GENERAL COMMENTS

I have read with interest this preprint submitted by Laroche et al. This study aims to clarify which connectivity indices (CI) are relevant to quantify the effects of structural connectivity on community structures, particularly species richness. This question is particularly relevant as there are currently many CI used in the landscape ecology literature. The originality of this study is the use of metacommunity models and simulations in virtual landscapes, in order to avoid any observation bias that might appear in an empirical study.

This approach seems relevant, even it forces the authors to formulate strong ecological hypothesis to properly guide their study and free themselves from excessive computation time. In particular, all the species used have similar characteristics in terms of dispersal capacity and habitat preferences. One of the conclusions of the study is that it supports Fahrig's Habitat amount hypothesis (HAH, Fahrig, 2013). I would be interested in authors' opinion on Hanski's response to it, particularly his sentence 'Analysing multispecies communities is problematic, because different species typically have somewhat different habitat requirements' and the following part (Hanski, 2015). The use of binary landscape with a homogeneous matrix resistance also constitutes a simplification that has probably consequences on the results found (we could have imagined more heterogeneous virtual landscapes with additional modelling of resistance surfaces and species movement using circuit theory).

Although the limitations of the study (mainly due to these initial hypothesis) are well identified and described by the authors (L425 sqq), these assumptions are the main weakness of the analysis. This preprint is nevertheless a valuable advance in the analysis of connectivity indices and fills a gap in structural connectivity studies. This study should be of great help in the future for those seeking to quantify the impact of connectivity on community structure or the presence/absence of particular species, including in empirical studies. The clearing of the jungle made by all the CI in the literature is more than welcome.

MORE DETAILED COMMENTS

In terms of concepts used, the latest work by Fahrig (Fahrig 2017a, Fahrig 2017b) and some of the responses to it (e.g. Fletcher et al., 2018) that questioned the concept of habitat fragmentation and its effects on ecological indices such as species richness could be a valuable addition to your introduction.

Once having generated virtual landscapes and metacommunities, the statistical analysis is performed in three steps: (i) classification of CI by analysing the correlation among them, (ii) analysis of the correlation between the different CI and species richness, (iii) combination of CI to better predict species richness.

The classification of CI is performed using a non-supervised clustering method implemented in R. This method seems relevant and the results showed tend to validate this approach, as it clearly distinguishes patch-based indices on the one hand and cell-based indices on the other hand, and flux and connector indices within the latter. Functionally similar CI like buffers and dF seem very correlated and this result is used later in the paper.

The correlation between CI and species richness is calculated using a linear model. The use of a linear model is not justified by the authors. We could however imagine other types of relation between different CI and species richness. The different CI are then sorted by ascending average Pearson correlation coefficient r (figure 2). The authors may have privileged the use of a likelihood-based method (LL, AIC, BIC) as indicator of the quality of the predictors, see Burnham & Anderson, 2004. They also could have selected the median instead of the mean, but the narrow distribution (cf. error bars) suggests that this choice has no incident.

Finally, the authors tested the combination of the CI dF computed at cell grain (which performed the best in the previous analysis) to a dllCconnector index to improve the prediction of species richness. This step is interesting and showed that the adding of a connector index to a flux index generally leads to an improvement of the prediction. This conclusion could have been discussed in a more detailed way in the discussion (L410 sqq), particularly discussing the concepts underlying the indicators that were combined. Note that different combinations of CI (not necessarily including dF) could also have been tested and could have theoretically showed better results. I guess that the authors could not test all the possible pairwise combinations due computation time and therefore chose this method.

CONCLUSION

This preprint is an ambitious analysis of a large quantity of structural connectivity indices found in the literature. The use of simulated metacommunities in virtual landscapes allows getting conclusions that avoid observation bias that could appear in empirical studies, even if it comes with the formulation of strong ecological hypothesis that require tempering a possible generalization of the conclusions. The conclusions are nevertheless very interesting and constitute a valuable contribution on the analysis of CI and their power as predictors of species richness. The paper is clear and well written. We can only regret an angle that is sometimes too technical and not detailed enough on the conceptual aspects, especially those underlying the indicators used or the relation between CI and species richness (assumed to be linear in this study).

OTHER DETAILED COMMENTS

L271: "The effects of buffers and dF at cell grain on species richness […] increased with the habitat proportion in the landscape". This does not seem perfectly clear (figure 3), especially between a habitat proportion of 0.2 and 0.4 (buffer and dF) or 0.1 and 0.2 (dF). The error bars seem to overlap, which would tend to temper this statement.

L366: "A decreasing exponential kernel"

L392 sqq: I would have expected a more functional/ecological explanation to this question of the optimal buffer radius in relation to the community dispersal

REFERENCES CITED

Burnham, K. P., & Anderson, D. R. (2004). Multimodel Inference: Understanding AIC and BIC in Model Selection. *Sociological Methods & Research*, *33*(2), 261–304. https://doi.org/10.1177/0049124104268644

Fahrig, L. (2013). Rethinking patch size and isolation effects: the habitat amount hypothesis. *Journal of Biogeography*, *40*(9), 1649–1663. https://doi.org/10.1111/jbi.12130

Fahrig, L. (2017a). Ecological Responses to Habitat Fragmentation Per Se. *Annual Review of Ecology, Evolution, and Systematics*, *48*(1), 1–23. https://doi.org/10.1146/annurev-ecolsys-110316-022612

Fahrig, L. (2017b). *Forty years of bias in habitat fragmentation research* (Vol. 1). https://doi.org/10.1093/oso/9780198808978.003.0005

Fletcher, R. J., Didham, R. K., Banks-Leite, C., Barlow, J., Ewers, R. M., Rosindell, J., … Haddad, N. M. (2018). Is habitat fragmentation good for biodiversity? *Biological Conservation*, *226*, 9–15. https://doi.org/10.1016/j.biocon.2018.07.022

Hanski, I. (2015). Habitat fragmentation and species richness. *Journal of Biogeography*, *42*(5), 989–993. https://doi.org/10.1111/jbi.12478