

Dear Dr. Goberville,

Many thanks to you and the two reviewers for the time and effort spent on assessing my manuscript « Efficient sampling designs to assess biodiversity spatial autocorrelation : should we go fractal ? ».

I have carefully adressed all the comments raised by reviewers in their second revision, covering all the points that you synthesized in your general comment about this work. I provided all the details about the changes made in a point-by-point answer below.

It is my pleasure to submit the revised version of the preprint to your evaluation.

Yours sincerely,

Fabien Laroche

Answer to reviews (in bold)

Reviewed by Nigel Yoccoz, 01 Nov 2023 06:01

The author has carefully revised the paper, adding much relevant information and additional simulations. I look forward to applications of some of the ideas developed in the paper, and the scripts provide the necessary tools.

Thank you for this positive feedback.

Reviewed by Charles J Marsh, 04 Nov 2023 12:55

Review for Laroche - Efficient sampling designs to assess biodiversity spatial autocorrelation: should we go fractal?

This is a follow up review. Again, someone better than me will need to evaluate the mathematical approaches, especially with regards the SI, and I have focussed my review on the other aspects. The author has put in considerable work to address comments reviewers had outlined last time, and I think those changes have been implemented really well. Changes include more realistic environmental covariates, better visualisations of the covariates and the results, an examination of trade-offs between sampling for multiple variables, a discussion of sampling effort required for different schemes, and a tidying up of the R code.

First, the previously uninterpretable code has been converted into a lovely Rmarkdown doc that outlines various steps and provides the code. Really a lot of work has gone into this, and I really commend the author on the effort, it is well worth it, and will be very useful for readers who might want to apply similar methods.

Second, the methods for defining the 'rugged' environmental variables is really nice, using sine waves and shifting the longitudinal position of the centre - an approach I think will be very useful applying to other simulation studies.

Thank you for this positive feedback.

My remaining comments are pretty low-level suggestions or tweaks:

The Rmarkdown doc and code –

I got it working after a bit of trouble-shooting. I can confirm the code provides the same results as the manuscript. I also tried running it with different seeds for the randomness in the hybrid designs and the results were fairly robust, with only minor differences (one risk of true randomness of course is that you can end up with a terrible distribution of points). It's still a bit opaque though in terms of annotations and formatting, which could be something to think about in the future to make the work more useful for others.

I have learnt a lot in addressing the careful comments of Dr. Marsh regarding the code presentation. I will make use of these advices in future works.

Otherwise, three small comments:

1) set the folder structure up in the code itself rather than in the markdown arguments to make it easier for users to repeat.

I am sorry to say that this is the only comment that I have not fully understood. I hope that the revised version of the code will have attenuated this problem in some way or another.

Also, better to use `file.path` rather than `paste` for users with non-linux systems.

I was not aware of the `file.path` command, which is indeed very useful. I have applied it throughout the code.

2) A lot of the code chunks are set to not evaluate, so knitting will fail. I understand that some are time-consuming and you prefer to read in the data files once generated, but maybe think about some simple if statements to run the loops only if the rdata files haven't been created yet (and you could always provide the data files for download).

I had not anticipated knitting problems for other users indeed. I have consistently replaced the unexecuted chunks by conditional testing on the existence of target result files, as suggested.

3) I don't know what the figure 'Global performance across autocorrelation values' is showing – please annotate.

This was a relictual, useless section which has been removed from the new code.

The example as visualised in the examples –

The `a_s` values span from 0.01 – 100, but the examples of `a_s` as in figs 4 and 6 are really limited showing only 0.09 – 0.33 (ranks 7-12 out of 28 total). This also doesn't include the grid mesh size which is the 'switching point' of behaviour (which I believe should be 0.38). When I have created the figures with a wider range of values it produces some interesting patterns not apparent from the current figures, and also makes much more sense of figure 8.

We have extended the range of `a_s` values illustrated in figures 4 and 6, still keeping only four values for the sake of display clarity. Values shown now span 0.09-0.62 (ranks 8-14). More extreme values show either strong divergence of error on `a_s` estimation (low `a_s`) or a convergence of the performance of all designs (high `a_s`), two situations that were fully anticipated by our asymptotic study, and thus quite uninteresting to explore numerically in a context of limited space of display. The values kept in those figures span the range of `a_s` where interesting quantitative changes

happen, and they now better cover better the 'switching point of behaviour', which is equal to $\sqrt{3}/6=0,29$ in our study. We made this latter point more visible by materializing the four values used as examples in Figs 4 and 6 along the ordinate axes of Figs 5 and 7.

