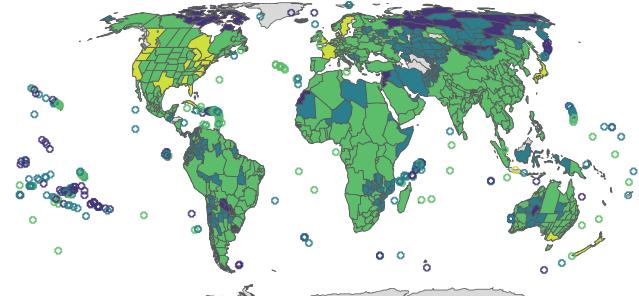




German Centre for Integrative Biodiversity Research (iDiv)  
Halle-Jena-Leipzig

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**



Neobiota 2022 – Tuesday 13<sup>th</sup> of September 2022

[matthias.grenie@idiv.de](mailto:matthias.grenie@idiv.de)



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



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

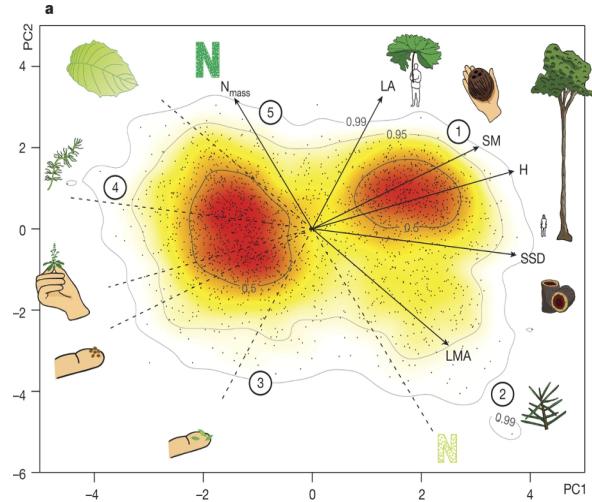
**GloNAF**  
Global Naturalized Alien Flora

iDiv is a research centre of the  
**DFG** Deutsche  
Forschungsgemeinschaft

# **Functional Invasion Community Ecology?**

# Functional Invasion Community Ecology?

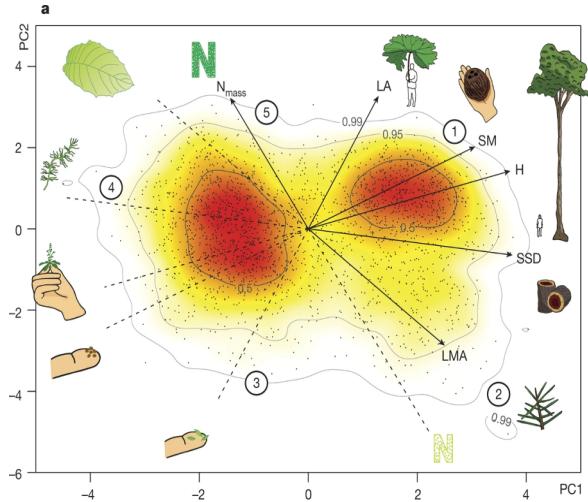
Functional traits let us **gain insight**



Díaz et al. 2016

# Functional Invasion Community Ecology?

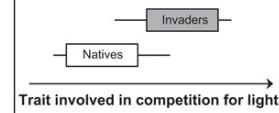
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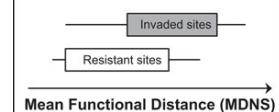
Díaz et al. 2016

**Community Ecology** focuses on **multiple species** together

Q1: Which species are more invasive?

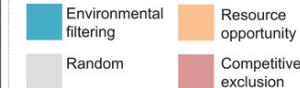


Q2: Which communities are resistant to invasion?



Q3: Which processes drive coexistence between invaders and natives?

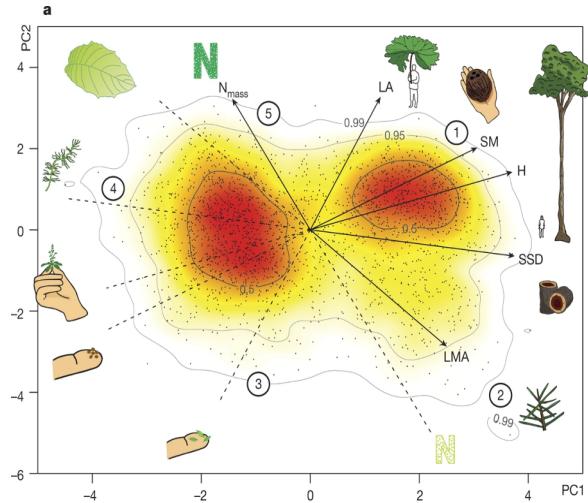
Proportion of sites



Gallien & Carboni 2016

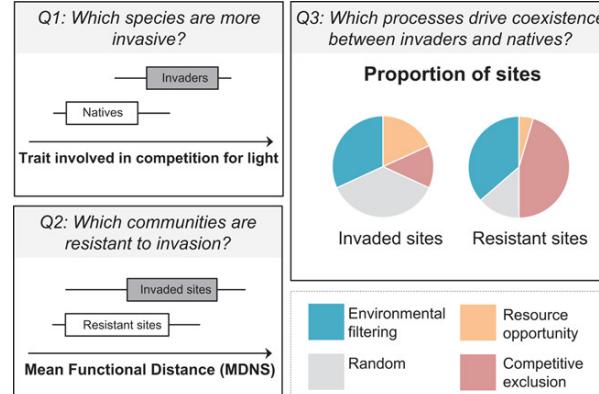
# Functional Invasion Community Ecology?

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**Community Ecology** focuses on **multiple species** together



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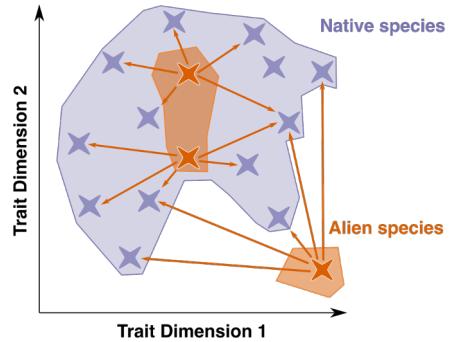
→ Study **community assembly processes** of alien species using functional traits

# **The problem...**

# The problem...

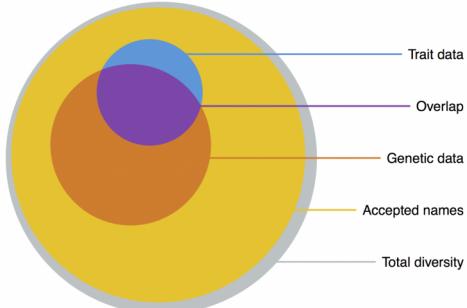
Wanted to study the “**Biotic Resistance Hypothesis**” globally in the **Tropics** with a **functional lens**

Functional Position of Aliens



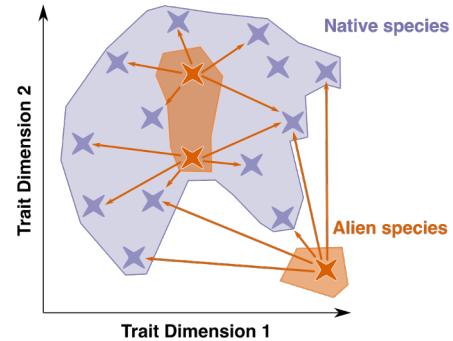
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Cornwell et al. 2019

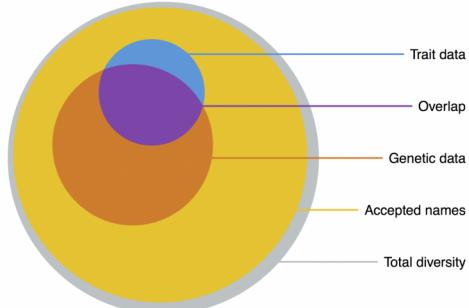
## Functional Position of Aliens



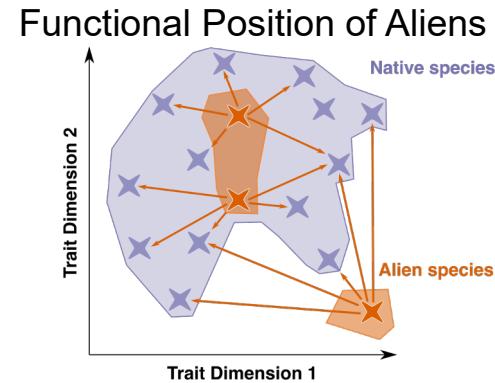
**Huge gaps** in trait data for alien species

# 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

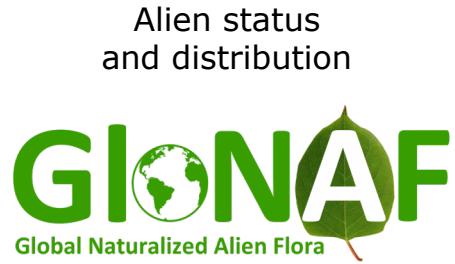
Alien status  
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(Open) Trait Data



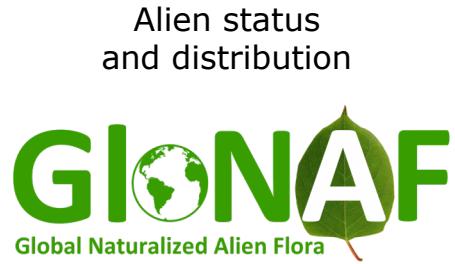
# Merging Alien Plant Species Lists and Global Traits



(Open) Trait Data



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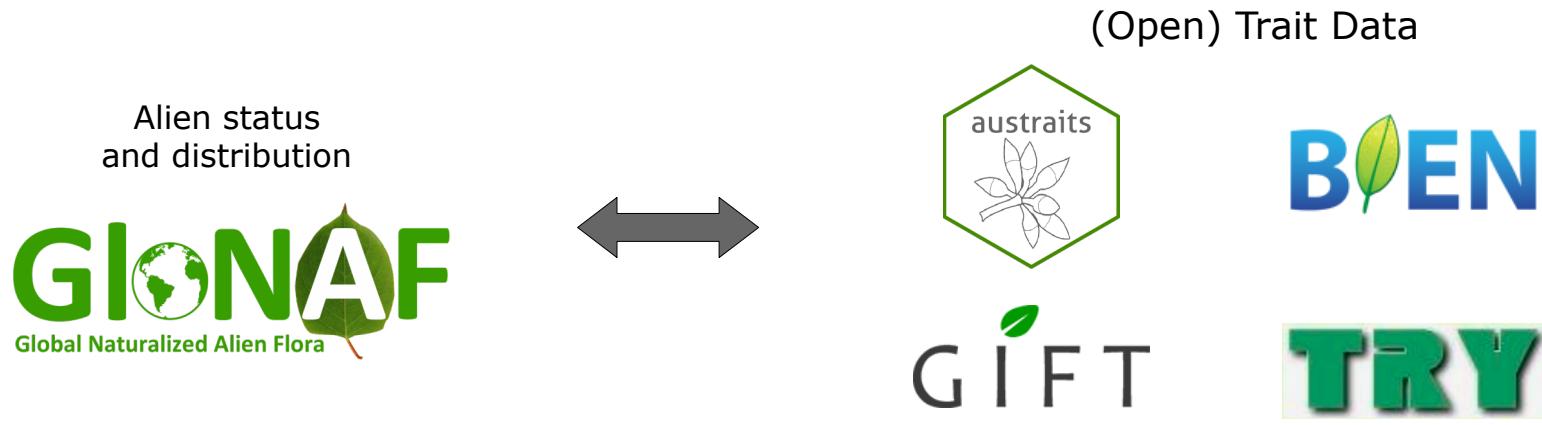


(Open) Trait Data



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

# Merging Alien Plant Species Lists and Global Traits



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

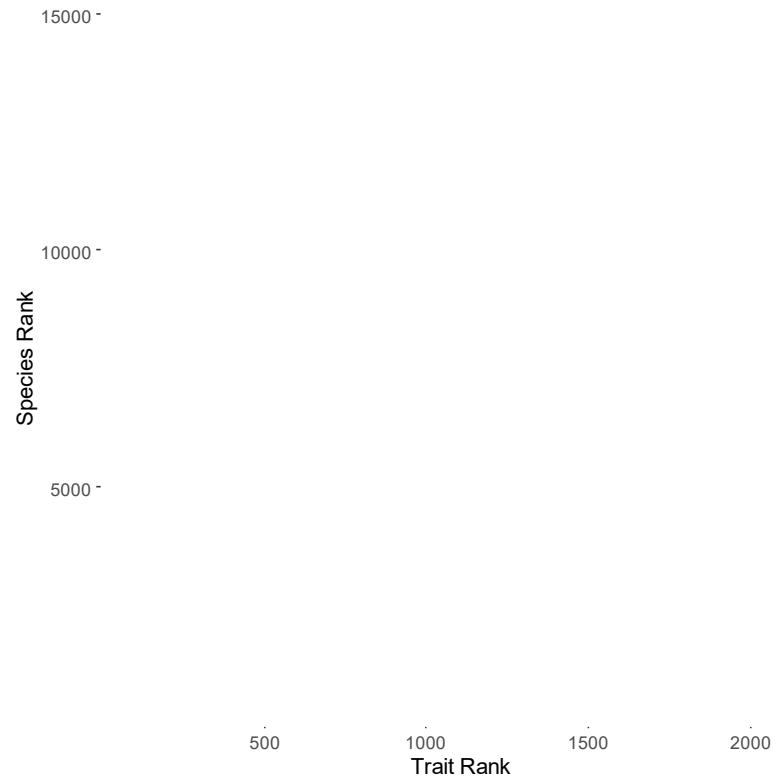
**16,538** species from GloNAF  
→ **15,490** species with **at least one trait (consolidated data)**

# Global Trait Matrix

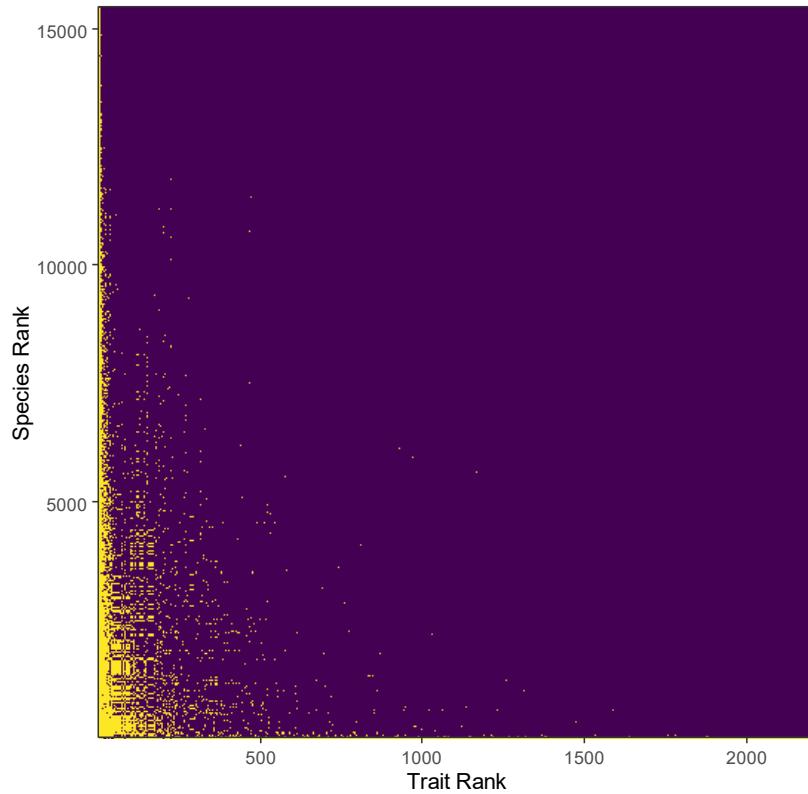
# Global Trait Matrix

500      1000      1500      2000  
Trait Rank

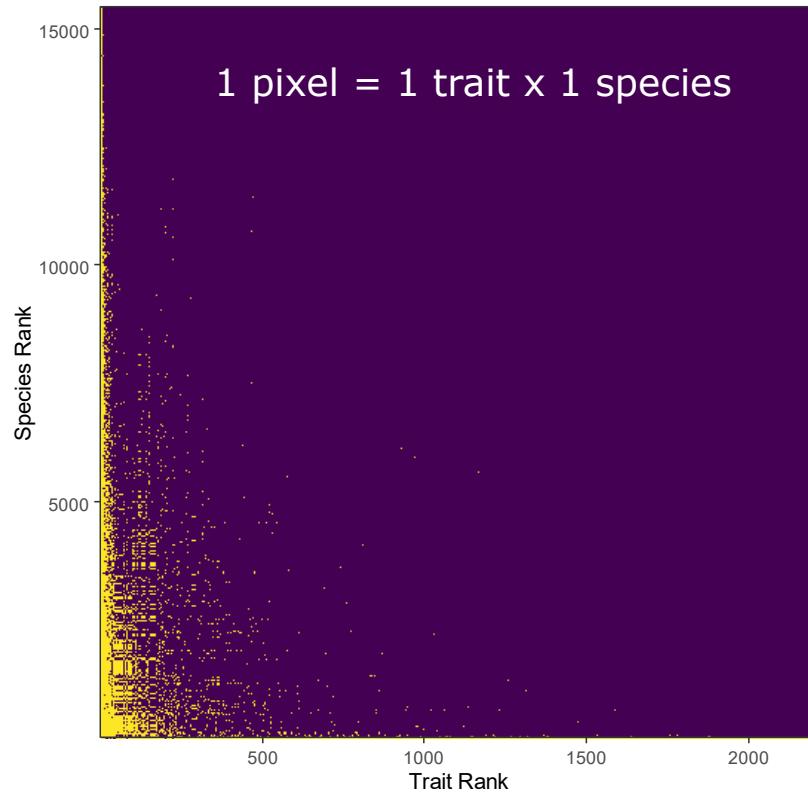
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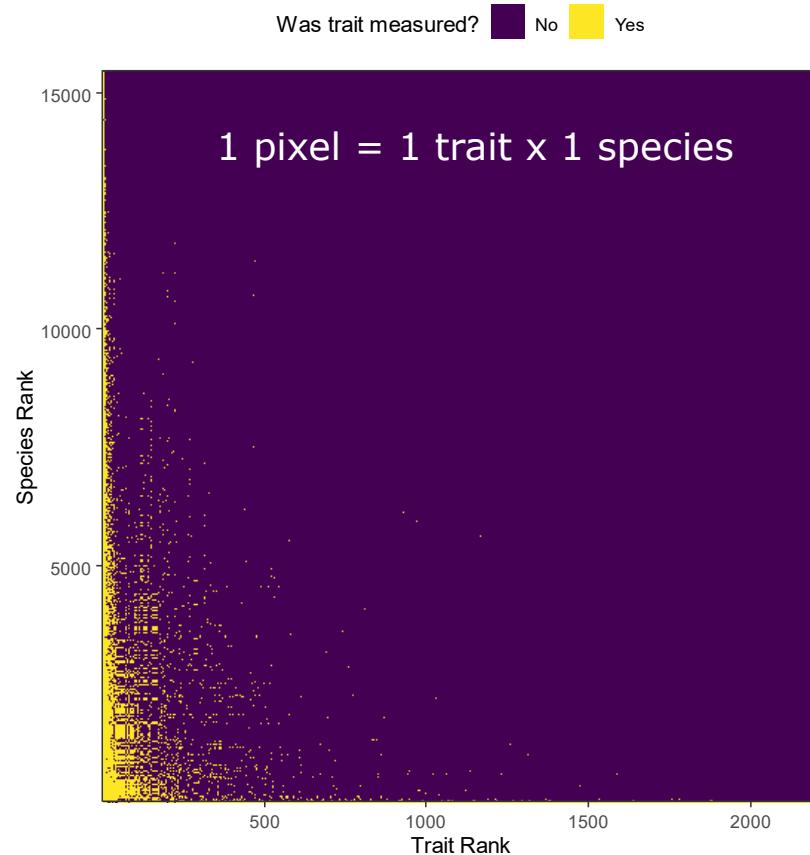
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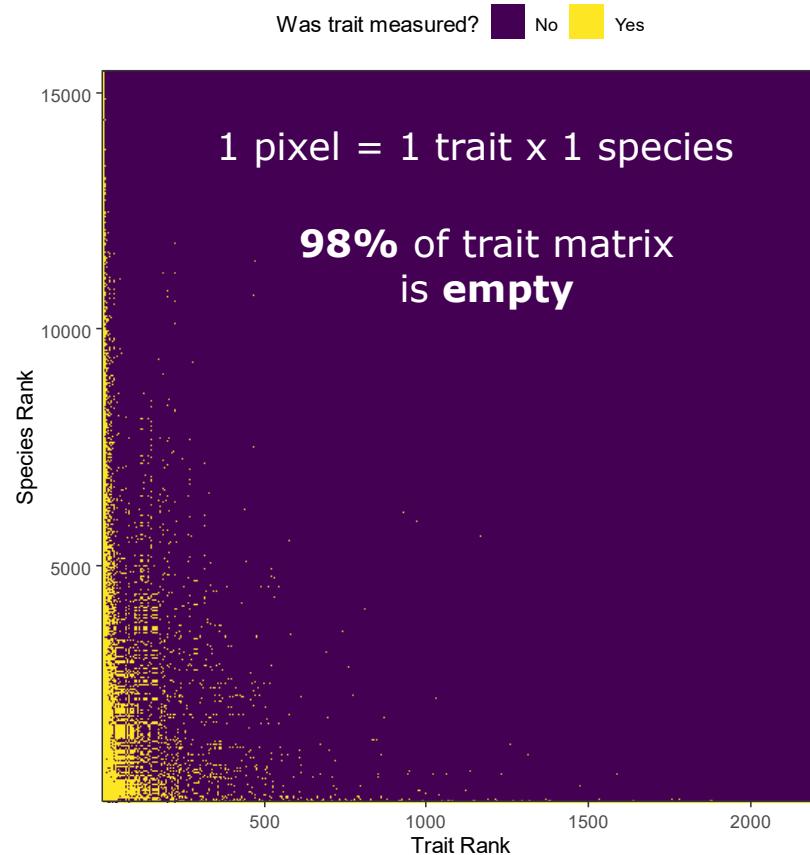
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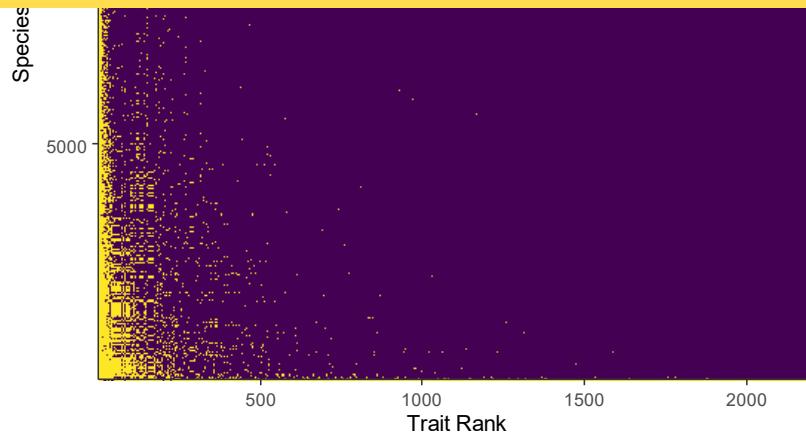


