**Trait-based BIEN use cases**

**Use case #1**

Variation in plant biodiversity along a latitudinal gradient: insights from functional diversity

***Provided by:***

Cyrille Violle

***Summary or abstract:***

Macroecological patterns of species diversity have long ago interested ecologists. In particular, the variation in diversity along latitudinal gradients has been widely discussed, but the underlying mechanisms remain unclear. One reason is the lack of consideration for the community level which is however probably the most relevant level of organization to explain species coexistence. At the community level, the maintenance of species coexistence is primarily regulated by interspecific differences that can be assessed by the differences between species’ traits like traits related to resource capture and reproductive strategy. Macroecological focus on community-level trait diversity is still lacking, probably due to the lack of available trait data. Such data are now available thanks to worldwide initiatives. Here we ask whether the within-community trait diversity does vary in a predictable way along a latitudinal gradient and whether it provides insights into taxonomic diversity patterns. As part of the BIEN initiative that aims at gathering herbarium and plot data as well as species traits across the New World, we calculated the moments of the trait distribution within 600 tree communities distributed along a wide latitudinal gradient. We studied four plant traits: specific leaf area, plant height, seed mass and wood density.

As expected, we found higher taxonomic diversity in the tropics. Trait diversity displayed a weak hump-shaped relationship along the latitudinal gradient and did not correlate with taxonomic diversity. However trait-by-trait analysis was of great interest to explain macroecological patterns of species coexistence. Seed mass distribution was uniform in the tropics while more peaky in temperate zones, suggesting a higher level of reproductive divergence in tropical areas. On the opposite, specific leaf area was more evenly-distributed in temperate zones, underlying a higher level of differentiation in terms of resource capture. Altogether this macroecological trait-based approach to community assembly highlights contrasting mechanisms that regulate the maintenance of species coexistence along latitudinal gradients and the important role of reproductive differentiation as a promoter of higher diversity in the tropics.

***Publication:***

Violle et al. in prep.

***Data source:***

Downloaded from SALVIAS ([www.salvias.net](http://www.salvias.net)), plot data (GENTRY plots).

Trait data downloaded from the BIEN trait database

***Raw data example:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PlotCode | Project | Family | genus | taxon | latitude | longitude | Number of individuals | Mean DBH | Trait 1 (mean species trait) | Trait 1 (genus mean trait) | Trait 1 ("local value") | BioClim Var 1 | BioClim Var 2 | etc. |
| ALEGRIA-1 | SALVIAS | Rubiaceae | Alibertia | Alibertia curviflora | -12,0411 | -69,1056 |  |  |  |  |  |  |  |  |
| ALEGRIA-1 | SALVIAS | Sapindaceae | Allophylus | Allophylus glabratus | -12,0411 | -69,1056 |  |  |  |  |  |  |  |  |
| ALEGRIA-1 | SALVIAS | Rubiaceae | Amaioua | Amaioua corymbosa | -12,0411 | -69,1056 |  |  |  |  |  |  |  |  |
| ALEGRIA-1 | SALVIAS | Ulmaceae | Ampelocera | Ampelocera edentula | -12,0411 | -69,1056 |  |  |  |  |  |  |  |  |

***Data end product needed:***

Species composition of the plots

Species abundance per plot (DBH and number of individuals)

Trait data (species-level means, genus-level means, individual values if measured in the studied plots)

***Data issues and manipulations:***

* 607 plots, 9304 species total
* lots of species without trait values
* Need to correct species abundances when missing trait values
* results differed a lot when using species means, genus means or individual values
* could be good to have the regional pool for all plots (overlap of different range sizes) to do null models

**Use case #2**

The relationship between number of species, available energy and functional richness

***Provided by:***

Irena Simova

***Summary or abstract:***

Strong correlation between climate (particularly variables associated with productivity) and number of species is a commonly observed ecological pattern. However there is currently no consensus concerning the main processes responsible for the observed correlation. One possibility is that abiotic and biotic parameters of the environment ultimately limit niche space which consequently affects the total number of coexisting species. This constraint is often valid within local communities of closely related species, but it is not clear whether this approach can limit diversity at large scales.

We tested this hypothesis by comparing communities differing in their size. We used ‘Gentry-style’ forest plots and USGS trees range maps located in US and Canada. For each community we calculated variables representing functional richness (variance and range in particular plant traits and functional diversity indices) and explored whether functional diversity varied with climatic variables, species richness and the size (area) of the community. As expected, we found strong increase in number of species with climate. Increase in functional diversity was weaker with both number of species and climate at all scales, but r2 increased towards larger scales. Surprisingly, both range and variance of seed mass and specific leaf area correlated strongly with both number of species and temperature at large spatial scales. These results indicate that number of species is not influenced by the effect of productivity on the total niche space. Rather, evolutionary constraints of species’ physiological tolerances may play an important role in generating global species richness patterns.

***Publication:***

In prep (Irena Simova, Cyrille Violle, Brad Boyle, Brian Enquist, et al.)

***Data source:***

Bien2 database: SALVIAS plots as a smallest scale and species’ traits (height, specific leaf area, seed mass, wood density)

USGS trees range maps: for estimating number of species at 1dg and 5dg scales

***Raw data example:***

***Data end product needed:***

Occurrences of SALVIAS plots’ species and trait variables for all USGS trees

***Data issues and manipulations:***

* Species’ names of USGS tree range maps were standardized using TNRS (<http://tnrs.iplantcollaborative.org/>) into the valid BIEN names (difference in names found only for 13 species).
* We removed all species from SALVIAS plots which were not marked as USGS tree species in BIEN (the case of herbaceous species and small shrubs). This excluded also cultivated exotic species which sometimes appeared in the plots.
* We used genus-level traits for species’ with missing traits values (about half of the species).