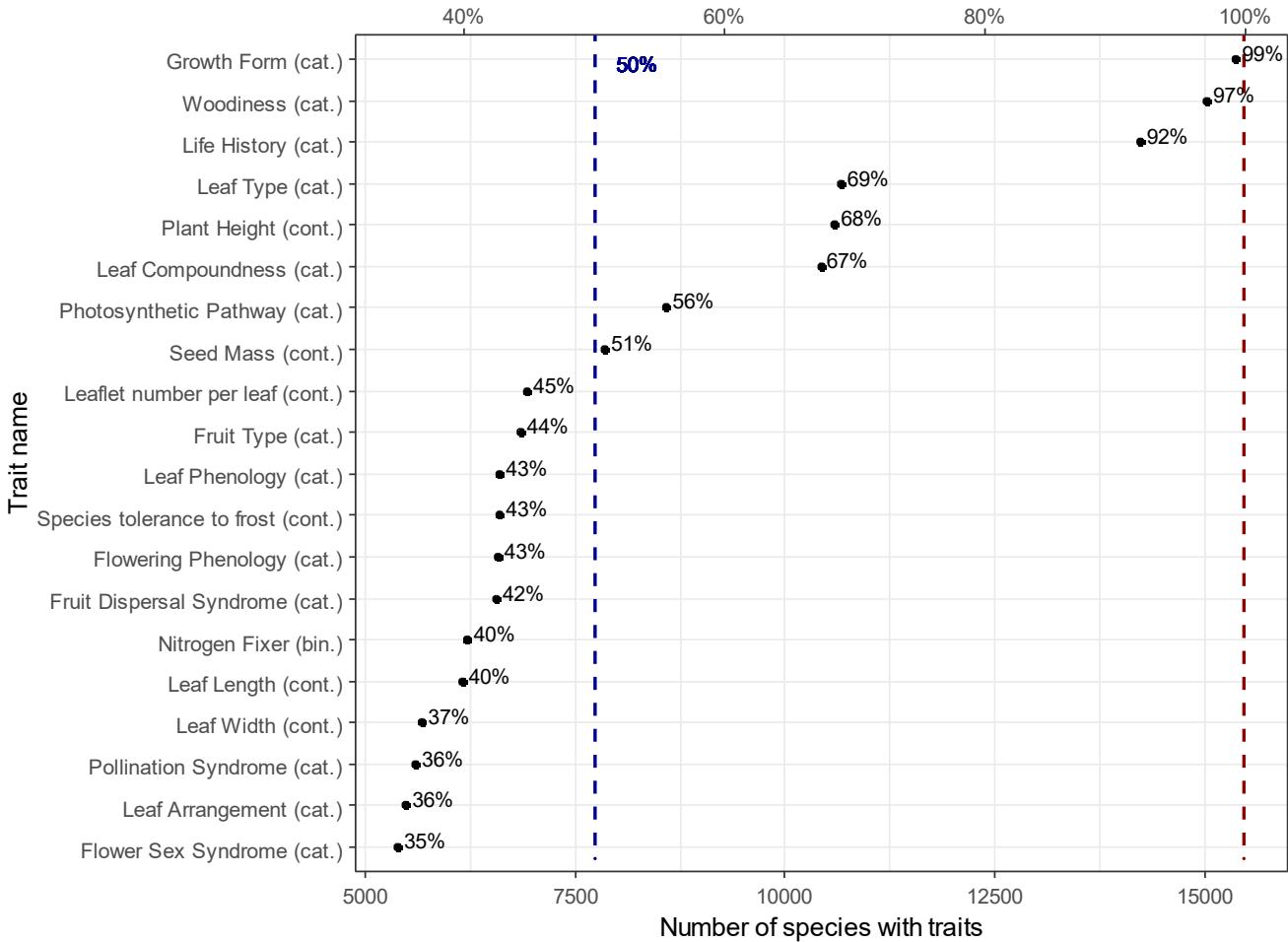


20 most frequently measured traits



20 most measured traits are
mostly categorical

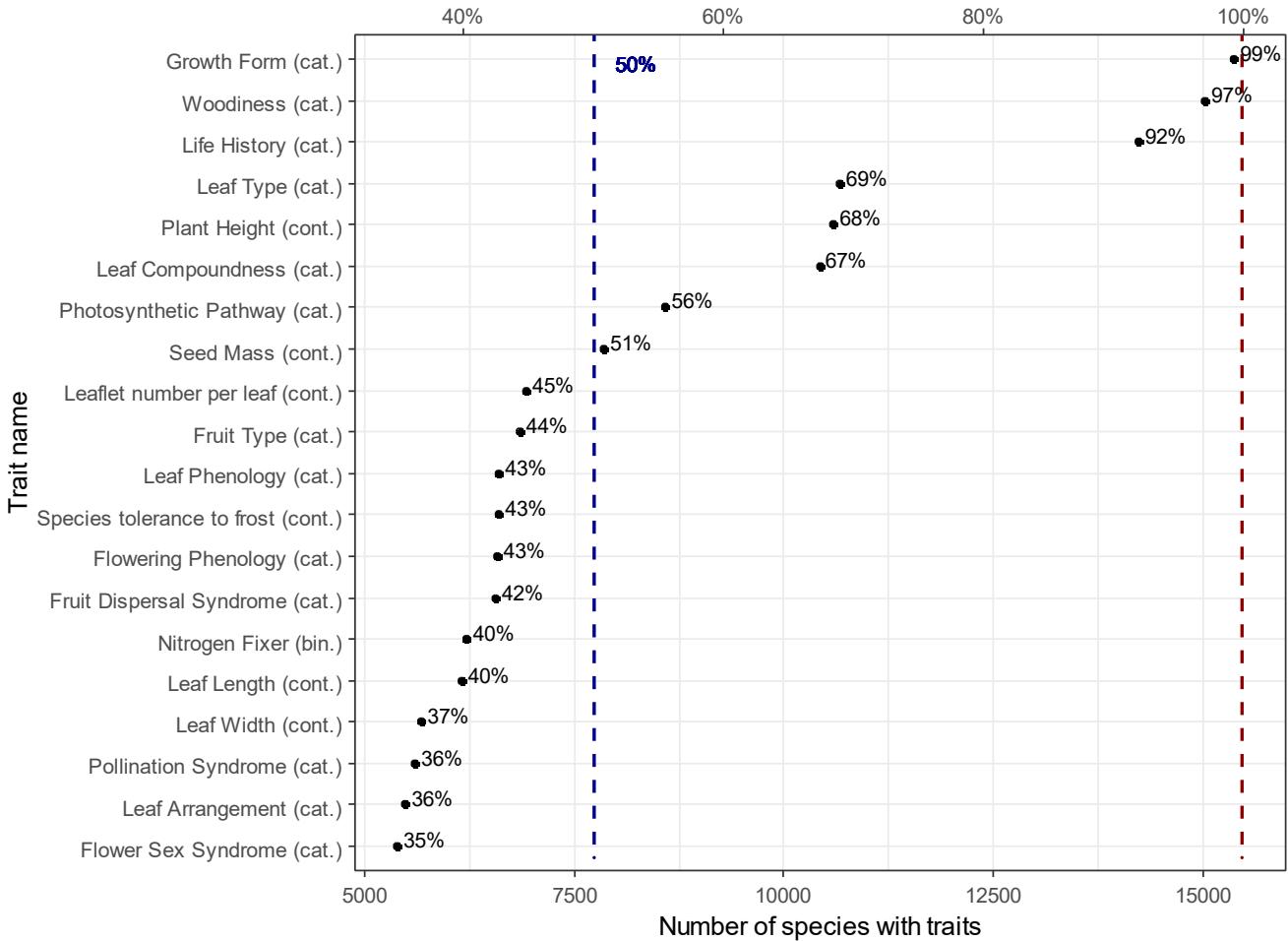
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Most traits measured
