19-Feb-2019  
  
Dear Dr. Meehan:  
  
Thank you very much for submitting your manuscript "Spatial modeling of Audubon Christmas Bird Counts reveals fine-scale patterns and drivers of relative-abundance trends" for review by Ecosphere.  The reviewers and I appreciate the work you have accomplished, and all feel it is a very worthwhile study. I am willing to consider a revised version for publication in the journal, assuming that you are able to modify the manuscript according to the recommendations. Your revisions should address the specific points made in the review comments.   
  
To submit your revised manuscript, log into <https://mc.manuscriptcentral.com/ecosphere> and enter your Author Center. You will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision. Please DO NOT upload your revised manuscript as a new submission.  
  
When submitting your revised manuscript, you will be able to respond to the review comments in the space provided. You can use this space to document any changes you make to the original manuscript. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the review comments. If you disagree with a review comment, please explain why. (Please note that the field does not retain type formats such as italics, boldface, or colors, so please format the responses accordingly.)  
  
IMPORTANT:  Your original files are available to you when you upload your revised manuscript.  Please replace files of the earlier version and delete any redundant files before completing the submission.  
  
Because the focus of Ecosphere is rapid publication, we request that you submit your revised manuscript within three weeks from today’s date. If you are unable to meet this deadline, please request an extension by contacting the Editorial Office at [ecosphere@esa.org](mailto:ecosphere@esa.org). If you are unable to revise the manuscript within three months, you will need to resubmit the revision as a new manuscript.  
  
Sincerely,  
  
Dr. Ginger Allington  
Subject-matter Editor, Ecosphere  
[gallington@gwu.edu](mailto:gallington@gwu.edu)  
  
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Reviewer #1 (Comments to the Author):  
  
This is a well-written and important contribution that offers an alternative method for analyzing messy count data collected as part of the Christmas Bird Count. The method improves upon the ‘standard’ analysis method by increasing spatial resolution, incorporating spatial autocorrelation structure, and speeding up implementation. I have not used R-INLA and so I don’t feel qualified to comment on some of the details of implementation in this package. Nevertheless, I think the authors have given a thorough and clear description of their method, and results are presented clearly. The paper should open up new possibilities for testing hypotheses related to changes in winter bird populations by allowing for inclusion of environmental covariates at ecologically relevant scales. I had just a couple of comments/suggested edits:  
  
Line 80: I don’t understand. While implementing the MCMC algorithm can be time-consuming, post-summaries at larger spatial scales is not.

We have removed the phase about processing MCMC chains. See new line 78.  
  
Lines 92-93: “may miss important regional variation”. Should be “local”, not “regional”?

We have changed regional to local. See new line 91.  
  
Line 213 (and elsewhere): Simpson et al. (2017) not in Lit Cited

We have added the Simpson reference to the Literature Cited section. See new line 709.  
  
Lines 457-458: Awkward, consider rewording. E.g., delete “, both,” (457) and replace “, and Audubon…” with “, as well as from”

We have modified the sentence as suggested. See new line 454.  
  
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Reviewer #2 (Comments to the Author):  
  
Dear authors,  
  
What a fabulous manuscript. I cannot tell you how much I enjoyed reading this manuscript. I thought it was very well written, thorough, on a topic I have long wished to explore myself (and just never had the time to do it), and demonstrates a sizable advance in this particular area of interest (i.e., trend determination from long-term broadly available community volunteer data).   
  
I have only one largish concern and but a number of relatively minor comments for your consideration, listed in order of appearance in the manuscript. My largish concern is that the code employed in these analyses must be made available, for my own selfish interests but also to serve the larger community. To not do so will limit the impact this work will have, a limitation wholly unnecessary and one that would be self-inflicted.

As noted in the previous version of the manuscript, the code and data for this analysis is already available in a free public GitHub repository: <https://github.com/tmeeha/inlaSVCBC>. However, we will also include a text file with the code in our next submission as Supporting Information. See new line 744.  
  
Other comments:  
Page 5, line 104 (also see page 6, lines 110 and 121; page 8, lines 168 and 169; page 9, lines 182 and 183; and perhaps elsewhere).  When a compound of an adverb ending in -ly and an adjective or participle precede a noun, they are not connected by a hyphen.

We have made changes as requested.  
  
Page 6, line 106. In a relatively obscure paper, Strassburg et al. (2015) provide exactly this, an application of the method to CBC data. See: Strassburg, M., G. M. Linz, S. M. Crimmins, and W. E. Thogmartin. 2015. Winter habitat associations of native blackbirds and invasive European starlings wintering in the southeastern United States. Human-Wildlife Interactions 9:171–179.

Thank you for the great reference. We have not added it to this paragraph because we are specifically discussing spatial statistics variations of the standard BBS analysis. While the Strassburg analysis has random effects for different spatial units, there are no specified spatial relationships between those units as is typically done in spatial statistics.  
  
Page 6, line 120. "on a uniform grid covering North America"

Changed as suggested.  
  
Page 7, line 138. Comma after 'tremendously' is unnecessary.

Changed as suggested.  
  
Page 8, line 169. Consider inserting E after 'effort effect'. A similar non-model naming convention would be helpful to the reader.

Changed as suggested.

