20/03/2020

Trying to clarify my mind:

**BEF**.

🡪 **Complementarity** and **selection** effects can explain a positive relationship between SR and ecosystem functioning (in controlled experiments – use of Loreau-Hector partitioning).

🡪 Environmental heterogeneity should affect the BEF relationships, directly (abiotic filter reduces the number of species) and indirectly (biotic filter: interactions between species expand or reduce the niche, and can impact ecosystem properties).

🡪 **MRH Grime** / **Keystone species** (effect disproportionate relative to their biomass): two opposite kinds of expectations. Functionally rare species can have an important biomass (and consequently they cannot be keystone species), and hav a strong impact on ecosystem functioning. See the concept of “key” species (Eva Maire ?).

**Niche theory**. Coexistence (stabilizing niche differences and fitness differences). Depends on the traits – multi-functionality.

**Traits**: response, effect. Functional traits: effect on performance (morphology 🡪 performance 🡪 fitness).

What history can I tell?

BEF relationships have been shown in a variety of experimental (and observational?) settings. There is an effect of richness, but also of composition. Disentangle both. Grime MRH suggests that some species have a stronger effect than others, and that this is proportional to their abundance.

Not clear whether rare species can have a strong effect. Define functional rarity.

Interest of removal experiments to see the contribution of some species (papers cited in Turnbul, 2016).

Manipulative experiments: not enough environmental heterogeneity. On the contrary, real-world prevents from manipulating (particularly long-term removal experiments) 🡪 correlative (Eva Maire). Here we have a model which explicitly takes into account competitive interactions between species. Useful setting to test biotic interaction effects.

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Stress effects on BEF: stress modifies intra and interspecific interactions. Environmental variations must be taken into account for BEF studies. To be added to the assembly processes (CAFE). All of this is linked to niche theory.

Interestingly, when trying to explain BEF relationships, we have to go into the competition/facilitation literature. The underlying ideas are:

* Biotic interactions (either positive or negative) modify specific productivities (among other properties), and these properties sum up to ecosystem functions.
* Environmental heterogeneity modulates inter (and intra)specific interactions.
* Consequently, the traits of the species matter for explaining BEF relationships, but this is theoretically expected to be context-dependent.
* This is what we observe in our simulations (i.e. different results for Bever and Bern).
* This context-dependency can be described using chain-rule decomposition, to analyze the effects of continuous (small) environmental changes on ecosystem functioning. In which cases might this framework be appropriate: global change seen as incremental changes in temperature? Local spatial heterogeneity in the field (but there is no reason why it should be continuous...)?
* In addition to a richness effect (which might or might not be a general rule), we thus expect that composition will affect ecosystem functioning, either by positively or negatively impacting species-level properties. These interactions need not be pairwise, but might more accurately be described as an “interaction milieu” (sensu McGill, 2006), i.e. a biotic background.
* We can quantify the effect of interspecific interactions using the comparison with monocultures. When we remove a given specie, if the amount of ecosystem property lost is higher in the mixture than in the artificial community made of aggregated monocultures, we can deduce that this specie positively affects the performance of the other species (and vice-versa). But how can we make these comparisons efficient? Quantify the drop in ecosystem property when we remove a given species, and see if it correlates between the mixture and the monocultures ? If it does, it means that when we remove a good performer, it reduces the ecosystem property accordingly. If it doesn’t, i) if the removal of a good performer is compensated by an increase of the property of other species, we can deduce that the good performer was also a good competitor; ii) if the removal of a poor performer (the quantification of “performance”, i.e. amount of ecosystem property, is made on the monocultures) reduces the ecosystem property more strongly than expected based on his amout of ecosystem property, we can deduce that this species acted as a facilitator.
* We can quantify the algebraic discrepancy between the amount of property expected to decrease when we remove a species based on its monoculture and the real decrease in the mixture. If this discrepancy is negative, it means the removal of this specie reduced the ecosystem property more than expected. The specie is thus important for ecosystem functioning (could it be considered as a facilitator? Maybe not, because we don’t know the effect it has on other species’ fitness, but it is clearly linked). We expect that this kind of species will be more common amongst the functionally rare species.
* Can we also use the CAFE framework? We could use it on both type of cultures (mixed monocultures and mixture), and see if the SIE.L correlates between the two cases (and the CDE too). First, I need to build the aggregated monoculture in a way that makes sense (see M. Chauvet’s PhD).
* What matters for ecosystem properties is individuals, more than species (🡪 Chris’ framework focuses on individuals). However, species, not individuals, are evolutionary units capable of allele transmission (at least for pluricellulars). 🡪 What then?