for <50% of species

20 most frequently measured traits

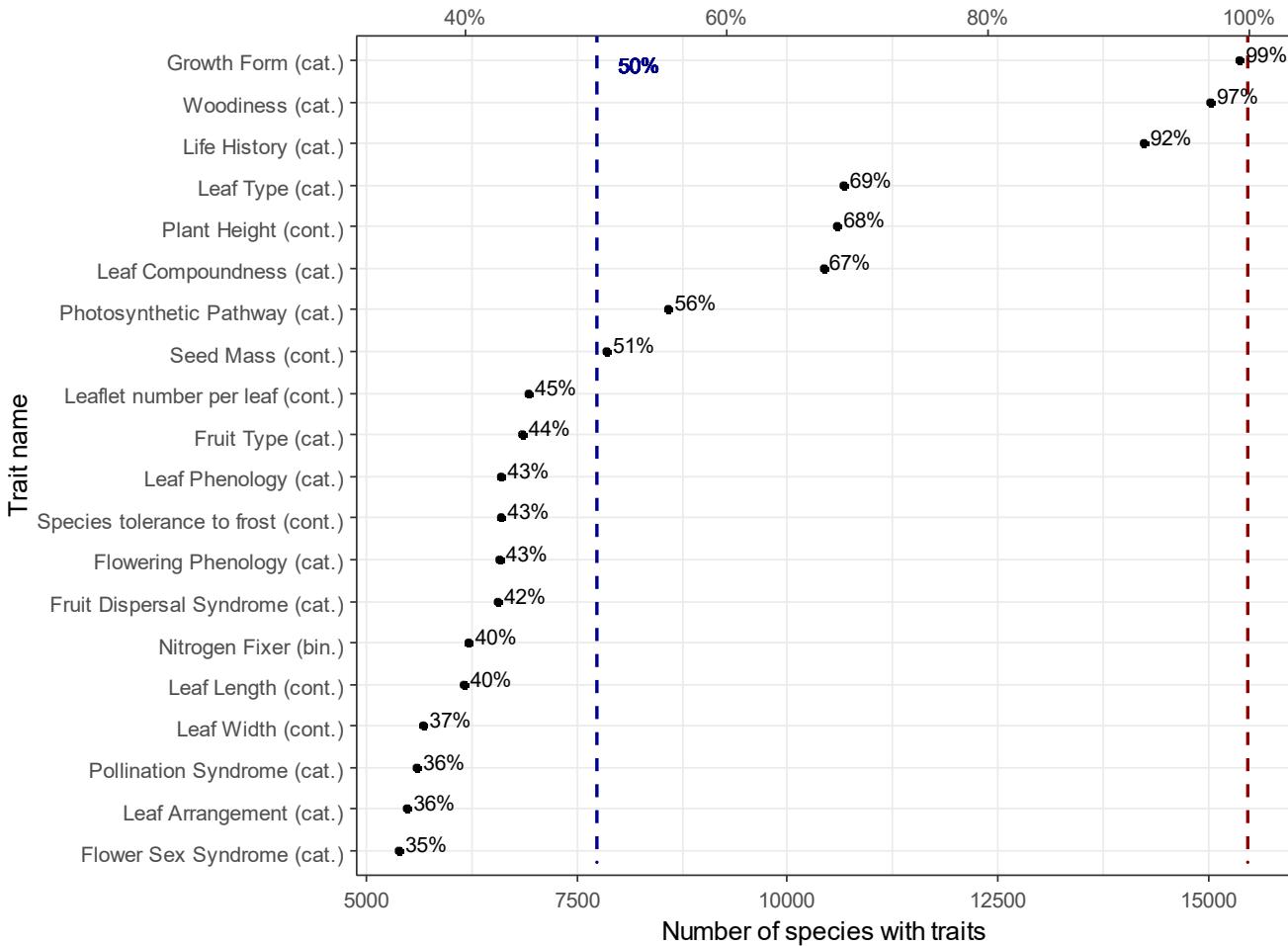


20 most measured traits are
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Most traits measured
for <50% of species

