Review of Lechon et al.

Kiseok Lee 6/4/21 (kiseoklee@uchicago.edu)

Summary

The authors simulate Consumer-Resource model dynamics in the microbial community and discover that cross-feeding topology could influence the result of community-community coalescence. Specifically, they analyze the effect of within-community competition and facilitation of each community on the success of community invasion. It was fascinating to see that the authors could show in-silico that more facilitative communities invaded less successfully compared to relatively more competitive communities, save for the case where metabolic leakage of microbe is extremely high and resource utilization regime is modular.

I have enjoyed reading the manuscript very much, and I agree with the authors that there has been less effort and emphasis put on the elucidating the role of facilitation in microbial communities. I also agree that community-level invasion or coalescence events cannot be explained holistically by simulating solely an array of single-species invasions.

That said, although there is no major issue with the model or the progression of logic, I want to make a few suggestions that could improve the manuscript's cohesiveness and novelty in order to get enough positive reviews so as to satisfy or even excel our journal's expectation for publishable research.

Always keep in mind that my less mathematically-inclined background could have led to misunderstanding of equations and concepts, hence rendering inaccurate feedbacks.

Suggestions for enhancing novelty

The tone of the manuscript seems to imply that this research was strongly influenced and inspired by Tikhonov et al.'s previous work. The authors seek novelty in saying that they have done something that Tikhonov et al didn't do. For example, they assert that facilitation or resource dynamics were additionally considered to their model.

However, I believe that this manuscript has more potential than just being an expanded version of previous models in terms of facilitation. Here, I will enumerate several possible avenues that this manuscript could pursue extra novelty within the boundaries of the main thesis of the article: the role of competition and cooperation on coalescence.

1. The properties of the community after coalescence could have been quantified. Firstly, the competition or facilitation of the community after coalescence could be an interesting aspect. This is because in nature, coalescence is not a single event, but a chain of events. The hypothesis may be that the level of competition or facilitation before coalescence could affect the degree of competition of facilitation after coalescence. Then, this could imply the direction of community evolution of competition or cooperation.

Secondly, the manuscript often cites previous works and mention resource use efficiency. Resource use efficiency could be quantified in this research to show what effect competition or cooperation has on resource use efficiency of the merged community.

2. Another major point made by the author is that the repercussion of single species invasion and community-level coalescence is distinct. To support this further or reconcile the disparity, they could set a gradient in the number of species (n) of the invading community and simulate if cooperative communities become more and more resistant to community invasion when n decreases.

3. As a microbial ecologist, I tend to think of the success of a community-level invasion not as whether the species in the invading community persists or not, but as whether functionality/links/interactions are persisting after the collision. For example, if the "core" members, usually the strongly co-varying subset of species, survives the coalescence, I would deem the invasion to be successful. This is because this small subset of species could still retain the functional emergent property. It would be interesting to see the success of "link" persistence or "modular structure" persistence after the coalescence event.

Since the authors are striving to demonstrate the effect of facilitation on coalescence, I suggest implementing a meta-parameter, similar to "modularity" in network models, to impose as constraint during the sampling regime. And observing the change of this meta-parameter or modularity of the merged community would be beneficial to track the impact of facilitation.

Improving cohesiveness

There are some concepts used throughout the manuscript that becomes much clearer toward the end of the paper. It would be more comprehensible to bring those clear explanations of the concepts to the front of the manuscript when the term is first used. I see this happening with the concept or term "cohesive" and "cooperation or facilitation". This is important because the authors need to justify and make readers understand why they defined and quantified the concepts as it is in the manuscript. For example, it takes a sudden leap by saying in line 102 that "facilitation links form when a species leaks by-products that are used by another". Our readers may like to first hear some reasoning as to why that is the case.

The term competition, cooperation, and facilitation are used profusely. It may be not clear to readers what competition or facilitation is being referred to, because these are general terms. It would be clearer if the author could define at the beginning that competition denotes within-community competition before the coalescence event, since competition could also mean community-community level competition.

Minor spelling

Line 90, Cb) → (Cb)

Line 219, expetedly → expectedly

Supplementary S1. 3. Consumer preferences ~, instead → instead of