# Global Trait Matrix

Was trait measured? No Yes



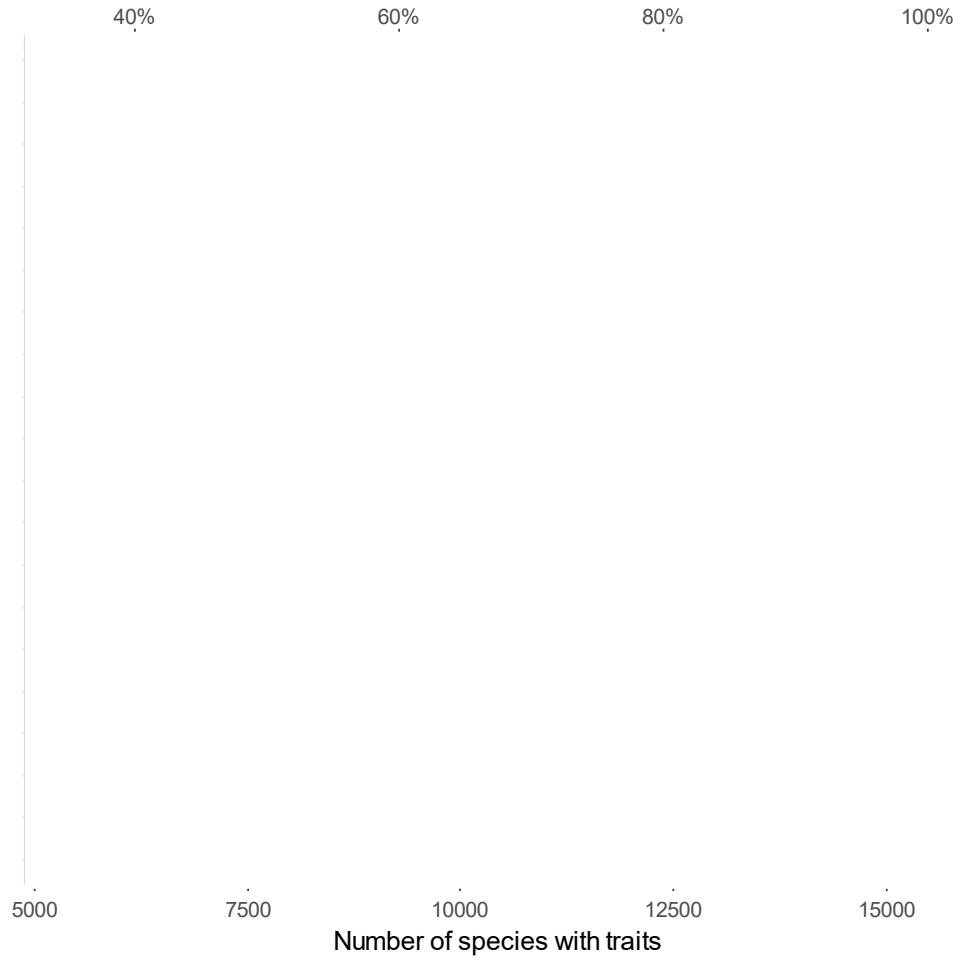
We are lacking much of alien plant species traits