Plant height is the
first continuous trait
Available for ~70% of species

20 most frequently measured traits



20 most measured traits are
mostly categorical

Most traits measured
for <50% of species

Plant height is the
first continuous trait
Available for ~70% of species

Seed mass is the
second continuous trait
Available for ~50% of species

Trait Combinations

Trait Combinations

Species (**16,538**) x Traits (**2,215**) matrix is **big**

Trait Combinations

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Reduce **complexity** → **trait combinations**

Trait Combinations

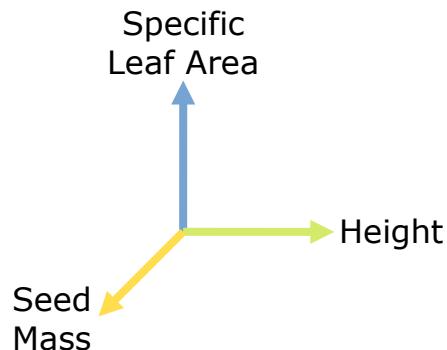
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Leaf-Height-Seed Mass

Westoby et al. 1999

3 traits



Trait Combinations

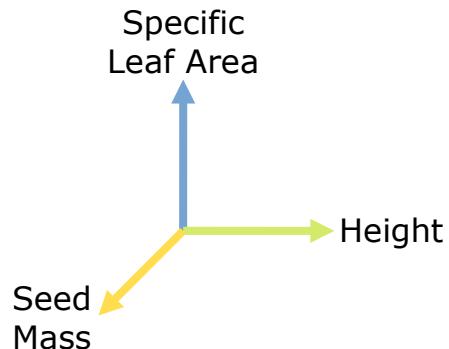
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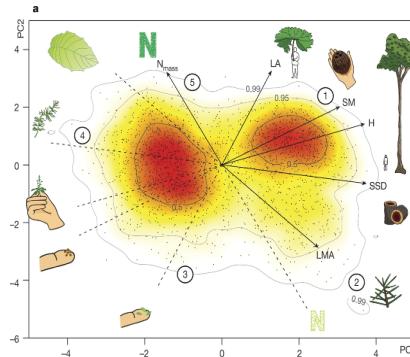
3 traits



Aboveground Traits

Díaz et al. 2016

6 traits



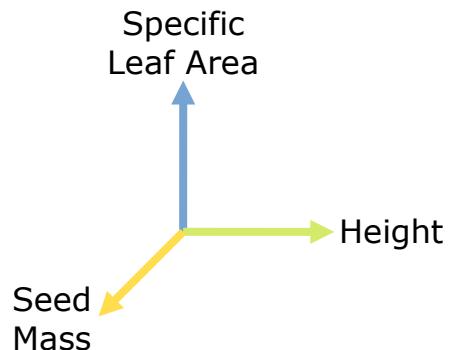
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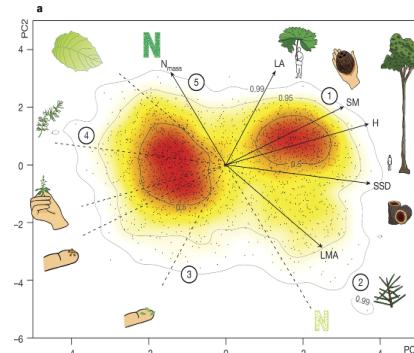
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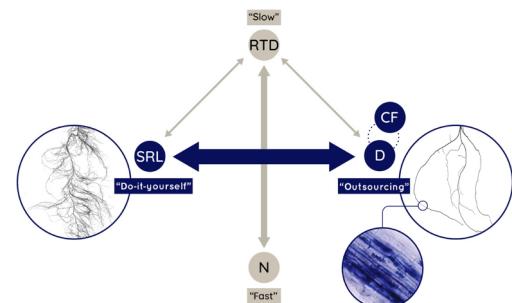
Aboveground Traits

Díaz et al. 2016
6 traits



Root Traits

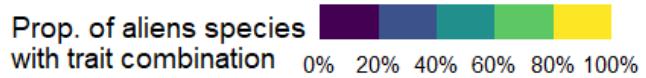
Bergmann et al. 2020
4 traits



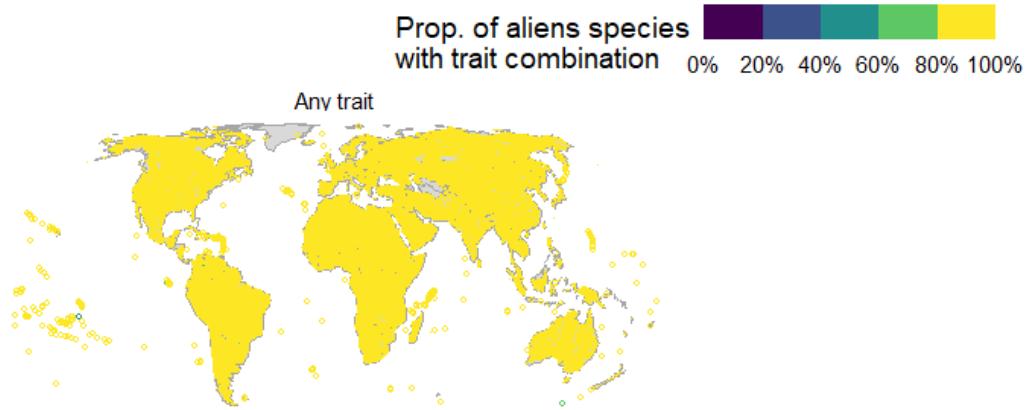


We have global gaps in trait combinations

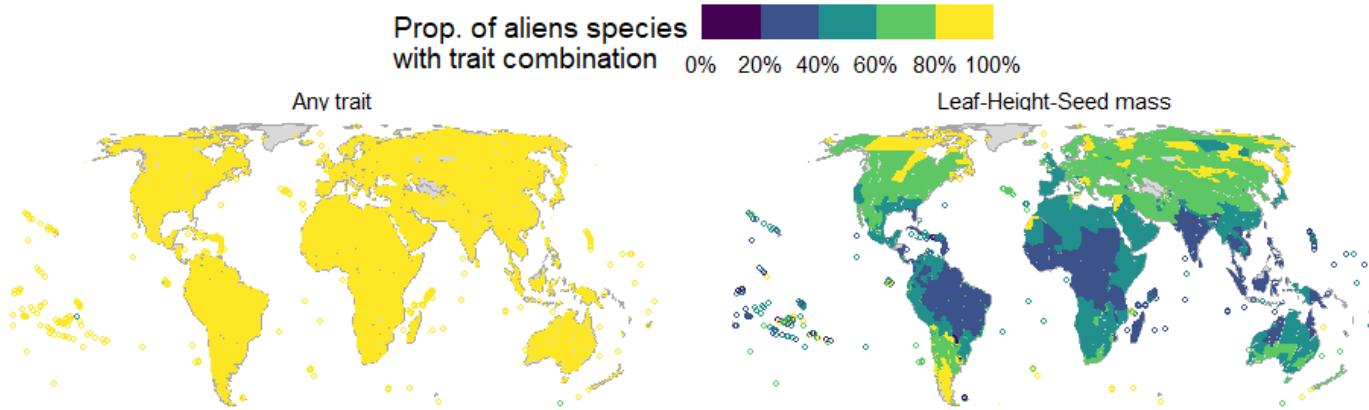
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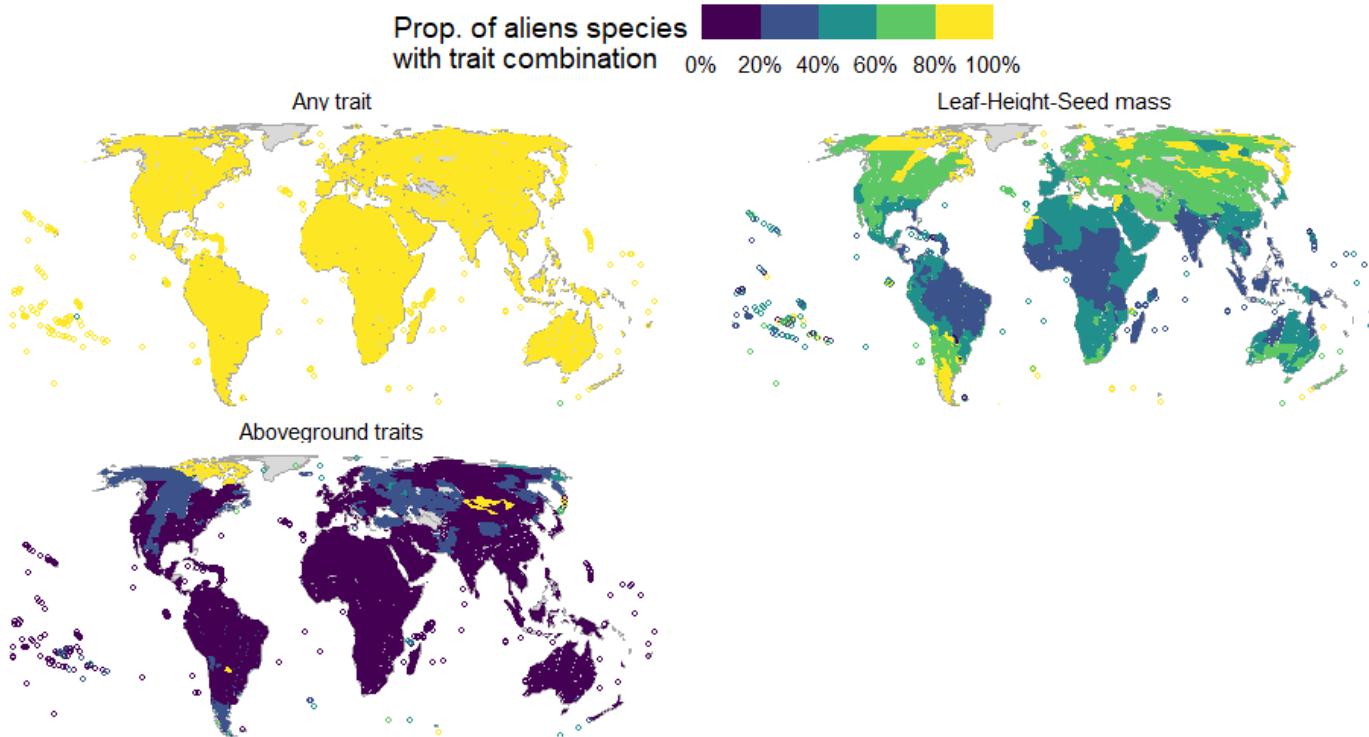
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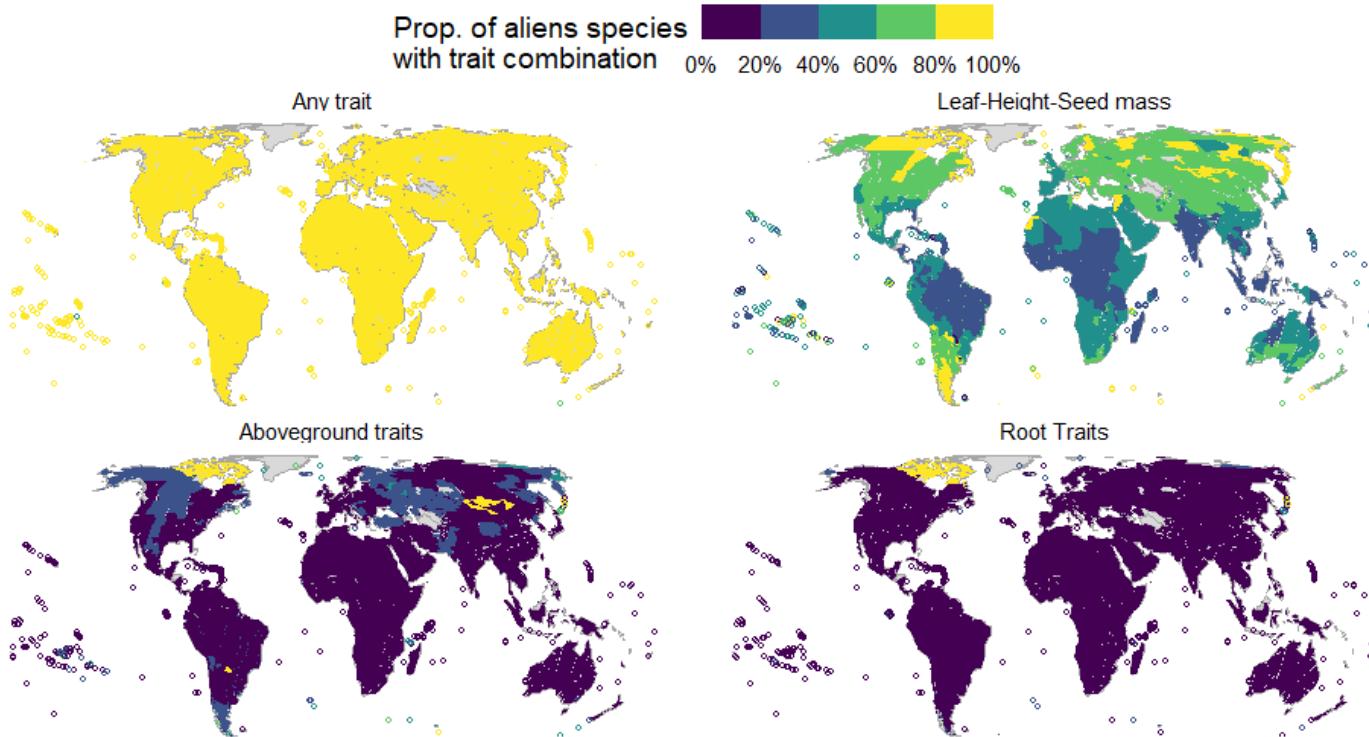
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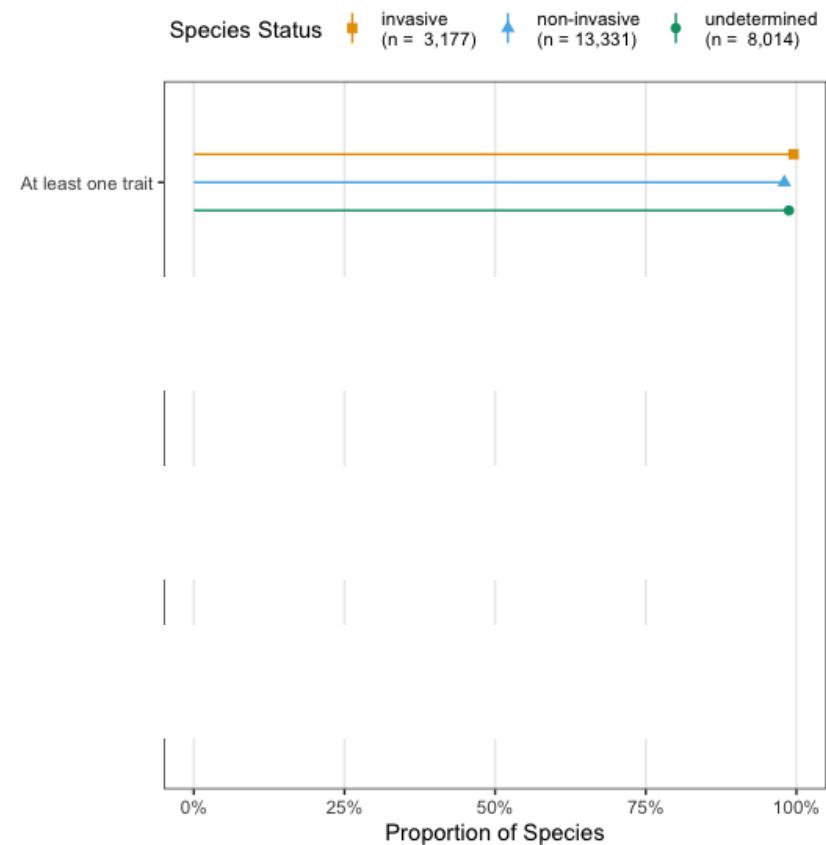




