

Plant invasions, species traits and climate change



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Background

Biotic invasions can alter ecosystem functioning, biodiversity and evolutionary processes. They can entail enormous economic costs. Changing climate and land use are only expected to enlarge frequency and impact of biotic invasions.

Understanding the mechanisms underlying invasion success are therefore of crucial importance for the management of current invaders and the prediction of future invasions. Furthermore invasions are a grant, yet unplanned, biological experiment and thus can inform ecological theory.

On a macroecological scale we follow two complementary approaches to learn more about invasion success in plants:

I. Analysing the effect of traits on invasion success.

II. Modelling the spatial distribution of plant functional traits in current and future climate and land-use.

Approach II

Questions

Where can we expect future invasions due to changing climate and land-use?

Approach I

Questions

1. Are there particular, single trait attributes that promote invasion success in plants?
2. Which are the most important traits and, is the specific combination of trait attributes relevant?
3. What is the influence of phylogeny?

Major Findings

1. Distinctive traits promote successful plant invasion in Germany. Yet, explained variation is most of the time small in single trait models.
2. Conspicuous increase of explained variation in multiple trait model results mostly from the incorporation of interactions.
3. Phylogenetic effects have a significant influence on invasion success, however, similar to single traits rather hold an explanatory than a predictive value.

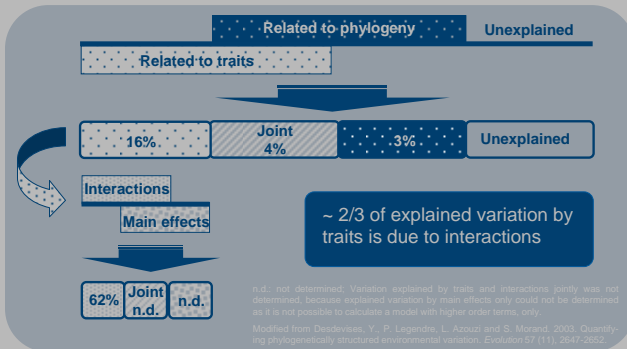
Methods

The study was based on naturalized neophytes in Germany. As measure for invasion success served (A) plant frequency and (B) the maximum degree of naturalization. Data on plants, phylogeny and 40 traits were obtained from the database BiolFlor (www.biolflor.de). Plant frequency measured as number of occupied grid cells (10' longitude x 6' latitude) was derived from the database FLORKART (www.floraweb.de).

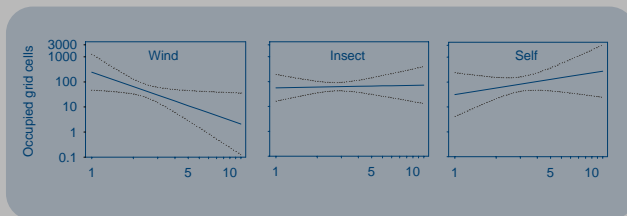
We used generalized linear models to analyse the effect of traits on plant frequency and degree of naturalization respectively. Evaluation of phylogenetic dependence followed Desclaves et al. (2003): We conducted a principal coordinate analysis on the patristic distance matrix of the subset of plants under study. Principal coordinates significantly explaining variation in invasion success were implemented as covariates.

For each indicator of invasions success we first analysed all traits in single trait models. Secondly, we performed a multiple trait model to permit additive and multiplicative effects between traits. We partitioned the amount of explained variation into components due to phylogeny only, phylogeny & traits jointly and traits only with a further differentiation of explained variation within traits due to interactions.

Example: Variation Partitioning Multiple trait model for plant frequency



Example: Trait Interactions Pollen vector * Length of flowering season



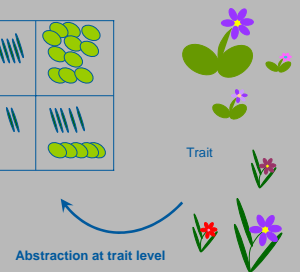
Synthesis

Certain trait attributes do not “per se” promote invasion success, but the combination is essential for direction of effect.

Prospects



1. Where are the traits now?
2. How will distribution of trait compositions be modified with future climate and land-use change?



Current distribution

100	0
0	100
100	50
0	50

Climate data
Land-use data
Geology

Projected distribution

50	0
50	100
50	100
50	0

Potential Invasion

