Dear Board members, recommenders and reviewers of PCIEcology,

We would like to thank you once again for your review of our manuscript. We revised our work accordingly by adding an analysis of the main outcome variables (recovery time, alpha-diversity and beta-diversity) depending on the distance and connectivity to unperturbed patches.
We also added an extensive paragraph to the discussion detailing the quantitative analysis of the spatial structure of extinctions.

Please find below our point-by-point response, hoping you find it satisfactory.

Thank you again for your consideration.

Yours sincerely,
Camille Saade, on behalf of all the authors.

Note: All lines and page numbers below refer to the track changes pdf version of the manuscript.

Round #2

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by Elodie Vercken, 2021-04-14 08:50
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minor revisions requested before recommendation

Dear Authors,

Thank you for your revision and for addressing carefully the comments of the reviewers and myself. You have been doing a great job, and I reckon that most

I still have one remaining concern that needs to be addressed before I can recommend your manuscript. Although the core topic of your manuscript is related to the effect of spatial structure in metacommunities, I feel that the issue of space is not fully appreciated in its present version yet.

When analyzing a larger landscape, you find (i) no difference for metrics measured in unperturbed patches in comparison with smaller landscapes; (ii) for other metrics, a larger effect of the spatial distribution in larger landscapes, which is driven by a quantitative modification of metrics measured in clustered extinctions.

These two points highlight the fact that the position of a given patch relative to perturbed or unperturbed patches is crucial here, and should be acknowledged and discussed more explicitly.

Regarding the first point (i): you analyze only unperturbed patches that are adjacent to a perturbed patch, so the local environment of these patches is more or less the same regardless of landscape size. This actually looks like the equivalent of an edge effect. It is quite interesting, and might be worth commenting.

Thank you very much for this remark, we discuss this point in the paragraph l. 547-553, to which we added a few sentences to make it more explicit:

"It is worth noting that the increase in α-diversity was only observed in patches adjacent to perturbed patches, which could be described as an edge effect (in the sense that indirect effects are only observed at the edge of perturbed patches). This means that isolated extinction events don't have large scale effects in our setting, as perturbed patches only have an effect on their local neighbourhood. Indirect effects, however, can affect large proportions of the landscape if extinctions are numerous and spatially dispersed (e.g., in the treatment with eight dispersed extinctions, all eight unperturbed patches were adjacent to perturbed patches vs. only four in the eight clustered extinctions treatment). Dispersed extinctions thus have both a stronger effect on unperturbed patches and affect a greater number of unperturbed patches."

For the second point (i): it does seem that the size of the cluster has a strong effect (no modification for dispersed extinctions, that do not change in larger landscapes), which is further supported by the analysis of recovery dynamics on Fig S18 and S19. The distance to an unperturbed patch (which is correlated to the size/depth of the perturbation cluster) has a clear effect on the recovery dynamics. I do believe that the use of quantitative indicators in the analysis of the simulations in large landscapes (not in addition to the clustered/dispersed factor, but in replacement of it) could give more insight on the general role of space here, outside of the specific clustered/dispersed modalities. Patches from all modalities could be pooled and analyzed with regard to their actual local environment. Multi-model comparison methods could be used to determine which indicator is most informative as different indicators are likely to be correlated (e.g., the distance to the closest perturbed/unperturbed patch or the number of perturbed/unperturbed patches in the neighbourhood).

Thank you very much for these suggestions. There indeed seems to be an effect of the distance and connectivity to unperturbed patches, but our experimental setting did not allow to statistically test this effect: there was little variation in the distance to unperturbed patches (distance = 1 or 2) and it was confounded with the treatments (distance = 1 in all perturbed patches from dispersed treatments) and connectivity to unperturbed patches (distance > 1 is equivalent to connectivity = 0, and connectivity > 0 is equivalent to distance = 1).

This was less of an issue in simulations using larger landscapes, so we analyzed our three main variables (recovery time, alpha-diversity and beta-diversity) as a function of the distance and connectivity to unperturbed patches (Fig. S20-S22) using these simulations. These new results seem to indicate that these variables mainly depend on distance rather than connectivity, which supports the observation that the size of the cluster has a strong effect.

We added an extensive paragraph to the discussion discussing this quantitative analysis (l. 419-453, see below).

I reckon that the discussion could be improved with a part addressing explicitly these issues related to a more quantitative interpretation of spatial structure, and would give the opportunity to make better use of Fig. S7-S8 and S18-S19, the latter not being called in the main text yet. Some parts of the discussion already address the issue of space (e.g. L. 435-439, 472-476, 548-551, 561-567, 591-586), but they are scattered over different paragraphs and could be brought together for more clarity.

Thank you very much for this suggestion. We added the following paragraph to the discussion (lines 419-453) to clarify:

“Influence of distance and connectivity to unperturbed patches

Statistically determining how the local properties of a given perturbed patch (namely the distance to the closest unperturbed patch and the number of adjacent unperturbed patch) affect its recovery is difficult from our experimental data because of the low variability and redundancy of these indicators (Fig. S18 and S19). However, the analysis of the simulations of large landscapes (Fig. S20, S21 and S22) gives us a hint of the underlying mechanisms. Overall, the recovery dynamics in a given patch seemed to be mainly determined by the distance to the closest unperturbed patches (which is directly related to the size of the extinction cluster).

In terms of biomass, the recovery time of perturbed patches increased linearly with the distance to the closest unperturbed patch (Fig. S20a) but was mainly unaffected by the connectivity to unperturbed patches (number of adjacent unperturbed patches, Fig. S20b). This was in

accordance with the experimental recovery dynamics (Fig. S18) where the patches further away from unperturbed patches recovered more slowly.

The local diversity of perturbed patches was also mainly related to the distance to the closest unperturbed patches (Fig. S21): α-diversity was the highest in perturbed patches directly adjacent to unperturbed patches (distance = 1) and decreased with the distance to unperturbed patches (Fig. S21a), because patches far away from unperturbed patches were either not recolonized or recolonized only by the better disperser. The connectivity to unperturbed patches almost did not affect α-diversity, as all patches adjacent to at least one unperturbed patch (connectivity greater or equal to 1, Fig. S21b) had similar α-diversity. This is once again coherent with experimental results: perturbed patches from the dispersed treatments were all adjacent to unperturbed patches and had a high α-diversity, while perturbed patches from the clustered treatments were in part further away from unperturbed patches and had a lower α-diversity (Fig. S19).

Lastly, β -diversity was also determined by connectivity and distance between perturbed and unperturbed patches: the beta-diversity of a landscape increased with the average distance between perturbed and unperturbed patches and decreased with the average connectivity between perturbed and unperturbed patches (Fig. S22).

These quantitative effects of the distance between perturbed and unperturbed patches explain the differences between dispersed extinctions (that result in perturbed patches mainly adjacent to unperturbed patches) and clustered extinctions (that result in a greater distance between perturbed and unperturbed patches). It also explains why the amount of extinctions usually had a marginal effect in dispersed treatments compared to clustered treatments (Fig. 1 and 2): increasing the amount of extinctions did not increase the distance from perturbed to unperturbed patches for dispersed extinctions (Tab. S2). On the contrary, more clustered extinctions result in larger clusters and thus in a greater distance from perturbed to unperturbed patches (Tab. S2).”