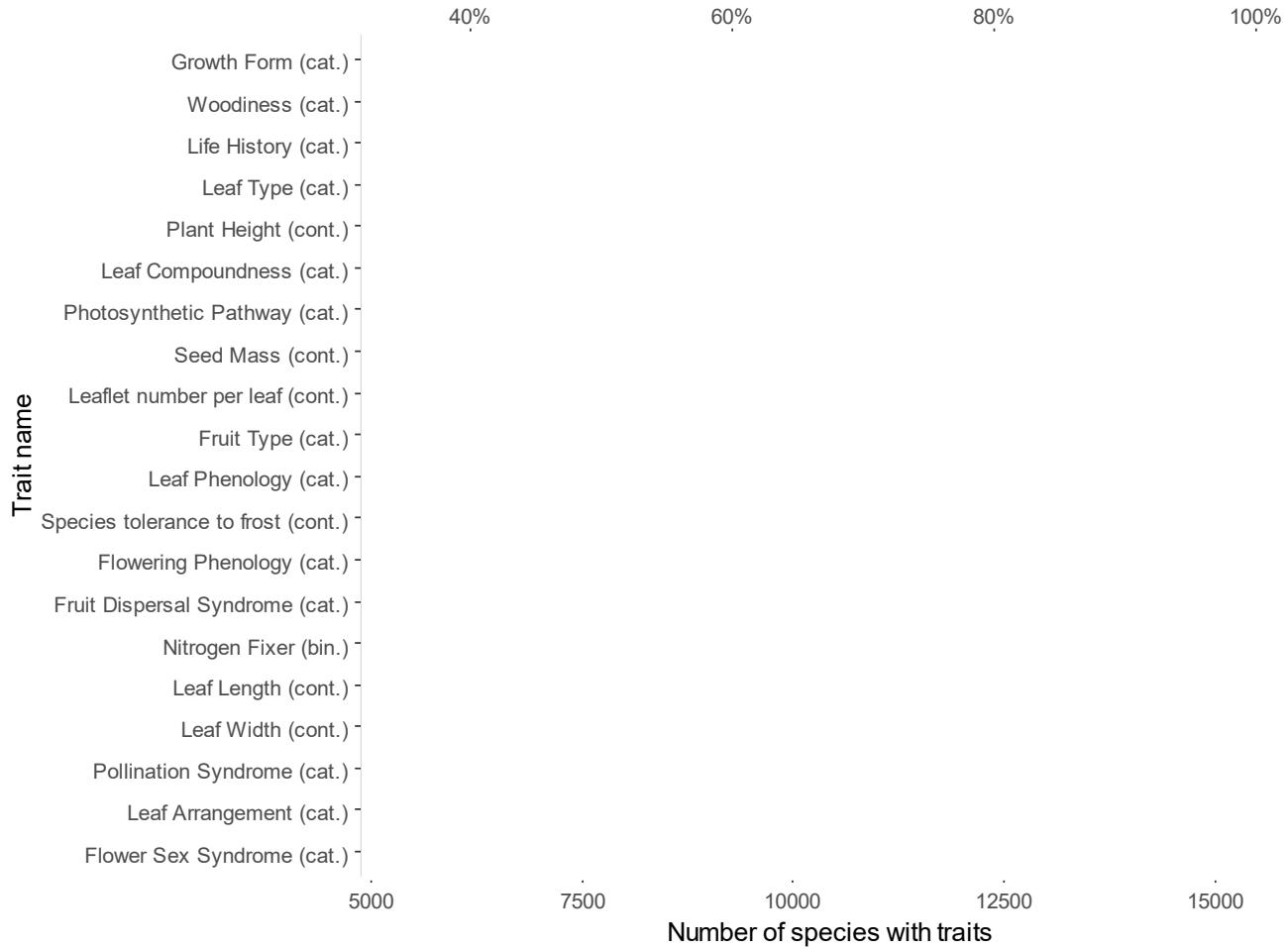


## 20 most frequently measured traits

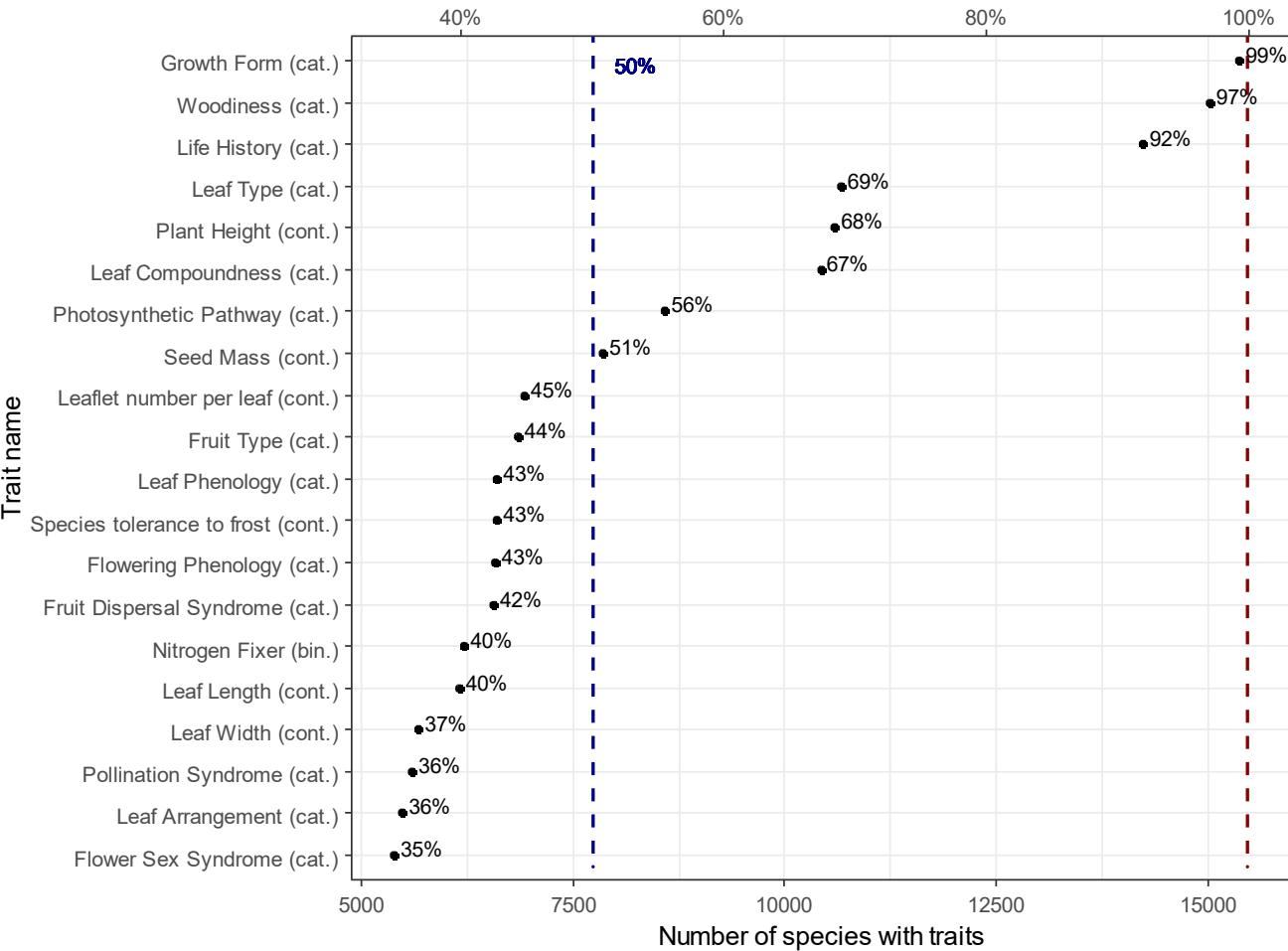
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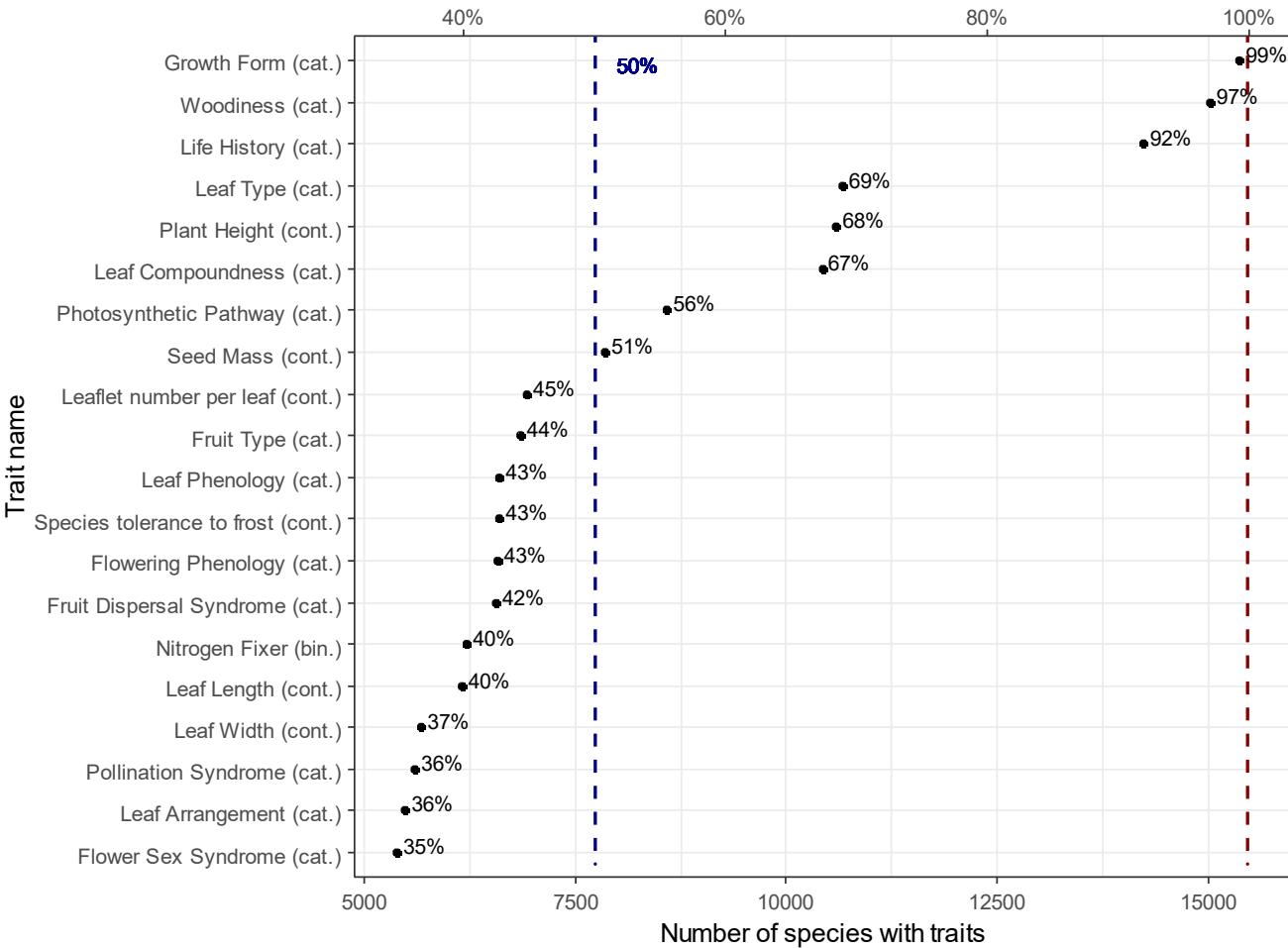
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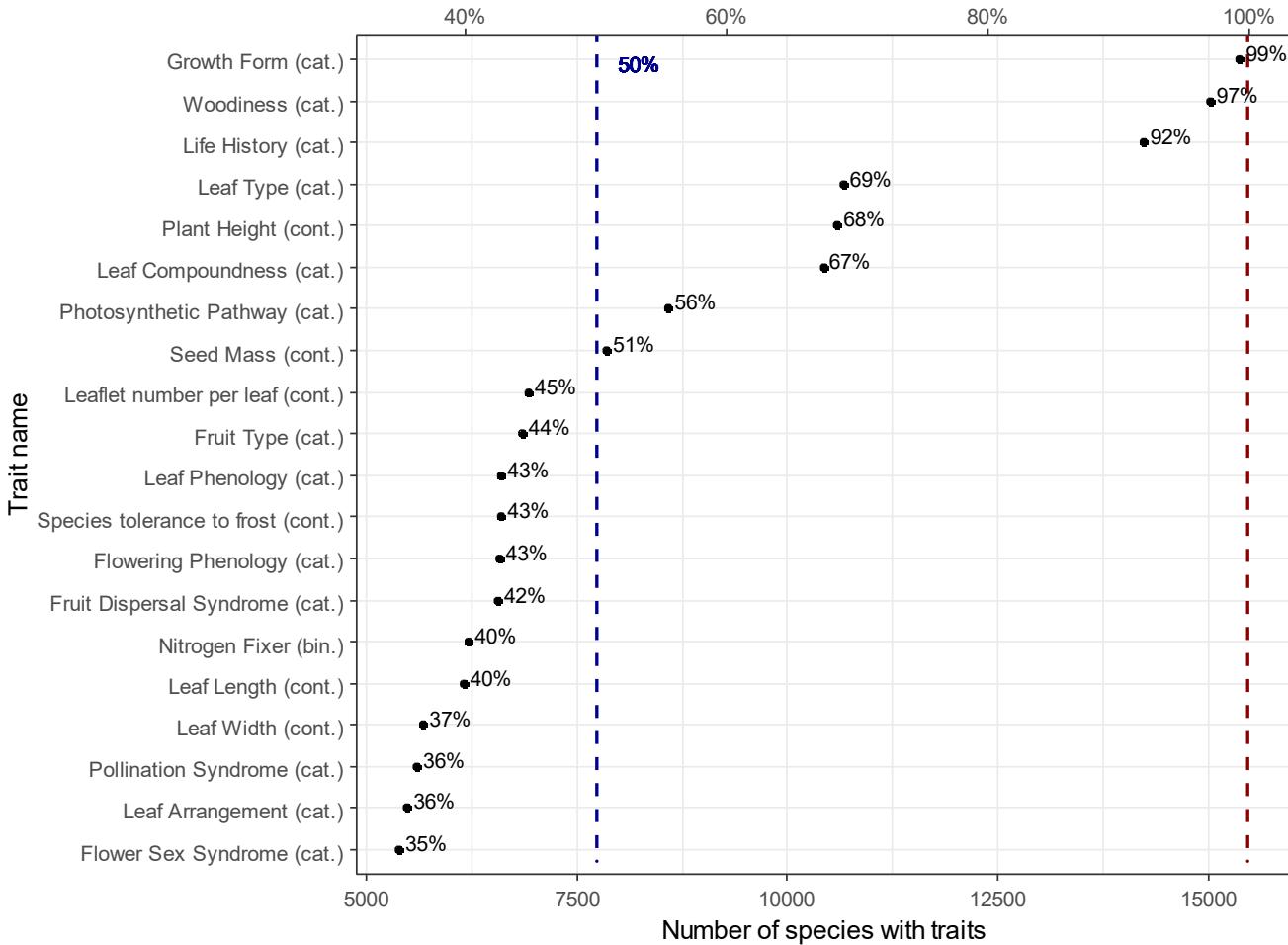


