Network structure modulates evolutionary dynamics in resource competition networks

Augusto N. Carvalho[1,*] and **Paulo R. Guimarães Jr.**[1]

[1]Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo - USP, São Paulo, SP, Brazil;

***Corresponding author: nunesaugustousp@usp.br**

Introduction

Competition for limited resources plays a key role in species trait evolution.

Competitors are often embdedded in **complex networks** of interactions, and differ in the number of resources they use.

The **trait mismatch** between consumer and resource affects consumer fitness.

Connectance describes on average how generalist consumers are in the number of resources they use.

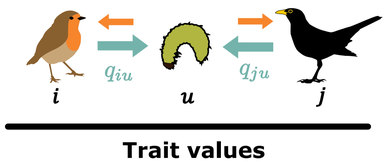
Hypotheses

We expected that species in **high-connectance** networks—and thus in networks with more generalist consumers—would be more negatively affected by competition, experiencing greater **trait shifts** and increased **trait mismatch** with resources compared to species in low-connectance networks.

Methods

1st: Used an evolutionary model

$$\underbrace{Z_i^{t+1} = Z_i^t}_{\text{Relevant Trait}} + \Big\{ \overbrace{\Big[\sum_{u=1}^{R} \frac{q_{iu}^t}{K_i^t}(Z_i^t - Z_u^t) + \sum_{u=1}^{R}\sum_{j=1}^{C} \frac{q_{iu}^t q_{ju}^t}{k_i^t}(Z_j^t + \varepsilon_{ii}^t - Z_i^t) \Big]}^{m_i} + \overbrace{(\theta_i - Z_i^t)}^{(1-m_i)} \Big\}$$



θ_i

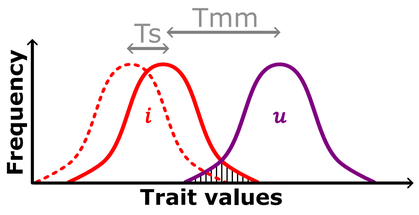
1. High resource importance $m_i = 0.8$

2. Varying generalization through connectance $C = \dfrac{\text{Interactions}}{\text{Competidors} \cdot \text{Resources}}$

2nd: Compared outcomes across scenarios:

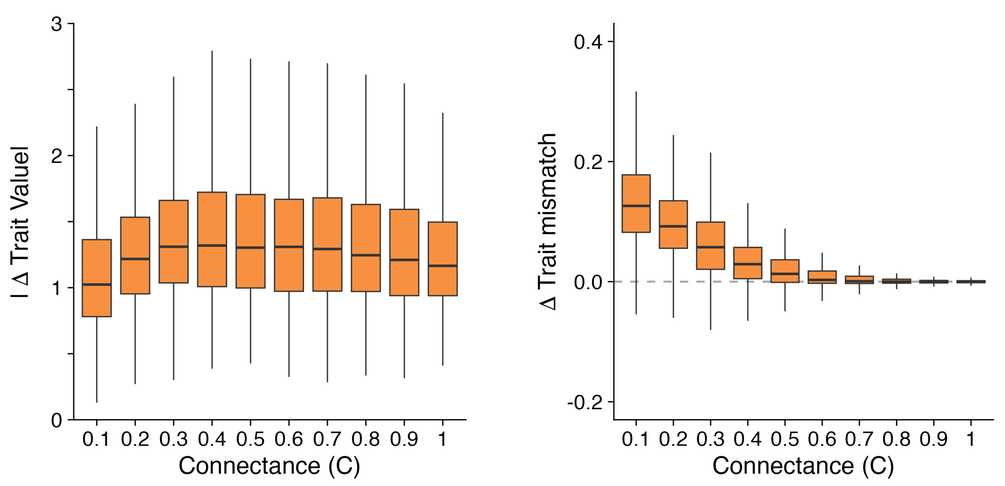
|ΔTrait value| & ΔTrait mismatch

No Competition$_{SC}$ – Competition$_{SC}$



Based upon: **Andreazzi et al., 2017**

Preliminary Results



While connectance was associated with a slight increase in trait shift between evolutionary scenarios, low values of connectance were associated with higher values of trait mismatch between consumers and their resources.

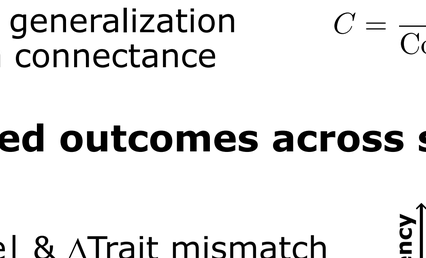
Then we explored the identity of the interactions:

Fraction analysis

No Competition$_{SC}$ Competition$_{SC}$

Kept the strongest interactions

$f = 0.5$

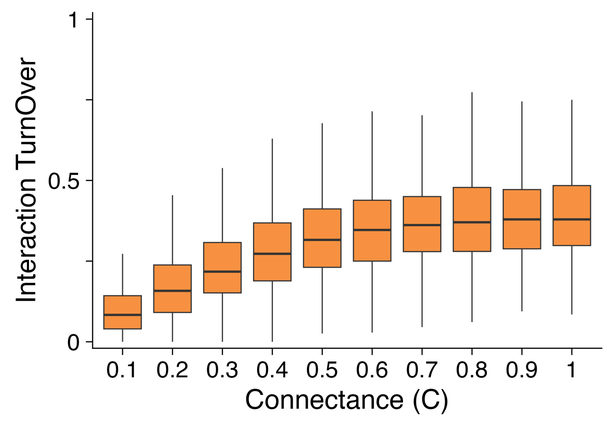


Compared resulting interaction matrices

bipartite::betalinkr()

Interaction Turnover β_{os}

Based upon: **Poisot et al., 2012; Tinker et al., 2012**



Connectance was correlated with increasing resource use shift between scenarios. Species with fewer resources seems to be more vulnerable to competition, as they are limited in what resources to use.

Next Steps

How do species with different number of resources react within the same network?

How does competition forces trait mismatch in empirical networks with distinc structures?

How do anthropogenic disturbances impact the evolutionary dynamics of native species?

Acknowledgments

This work was funded by SNSF Spark - CRSK-3_228777 and FAPESP 2018/14809-0.

Birds silhouettes were inspired by Anthony Caravaggi.

For more: