HOW MANY AND WHICH SPECIES TO PLANT? A MULTI-TRAIT-BASED APPROACH TO SELECT SPECIES TO RESTORE ECOSYSTEM SERVICES

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INTRODUCTION

Trait-based frameworks for restoring ecosystem services have advanced in important ways towards a more predictive restoration (Laughlin 2014; 2018; Rayome et al. 2019).

Despite the advancements, these frameworks do not inform how many species are necessary to achieve a maximum of ecosystem service provision and resilience with a minimal set of species. Our framework was built exactly to fill this gap and should help optimizing restoration, especially in megadiverse ecosystems.

Topic: Conservation and restoration

AIM

Our aim was to provide a trait-based framework that enables to select a minimal set of species that maximize the **functional richness** (FRic) and the **functional redundancy** (FR) of the restored community, a proxy for the provision of multiple ecosystem services and resilience to environmental changes and disturbances, respectively.

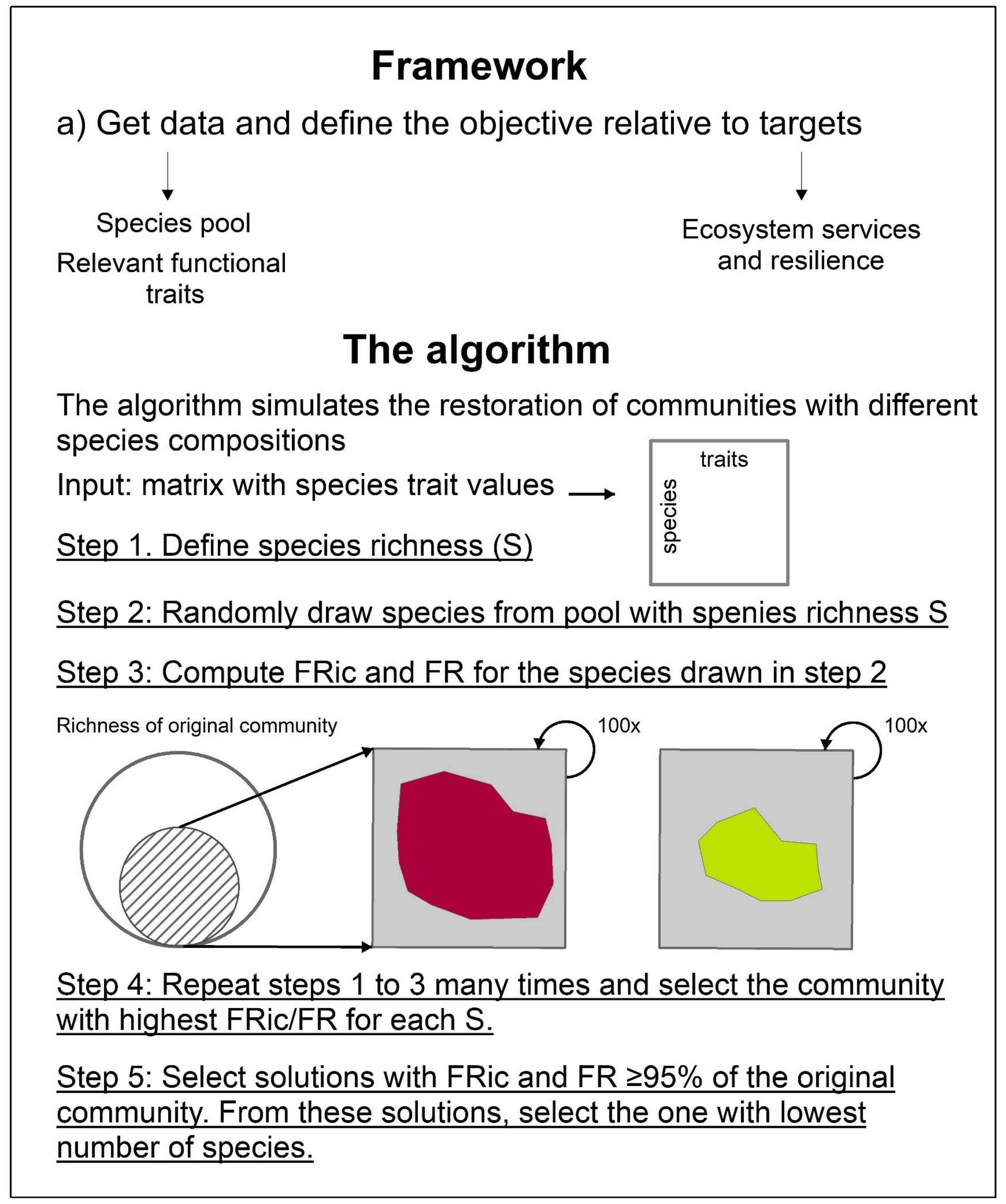
Trait-based framework

- We evaluated two aspects of functional structure of the community: functional richness (hereafter FRic) and functional redundancy (hereafter FR).
- FRic was measured as a trait hypervolume (Cornwell et al. 2006; Villéger et al. 2008).
- FR was measured using the index described by Ricotta et al. (2016), originally proposed by de Bello et al. (2007).

The algorithm

- We developed an algorithm to simulate local community reassembly, which looks for minimal sets of species with the most functional richness and redundancy.
- The algorithm takes as input the species found in the original local community, simulating its restoration.
- Random communities are generated, with increasing species richness. For each species richness, 100 communities are generated by random selection of species from the total original pool.
- FRic and FR were computed for all restored community. For each species richness, the algorithm select the community with higher FRic and FR, with the lowest species richness possible.