Widespread and Invasive Species are better known

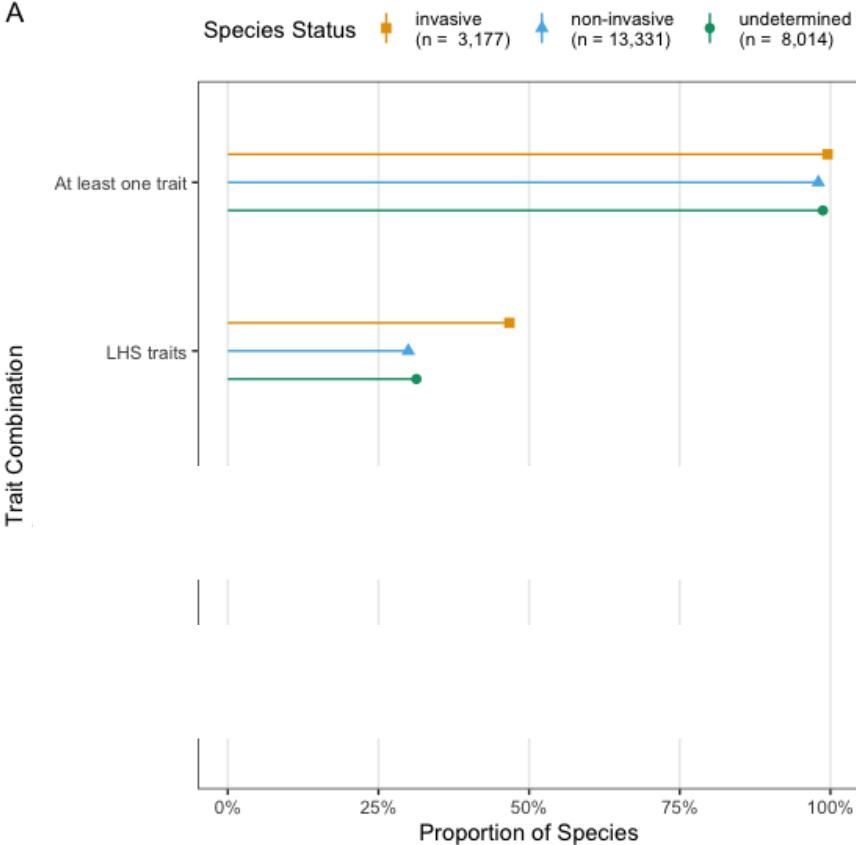
Widespread and Invasive Species are better known

A



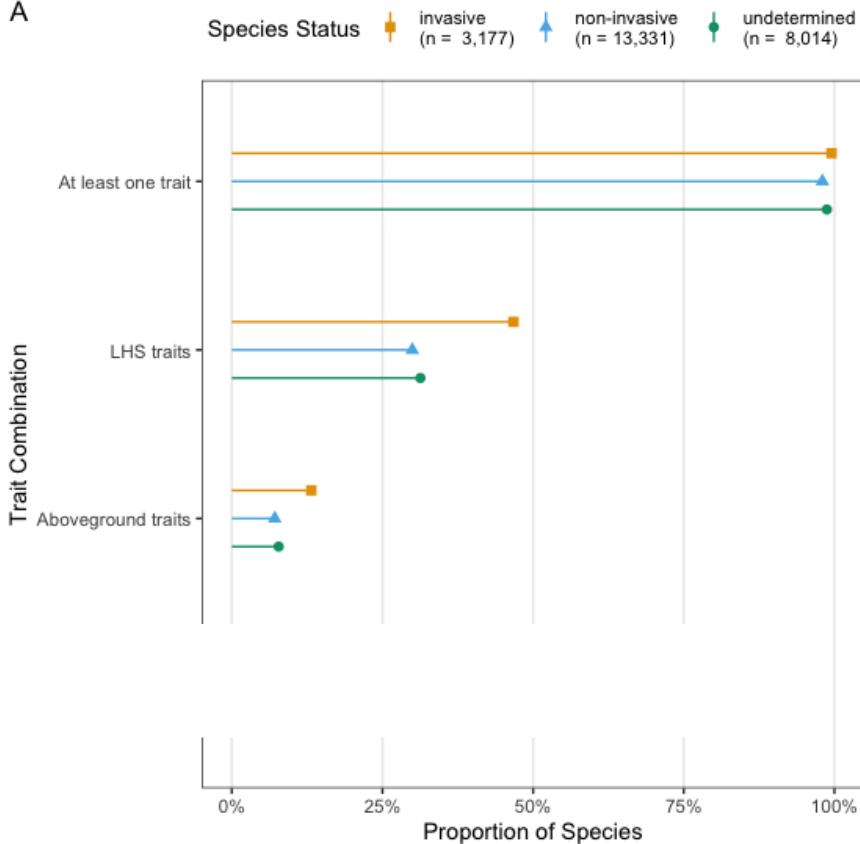
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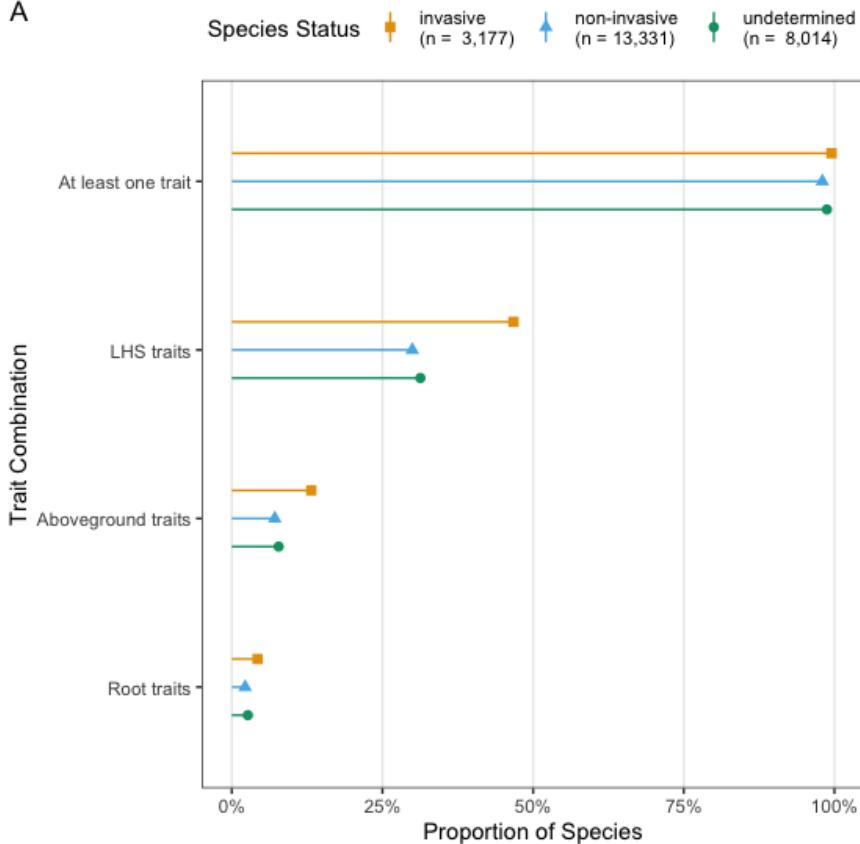
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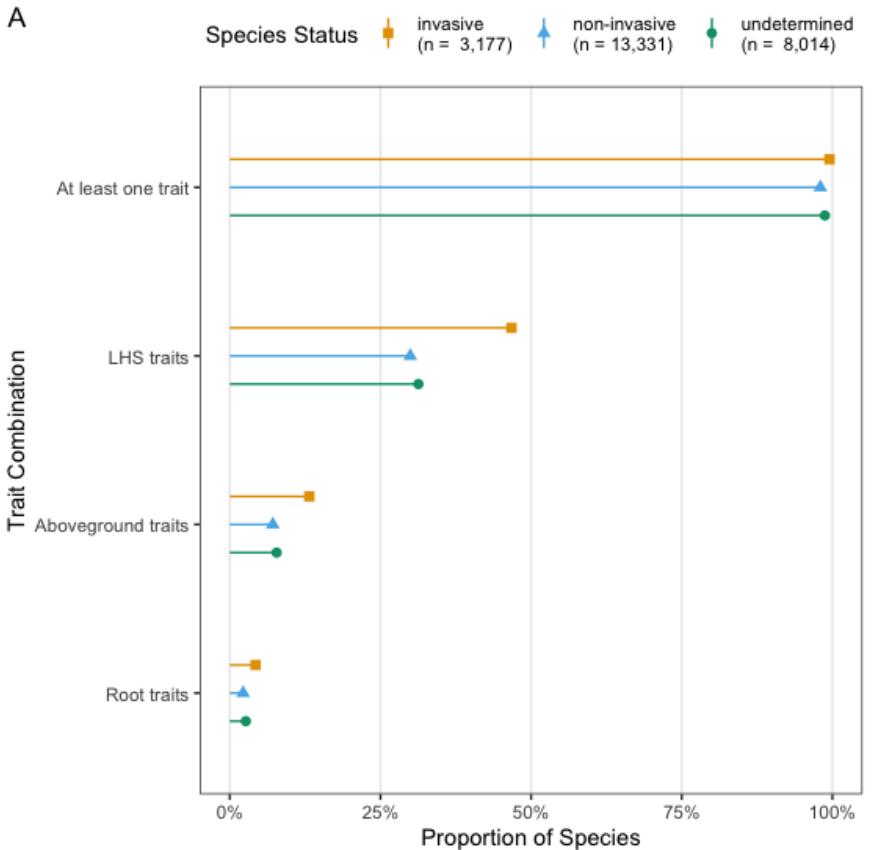
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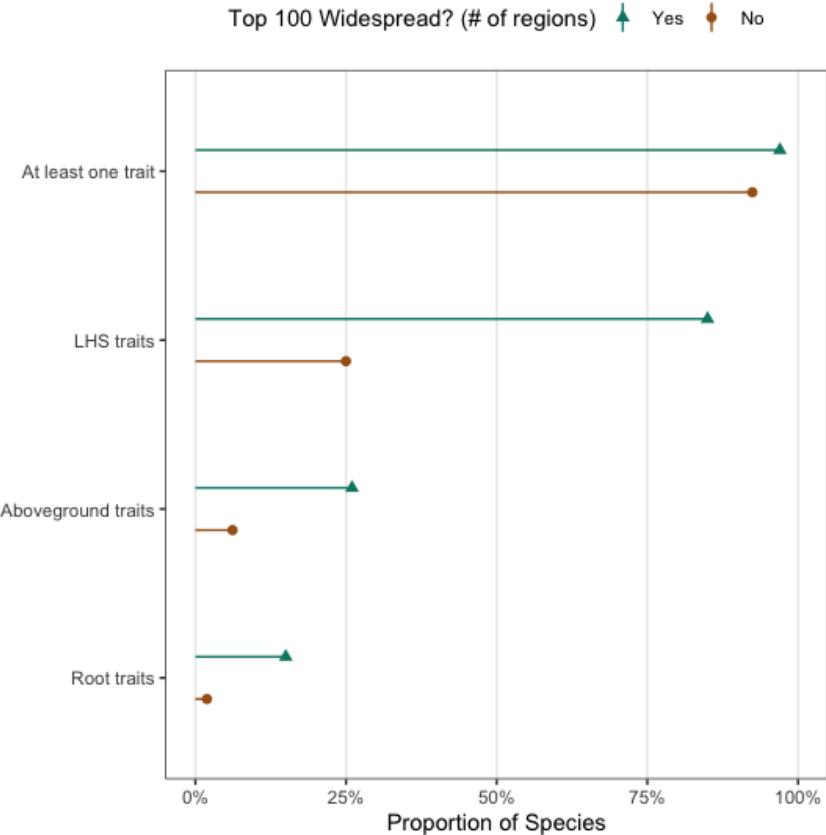