## 20 most frequently measured traits



20 most measured traits are  
**mostly categorical**

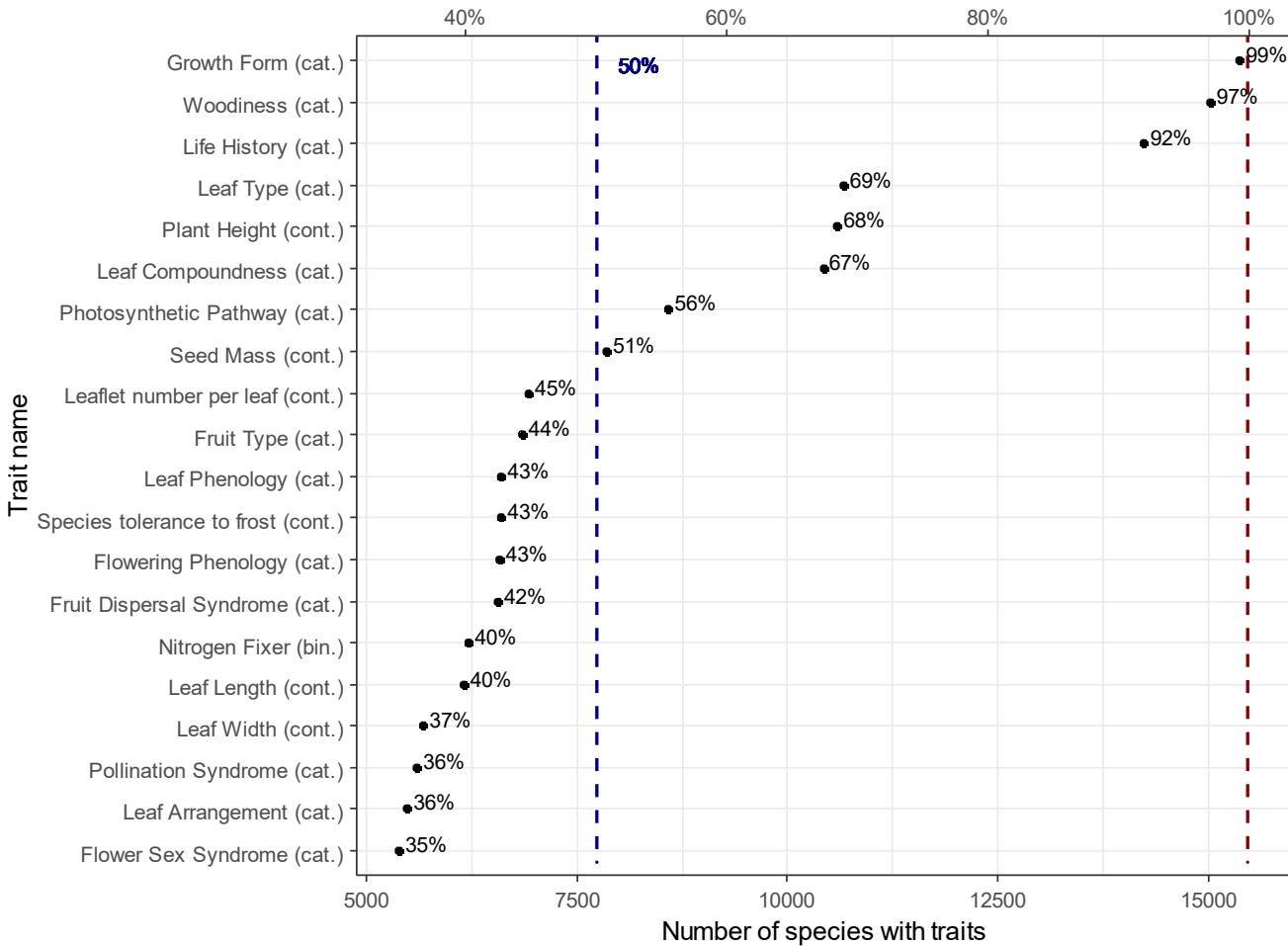
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Most traits measured  
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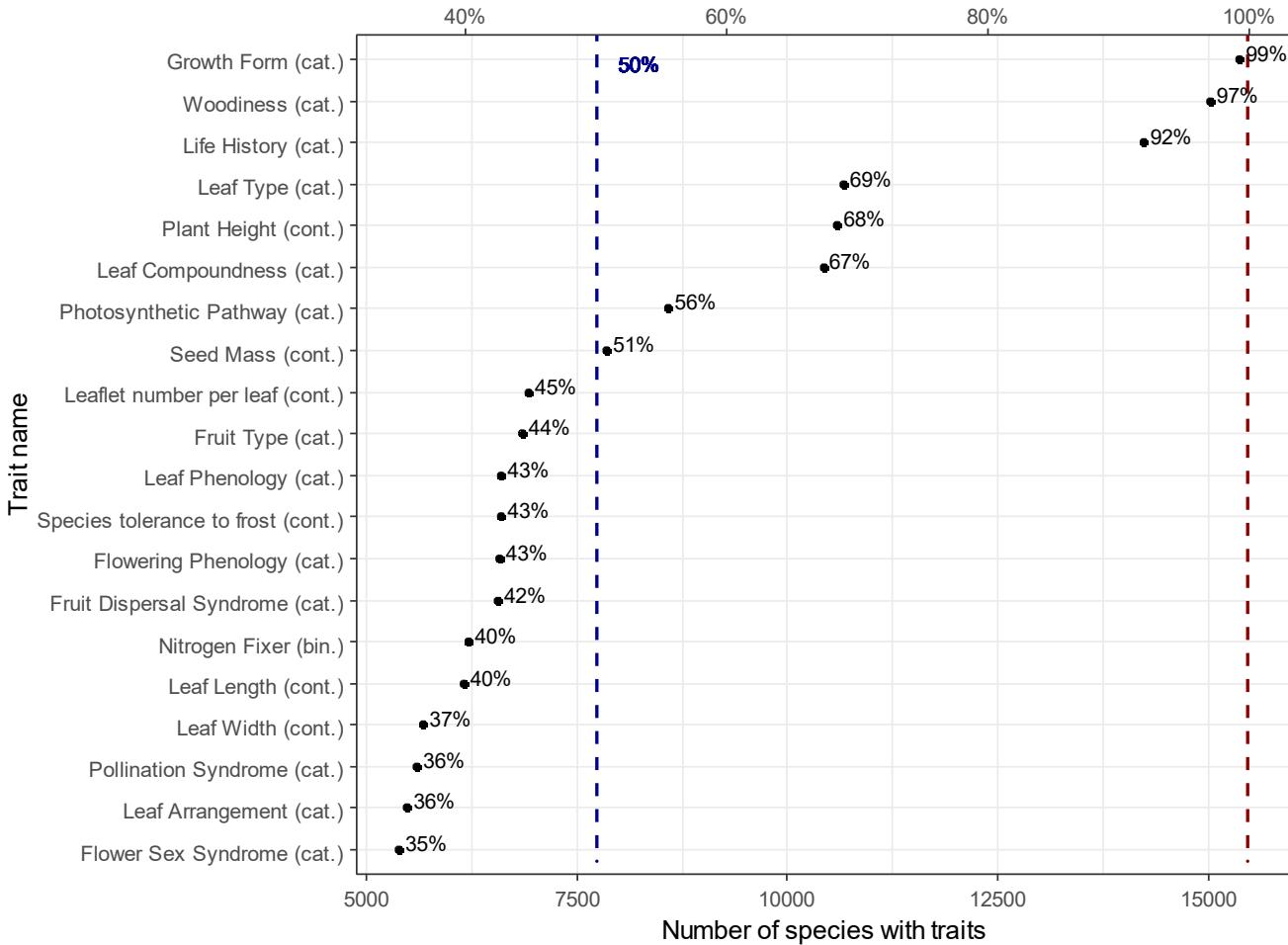


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Available for ~70% of species

## 20 most frequently measured traits



20 most measured traits are  
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Most traits measured  
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**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

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

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

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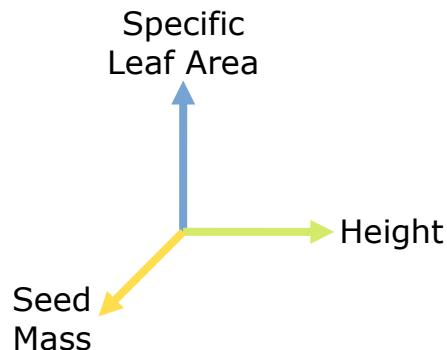
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## Leaf-Height-Seed Mass

Westoby et al. 1999

3 traits



# Trait Combinations

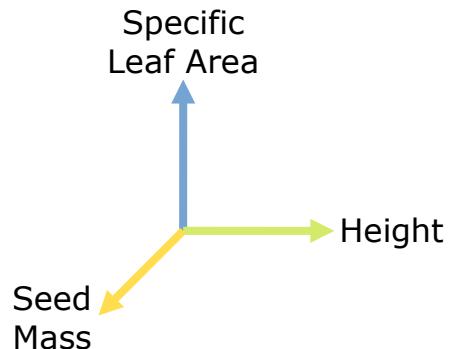
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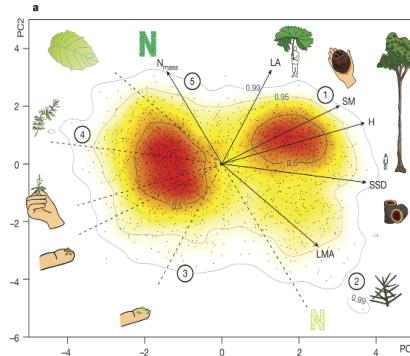
3 traits