Page 9, line 175. Finley (2011) is relevant to the 'lack of stationary' aspect, not the 'effort effect'. Consider inserting the citation after 'stationary' to avoid the suggestion that this article speaks specifically to stationarity in effort.

Changed as suggested.

Page 10, line 210. Comma after 'years' is confusing. If you take out the text between commas, you have a sentence that reads: 'After filtering, available for modeling.'

Modified commas as suggested.

Page 12, line 243. Replace 'reasonable' with 'reasonably'.

Changed as suggested.

Page 12, line 254, and page 18, line 389. 100 km is an adjective of results and should be written as a compound modifier with a hyphen connecting the two (i.e., 100-km results).

Changed as suggested.

Page 12, line 256. 'in order' is extraneous; consider eliding.

Changed as suggested.

Page 12, general comment 1. It seems somewhere near here that it is objectively stated that you used the standard approach to calculate trends. As it currently reads, until you get into the Discussion (but even there it isn't necessarily obvious), the reader is left to wonder if the comparison to the standard approach is based on published results of standard models or if the authors also calculated those models themselves. If you calculated them yourself, explicitly state as much, with a bit of detail on the methods you employed (i.e., in BUGs, JAGs, etc., which will be helpful for putting context of the 10-hour calculation time described in the Discussion in perspective).

The trends were precomputed by the National Audubon Society. Version and download information have been added on line 255.  
  
Page 14, general comment 2. When I first began reading this manuscript my initial thought was that when it came time to evaluating the effects of covariate information on American Robins, this would entail amending Equation 1 by inserting these covariates in as fixed effects and evaluating their effect on predicted relative abundance (as opposed to the trends). When reaching this page of the manuscript, it only now becomes clear why this is not the route taken, because there is a focus not on spatial patterns in abundance and the drivers of those patterns, but rather on the trends and drivers of spatial patterns in them. It seems to me that this distinction needs to be better addressed earlier in the manuscript, perhaps in the Introduction. Why focus on explaining trends rather than abundance?

Excellent question. We considered including the covariates in the base trend model. However, we decided to work with precomputed trends for a few reasons. First, Audubon has made an effort to move beyond providing only raw count data, toward making precomputed trends easily available. See, for example, <https://www.audubon.org/conservation/where-have-all-birds-gone>. This move is intended to encourage people to use trend information produced using statistical best practices. Statistical best practices are often not followed in studies that use raw CBC data. Second, building a trend model that includes abundance covariates requires a certain statistical computing skillset. It would be a shame if lack of that skillset hindered expanded analysis of CBC trends.

We have made our approach clearer in the manuscript by describing trends as precomputed where appropriate (including the introduction). We have provided a brief justification for this approach starting on line 273.

Aside: Trends are currently given a prior with a mean and variance. It is reasonable to think that future elaborations of this or similar models will entail depicting this component as a covariate-informed function, perhaps arranged in a hierarchical form.

That is a great idea. We will consider how this might be done using INLA. Doing this with MCMC would take a very long time.  
  
Page 15, line 314. Replace 'Analysis' with 'Calculation'.

Changed as suggested.

Page 15, line 327. If there were an endless supply, then the reporting of a mean of 4.28 or a maximum of 73.5 seems low. Perhaps a less-hyperbolic adjective would work better here? I have to admit, none come to my mind.

Yes, the endless supply comment was an attempt at subtle humor. Nevertheless, consider that the 73.5 number is for 1 party hour. For a count with 100 party hours, that is 7,350 robins. Not too shabby.  
  
Page 15, lines 331 and 332. Insert '/yr' after '%'.

Changed as suggested.

Page 16, lines 345-346. It would be helpful to the reader to name these parameters (e.g., mean effect, circle effect, effort effect, and year effect, respectively). At present, I suspect many readers will need to hunt down what K is just to re-familiarize themselves with what is being reported here.

Changed as suggested.

Page 17, lines 361 and 363. Insert hyphens after 'information', i.e., information-rich and information-poor.

Changed as suggested.

Page 17, line 378. It is unclear what fraction of variation is explained by the model associating covariates to the spatial pattern in trends (this could be described somewhere in lines 367-374). Perhaps replace 'their' with 'relevant' to at least not suggest the entire set of drivers have been identified.

Wording changed as suggested. We also added text related to the relative importance of the fixed effects and the predictive ability of the model. See new line 378.

Page 18, lines 381-382. Perhaps re-order these two sentences to read something like:  
'Fine-scaled trend estimates for the American Robin,..., were very similar to those produced by the standard analysis approach. But, the use of INLA for model analysis resulted in a dramatically reduced computing time.'

Changed as suggested.

Page 20, line 437. 'This' is naked. Consider clothing it with 'option', i.e., 'This option...'

Changed as suggested.

Page 21, line 458. Consider removing the comma after scales.

Changed as suggested.

Page 21, line 458. Consider conforming the verb tense to be the same. 'researcher wishing' and 'volunteers desiring'.

Changed as suggested.

Page 22, lines 483-486. Comment: particularly given that K, the circle effect, suggests some measure of unexplained residual variability.

Good point!  
  
Page 36, line 754, Figure 1 legend. Consider inserting parenthetically the years described by the trend.

Changed as suggested.  
  
Page 36, Figure 1 legend. (F) is not defined.

Fixed.  
  
Page 37, Figure 2 legend. Tau is not defined.

Fixed.  
  
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