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Dear Editors,

Please find enclosed a copy of our manuscript entitled *Top-down and bottom-up cohesiveness in microbial community coalescence* for its consideration as a Research Report in ***PNAS***.

Our paper addresses a fundamental but poorly understood question in microbial ecology: how do interactions between the members of a community affect the outcome of microbial invasions? These often involve entire microbiomes invading one another, a phenomenon that has been termed *community coalescence* (Rillig et al. ***Trends Eco Evol*** 2015). Community coalescence is a key mechanism for the assembly and stability of microbial consortia. Despite the substantial amount of theoretical work that has aimed to understand this process, investigating it experimentally has been challenging in the past. Our experimental setup enables the systematic exploration of coalescence outcomes in high throughput, which has allowed us to confirm some of the theoretical predictions anticipated by existing models. Recent theoretical work –including that of one of the authors of this paper– has suggested that interactions across members of a community can determine whether species recruit one another during coalescence (Lechón et al. ***bioRXiv*** 2021, Tikhonov ***eLife*** 2016), resulting in an emergent *cohesiveness* at the community level. This hypothesis predicts that *ecological co-selection* (the situation where the fate of a species in coalescence is determined by that of other members of its community) may be common in microbial invasions. However, no experiments to this date had systematically tested this prediction.

Here, we have used a novel experimental system (Goldford et al. ***Science*** 2018) where environmental communities are stabilized in synthetic laboratory conditions to perform over a hundred coalescence and invasion experiments. Our results provide direct evidence of ecological co-selection both in its *top-down* and *bottom-up* forms, that is, the dominant (most abundant) species of a community co-selecting the rarer members or being co-selected by them. Notably, we found that these two forms of ecological co-selection do not occur simultaneously. These, and all other experimental findings in our paper are predicted by mathematical models. The success of consumer-resource models at explaining and predicting the specific outcomes of our experiments provide us and the microbial community ecology community with a theoretical tool to interrogate the mechanisms of community coalescence, and to generate expectations about the outcomes of coalescence under different ecological and environmental conditions. Importantly, our results indicate how cross-feeding interactions may produce correlated invasional outcomes and highlight the critical role played by the rare taxa in the emergence of community cohesiveness.

We firmly believe that our work represents an important advance in the field and we hope you find our manuscript suitable for publication in ***PNAS***.

Sincerely,

Álvaro Sánchez