- **Box 1**: Steps of the framework to select species to maximize the FRic and FR.
- **Figure 2**: A – B: Species proportion of the selected solution to maximize FRic and FR of the 24 riparian woody communities. Lines connect the solutions of each community. C – D: Maximum FRic and FR by species proportion, respectively, in community # 24.



Box 1

RESULTS

- The proportion of species to maximize FRic was higher than the proportion to maximize FR. Our simulations indicated that the presence, on average, of 66% of the original species is necessary to recover ≥95% of FRic of the original riparian woody communities, while for FR on average 59% of the original species are required.

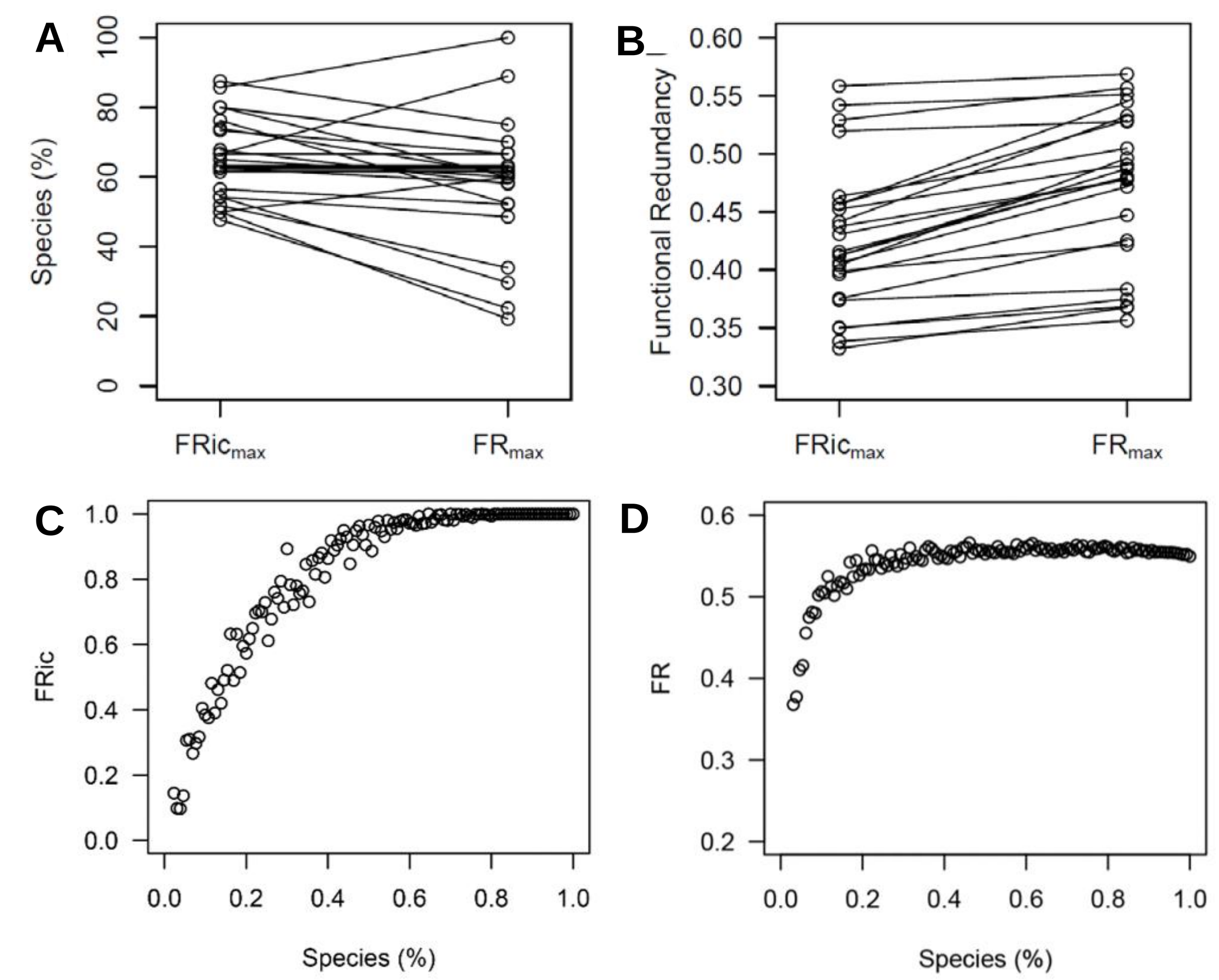


Figure 2

METHOD

Compilation of communities and functional traits data

- We used Cerrado riparian communities composed by arboreal and arborescent species as a study system.
- Functional traits that characterize major dimensions of plant ecological strategies in distinct environments was used: specific leaf area (SLA), maximum height (Hmax) and seed mass (SM).
- We worked with 24 communities, with seven to 130 species, and 318 species in total.

CONCLUSIONS

A few or a lot of: How many species should we use in restoration?

Computer simulations can give predictive solutions to environmental problems using ecological theories.

Our framework contributes to solve one of the biggest challenges in ecological restoration, which is defining how many and which species should be used to achieve functional targets. With information about the original local community (as a reference for restoration simulations) and relevant functional traits, the algorithm provides the minimum sets of species to maximize the provision of multiple ecosystem services in a resilient restored ecosystem.

We hope to contribute to advance in the application of ecological theory into ecological restoration.

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