Introduction

Arguably the biggest challenge faced by community ecologists is to understand, and predict, how ecosystem properties will change in the face of large-scale disturbance events. Ecosystems functions emerge from both the identity of local species, and the way they interact, in a given environmental context. Species range shift, micro-evolutionary changes, and rapid environmental variation, is therefore expected to disrupt the current state of communities, and thus change the way ecosystems function. Although hypotheses have been generated, and data gathered, regarding the relationship between community structure and ecosystem properties, it is not clear whether they are sufficient to *predict* the outcome of large-scale changes. The core issue lies in the fact that emerging communities, rather than being an additive combination of existing ones (*e.g.* species from site A relocate to site B to track their temperature optimum), will be entirely novel ones. This novelty will emerge through a variety of ecological and micro-evolutionary mechanisms. **(i)** Species will use different tactics to cope with change, that can result in any combination of range shift, and rapid adaptation. **(ii)** Because of the precedent point, this will result in either new species entering existing interaction networks, or establishing different interactions within them. Finally, **(iii)**, the environmental conditions themselves will change, affecting the traits, abundances, and presence of different species. Because all of these mechanisms are interwoven in feedbacks, the way we approach them should incorporate concepts and elements from separate bodies of work, and focus on understanding which are well-articulated, and which are not.

1. Literature on species interactions at the community level neglected variation in either species, or the way they interact
2. Accounting for species interaction is needed to predict biogeo distribution and response to global changes
3. Accounting for micro-evolutionary changes is important to predict response to global changes as well
4. The establishment of interactions relies on traits (mis)matching, so the consequences of biogeo/evo changes must be done in a trait-explicit framework

The state of the art

In this part, we showcase the elements of network theory, biogeography, and coevolution studies that are necesary to achieve an integration between the three fields.

we don't discuss the overlap yet: think of this as the basic ingredients of the integration, not how we will integrate them

Network theory:

Constraints on species presence / absence, species dynamics, involve functional traits

Jenn / Memmott : robustness, species extinction cascades, pressure to select the more robust network (indirectly) – the probability of extinction of one species varies with the risk of extinction of other species below it

Biogeography:

large scale variations, species presence f(environment), predicts community composition, spatial heterogeneity, consequences for species evolution (at the single species scale)

Coevolution:

TP – feedbacks between species traits and interactions: is essentially an evolution of constraints on species distribution

The current overlap

The good: biogeographic perspectives on coevolution

TP – GMTC, Nuismer models

The bad: understanding network variation over space

DG/KC – TTIB, beta

The ugly: evolution of networks, evolution in networks

TP – Loeuille, web world

The road to synthesis

Scaling-up coevolutionary concepts

Scaling-down the species interaction network paradigm

Perspectives

How do we switch from no network (autotrophs) to a network (heterotrophy): important qualitative change, intermediate steps?