Widespread and Invasive Species are better known

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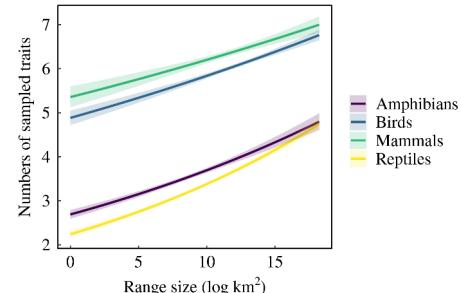
B



Perspectives

Perspectives

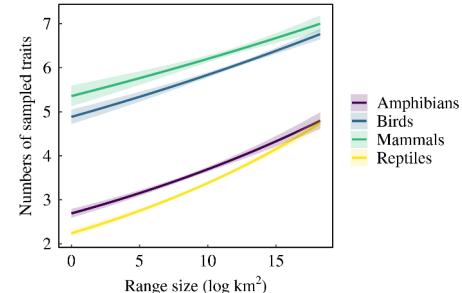
- Identify the **drivers of trait knowledge** in alien species
(range size, country of origin, growth form, invasiveness, etc.)



Etard et al. 2020

Perspectives

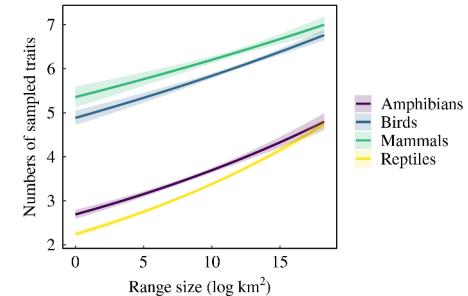
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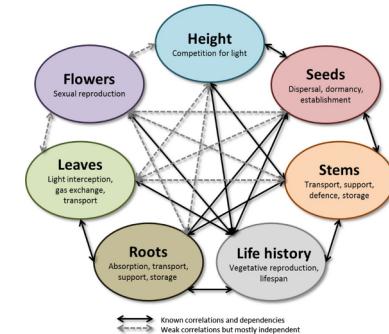
Etard et al. 2020

Perspectives

- Identify the **drivers of trait knowledge** in alien species (range size, country of origin, growth form, invasiveness, etc.)
- Analyze amount of **geolocated information (trait provenance)**
- Prioritize species/regions/traits on which to close the gaps
→ costs, heavily invaded region, easy to “close” region



Etard et al. 2020



Laughlin 2014

Closing the trait gaps?

Closing the trait gaps?

Scientific Literature
(+**Floras**?)

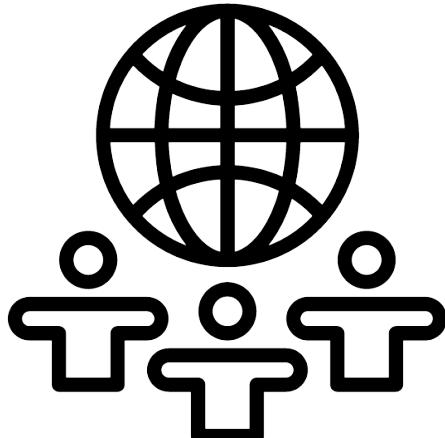


Closing the trait gaps?

Scientific Literature
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Distributed Field
Campaign

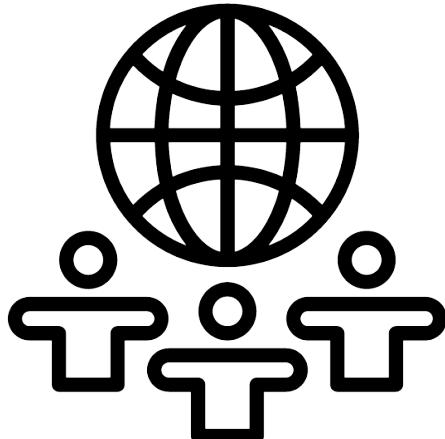


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Call for data contributions

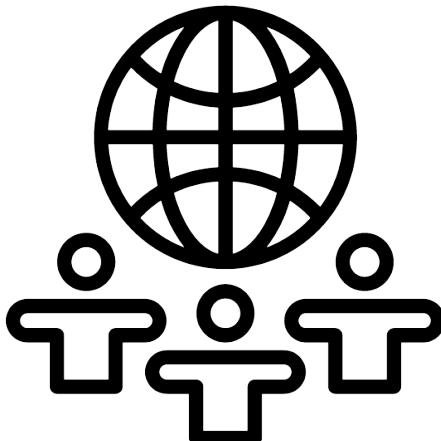


Closing the trait gaps?

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Distributed Field Campaign



Call for data contributions



Recent Examples
LT-Brazil (Mariano et al. 2021)
FunAndes (Baez et al. 2022)

Closing the trait gaps?

Scientific Literature
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Distributed Field Campaign



Call for data contributions



Recent Examples
LT-Brazil (Mariano et al. 2021)
FunAndes (Baez et al. 2022)

We need a **coordinated global effort** to close the trait gaps

matthias.grenie@idiv.de



[@LeNematode](https://twitter.com/LeNematode)



<https://rekyt.github.io/>

Thank you!