## Aboveground Traits

Díaz et al. 2016

6 traits



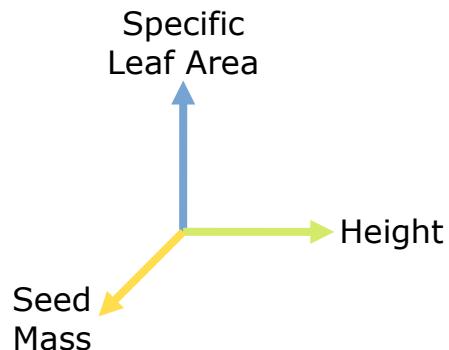
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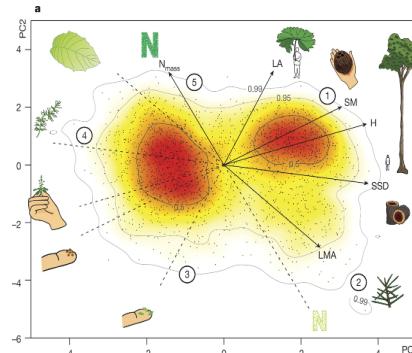
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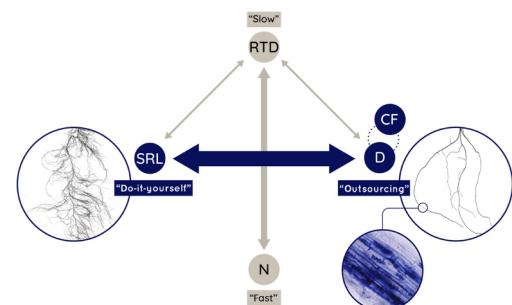
## Aboveground Traits

Díaz et al. 2016  
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## Root Traits

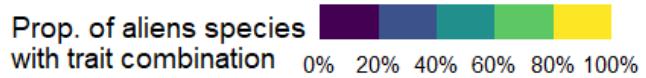
Bergmann et al. 2020  
4 traits



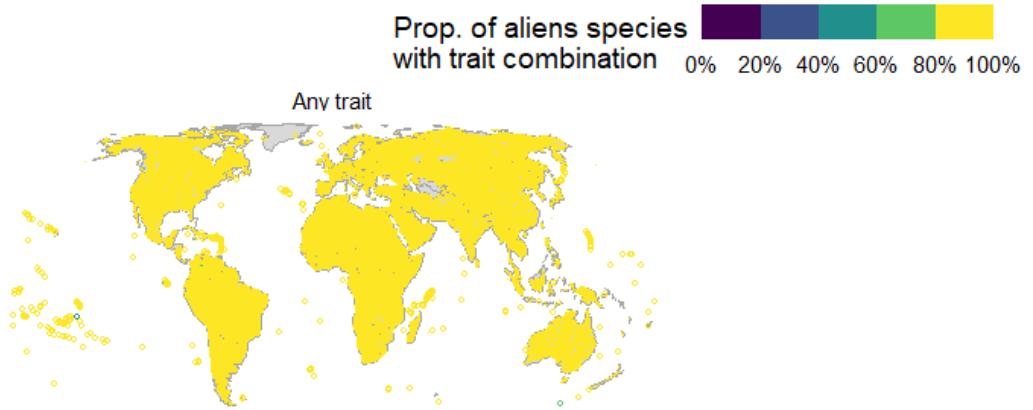


**We have global gaps in trait combinations**

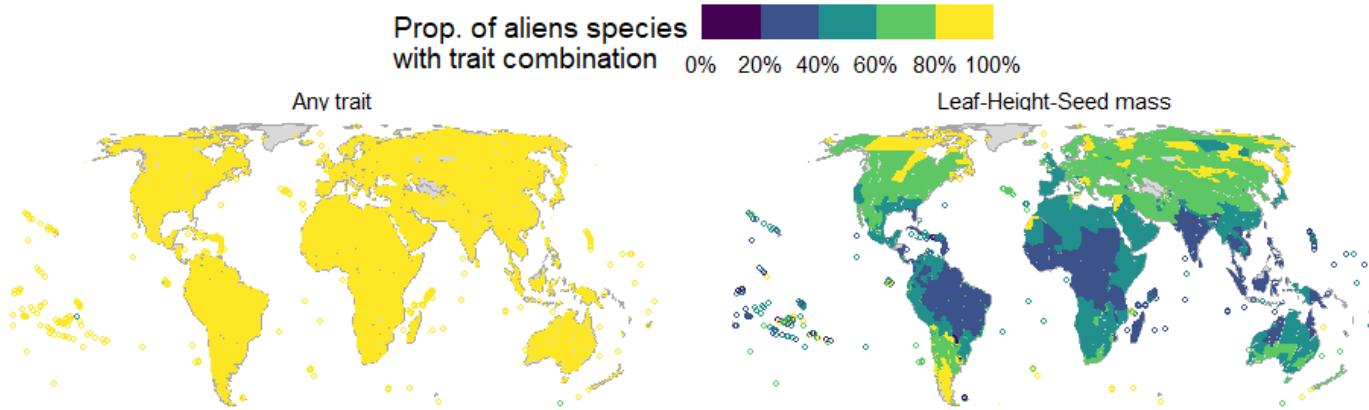
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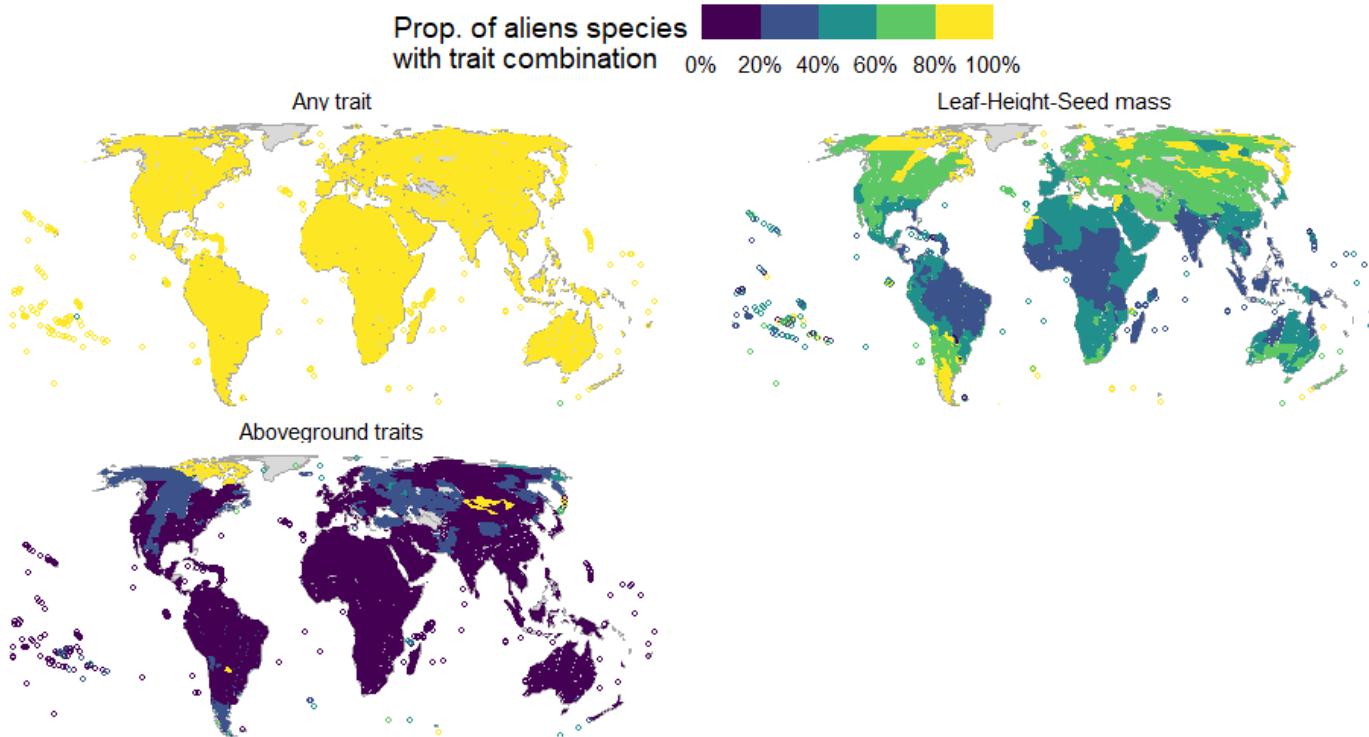
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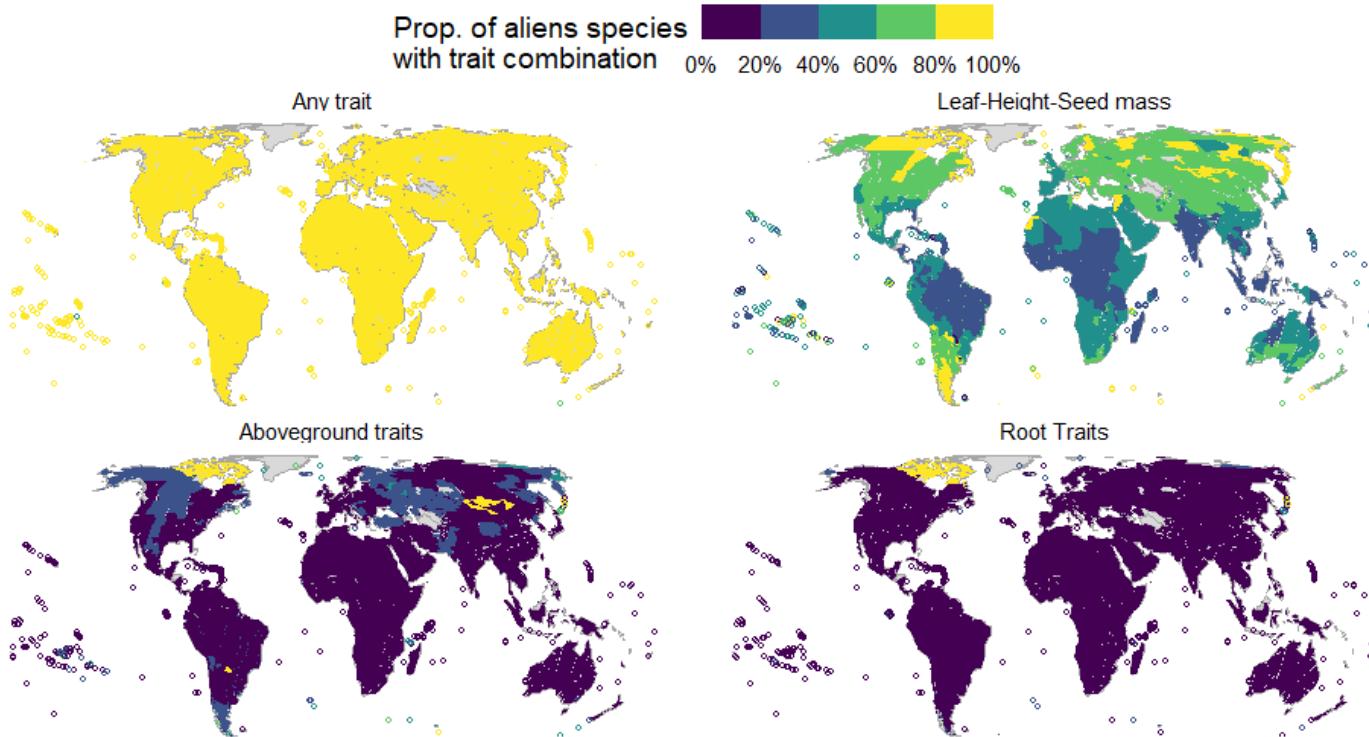
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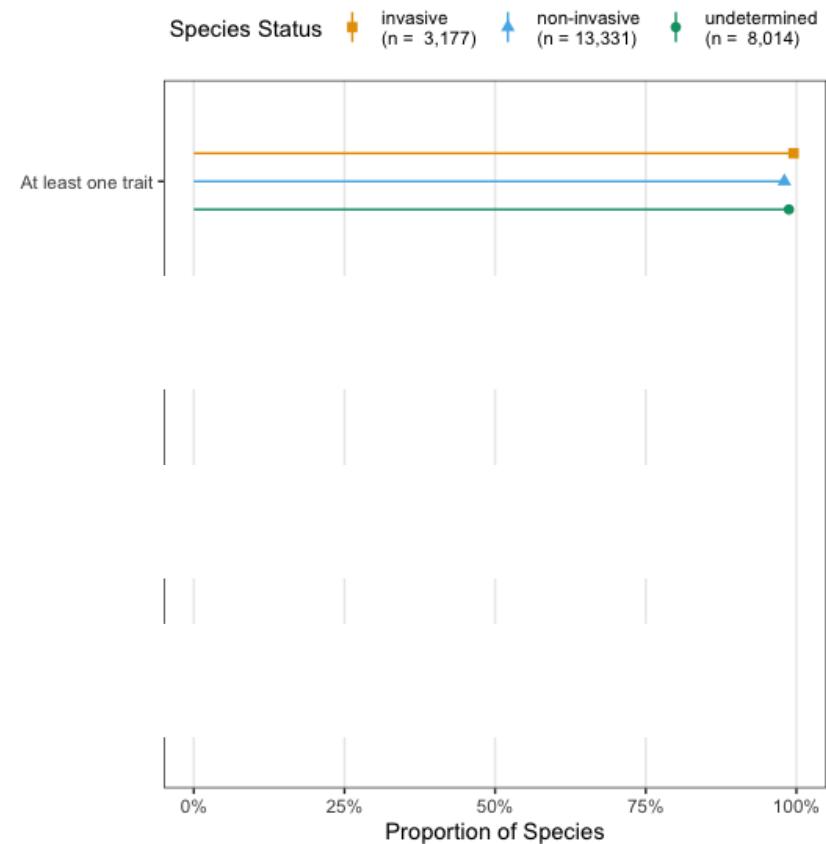