The 'Spanning path length' analysis –

This addition seems to be a bit of an afterthought – it is not described at all in the methods section and comes out of the blue in the results, with no indication as to the purpose of the analysis. Introduce the rationale for it and the methodology in the methods section, as it is important for the interpretation of the final figure.

The addition of the minimum distance needed to cover designs was indeed an afterthought in the previous version, inspired by the relevant comments made by Dr. Marsh on the previous version of the manuscript. I had not realised that it was missing from the method section, making it poorly introduced. I have moved most of the elements in the method section that presents sampling designs, adding a motivation for this analysis (ll. 166-187), and I only kept what is actually results (Fig. 9 and ll. 437-439) in the result section

Missing info in the methods –

As well as the distance analysis missing from the methods, there seems to be other key info not outlined in the methods and only apparent when going through the code. For example it is not clear from the methods whether there were any repeats, how many etc, and how they were averaged (working through the code I can see it is 30 reps but this info should be clearly stated in the methods). Please check that everything needed to replicate the study is outlined in the methods without referral to the markdown doc.

We specified in maintext that hybrid designs have a random fraction which is explored using 30 replicates (ll. 149-150). We also clarified that errors of hybrid sampling designs were thus obtained by averaging the errors of the 30 replicates (ll. 243-245). We believe that no other key elements is missing to replicate our study. In particular, we described all the environment profiles, we presented the 30 a_s values explored, we specified the values of sigma and beta used in the numerical analysis without loss of generality.

Fig. 8 legend –

All a bit messy. 1) What is the grid mesh size? What does centred mean if we don't know what the extremes are? You may as well give the actual values (0.038 – 3.8, centre = 0.38 I think?).

Part of the answers were actually provided in methods (ll. 264-275), but not easy to relate to the Figure 8 which comes up much later in the text. Consequently, we added all the requested clarification in the legend of the figure.

2) Remove all the abbreviations (I'm not sure what 'resp.' means).

Done

Fig. 4 and 6, maybe also other figures –

As well as indicating the most disordered value with a triangle, for the hybrid models you might consider having two symbols – one for the regular grid and one for random. Most people will really be only interested in the regular grid vs fractals, and so it is really worthwhile in every figure making it obvious where that regular grid lies. More minor, tweak the plot titles so that $a[s]$ is in subscript

Done, I used squares for the most regular end of design strategies.

Figure 10 –

I'm not sure about the representation of the sampling area-budget arrows on the left and how easy it is to interpret. I see it is as more of a sampling area:no. sampling points ratio (more useful than sampling 'budget' I think, which depends on lots of other things). This then determines the FGM, which ultimately interacts with as. Perhaps that ratio can be defined by L as you have in the results, or maybe it is not generalisable in that fashion?

Sampling budget was indeed not a clear term, I was actually referring to the number of sampling sites (N in our study). The ratio mentioned by Dr. Marsh is the inverse of sampling density, which is indeed tightly connected to the feasible grid mesh size. The FMGS is expected to be proportional to the square root of this quantity. However I reckoned that adding this intermediary step in the figure would have made it harder to read, I preferred to clarify the terms, and add clarifications in the caption.

Also, you could think about breaking it down for whether you are interested in estimating the autocorrelation mean or the range (or both).

The figure is made for users that are interested in estimating both. I preferred not to go break it down along single objective because I felt it went against the general message of the introduction that large, long-term sampling designs should seek for some robustness to a variety of research question (ll. 91-95)

Other trivial things:

Lines 333-337 – you could always use different coloured boxes to help indicate these

I used dashed versus continuous boxes, which I propagated to figure 6.

Sampling design figs 1, 2, 3 – v minor niggle but set $asp=1$ to keep aspect ratio of coordinates even

Done

Line 50 – estimated ranges of what exactly, the autocorrelation range or distributional range?

I clarified.

Line 189 – '... accurately estimate ...'

I corrected.

Line 220 – accurately what?

I corrected.

Line 445 - '... autocorrelation range was smaller ...'

I corrected.

One final important point. I'm not Rob Ewers (I don't have the beard for one), so make sure to remove his name from the acknowledgements.

I am really sorry for this confusion which I corrected in the new version.