## **Widespread and Invasive Species are better known**

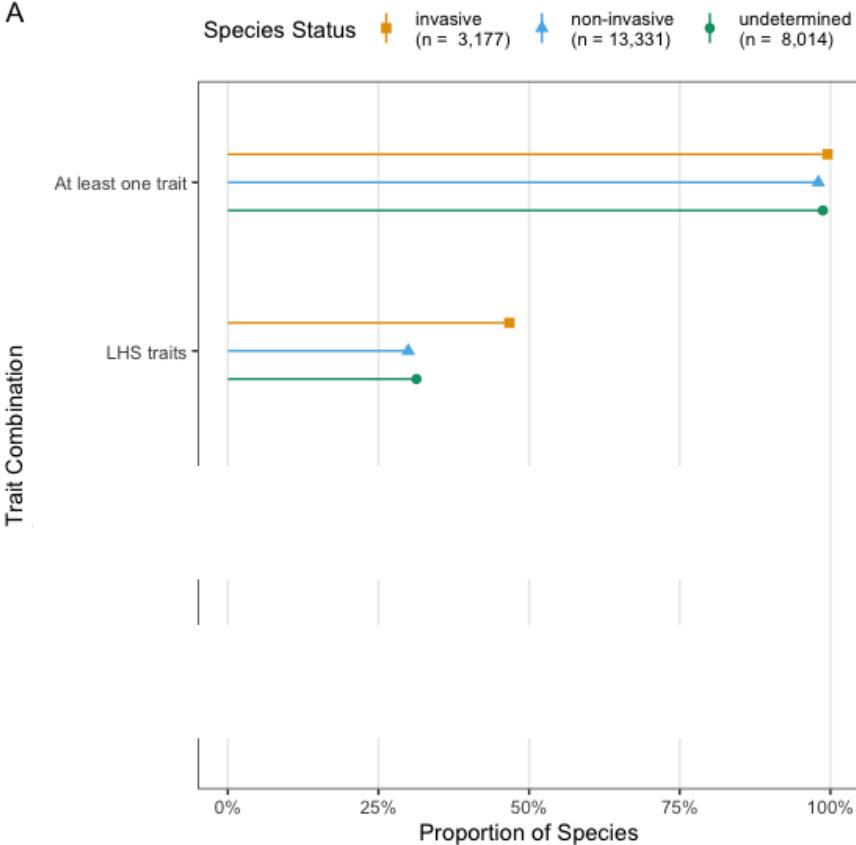
# Widespread and Invasive Species are better known

A



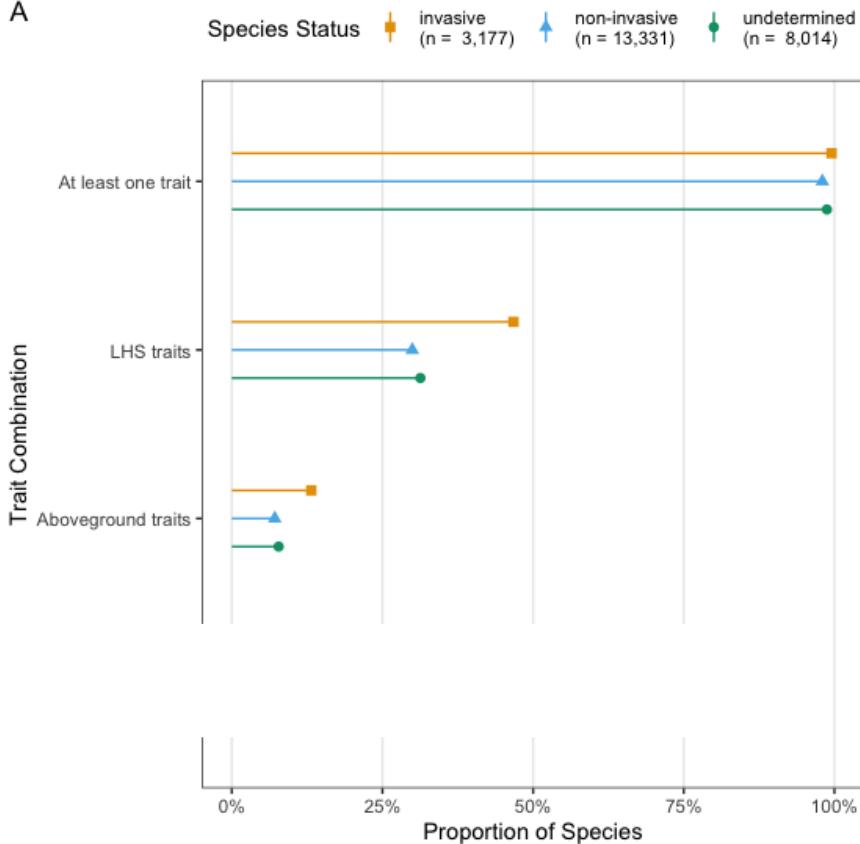
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A



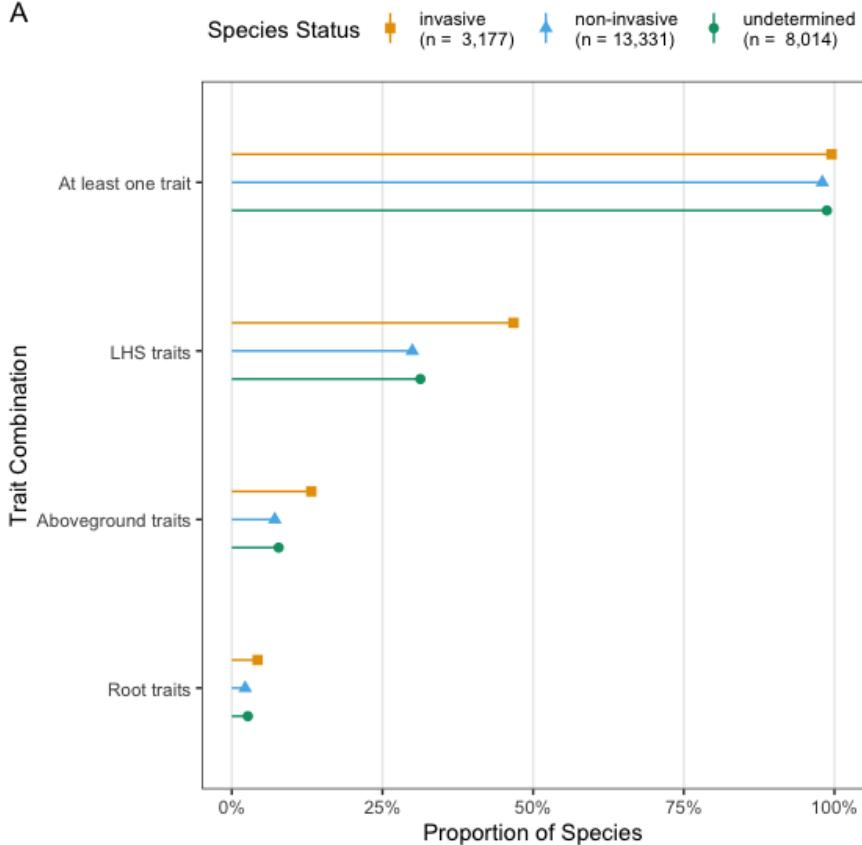
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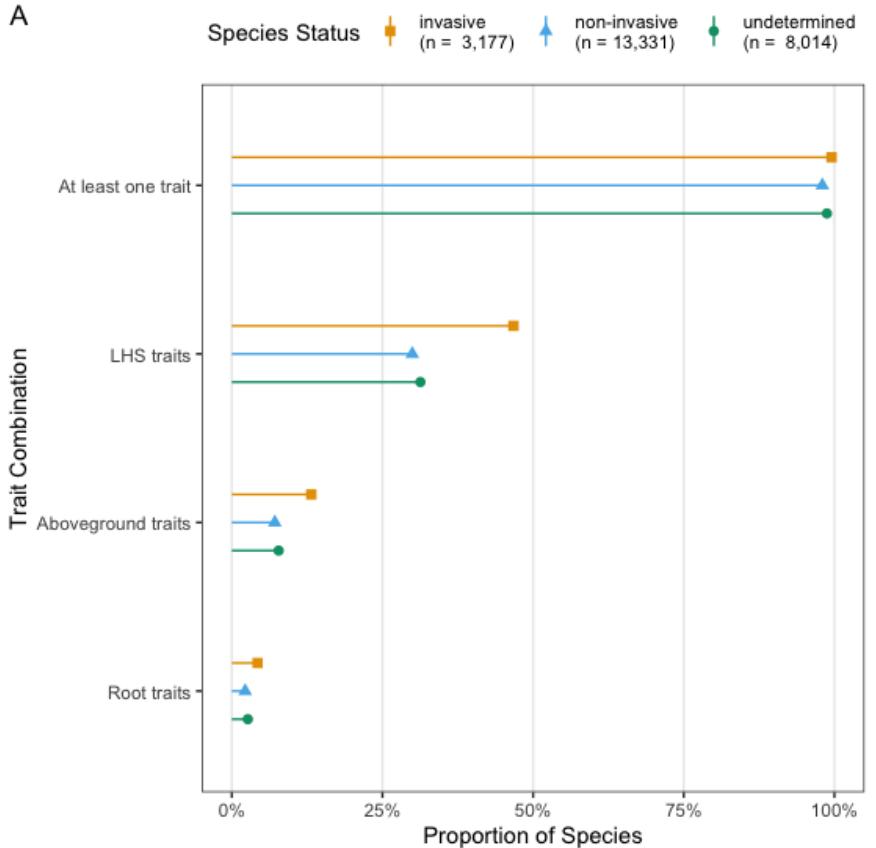
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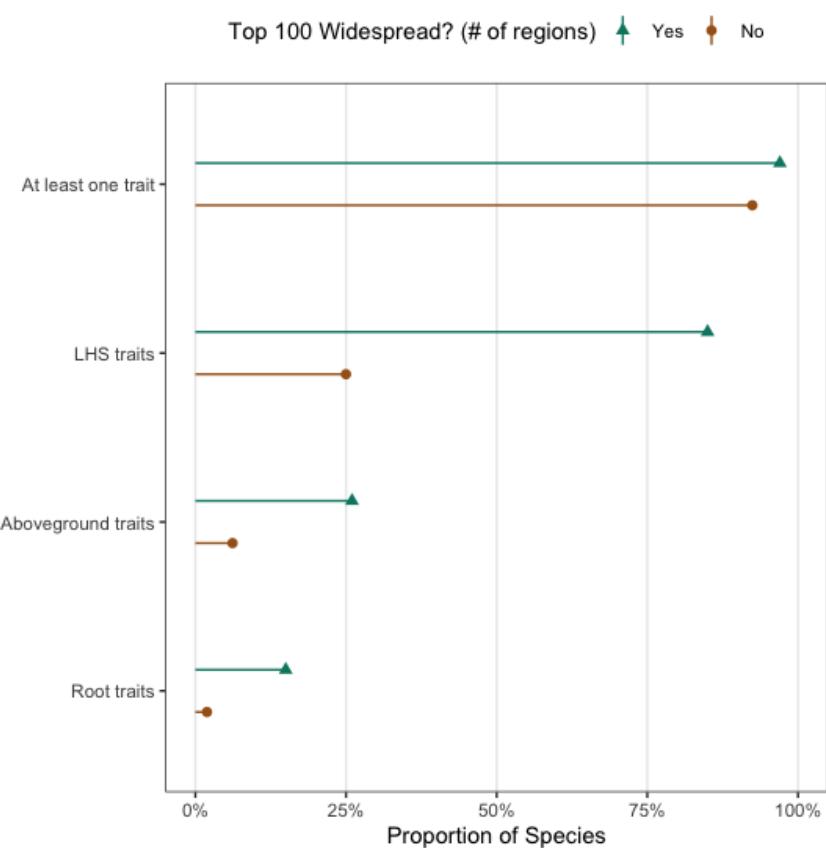


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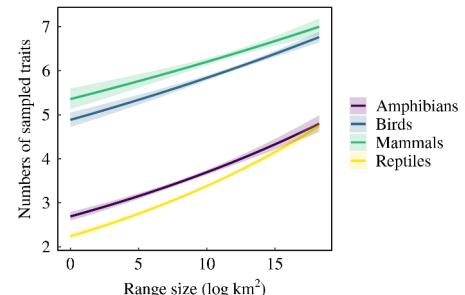
A



B



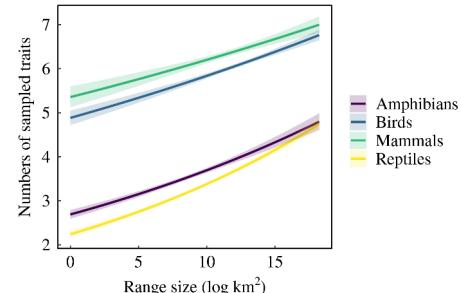
# Perspectives



Etard et al. 2020

# Perspectives

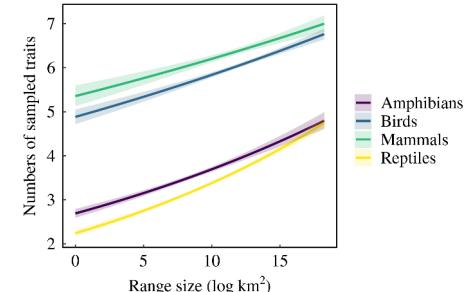
- Identify the **drivers of trait knowledge** in alien species  
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Etard et al. 2020

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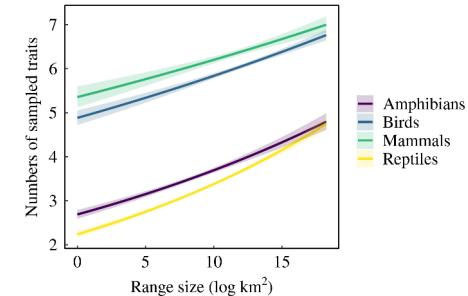
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- Analyze amount of **geolocated information (trait provenance)**



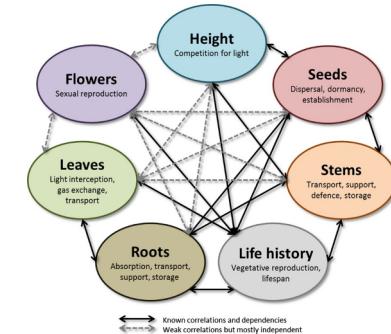
Etard et al. 2020

# 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**?)

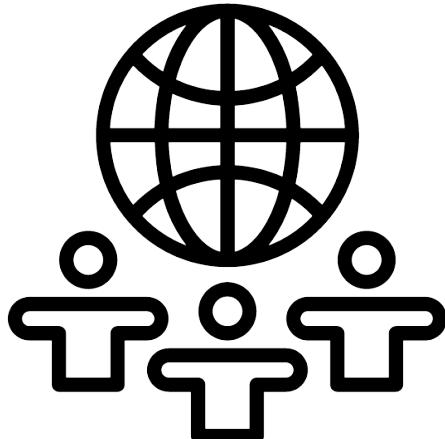


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Scientific Literature  
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Distributed Field  
Campaign

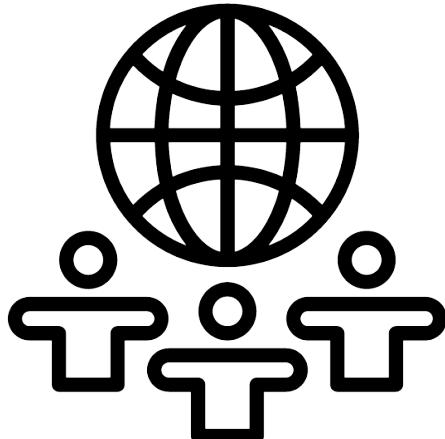


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Call for data contributions

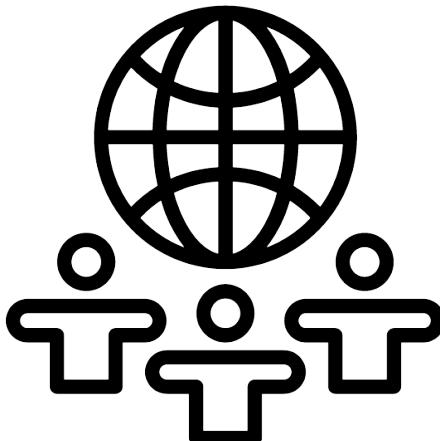


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Scientific Literature  
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Distributed Field Campaign



Call for data contributions



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

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Scientific Literature  
(+**Floras**?)



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](mailto:matthias.grenie@idiv.de)



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



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

