Paul Regular

DFO address

2019-12-XX

Dr Duplisea,

Thank you for considering a revision of the manuscript PONE-D-19-26904, “SimSurvey: an Rpackage to optimize the design and analysis of fisheries surveys by simulating spatially-correlated fish stocks” by Paul M. Regular, Gregory J. Robertson, Bob Rogers, and Keith P. Lewis.

We thank the Reviewers for their thoughtful and thorough comments which will clarify and improve the manuscript. We agree with many of the comments and have made every effort to incorporate these into the manuscript. Below are the reviewers' comments with a brief accounting of our response to each concern or suggestion in bold. Further, the Reviewers comments and a re-reading of the manuscript has suggested a few minor changes, e.g. additional references, minor wording changes, etc. Similarly, due to the many requests for more information, the second and third paragraphs of the “Study Area” section required some re-arranging of text to improve flow.

Lines numbers refer to the revised manuscript.

We submit this revised manuscript for your consideration and look forward to your decision.

Yours sincerely,

Paul Regular

**Reviewer #1:** This paper describes the R package “SimSurvey” which is a package to test the design and analysis of fisheries independent surveys.  
I found the paper very interesting and the package of great potential value and interest to many fishery scientists. However, I have several comments that I would like the authors to address first before I recommend acceptance of this paper. **My main comments relate to:**  
1. Verify some of the equations and model description used in the model. I think that some of them lack description to fully understand what was done and few others are misleading, even incorrect. The detail can be found below but in general, they are linked to the problem of bias correction for log-normal distribution, re-scaling”, moving from abundance at age to abundance at length.

Please see our specific responses to L94&95&104, .

2. Add additional explanation to justify the choices. E.g. why population dynamics is modeled independently of the spatial distribution. Is this reasonable, limitation, etc.

3. Few suggestions (add-ons, renaming) to increase the generality of the paper (without requiring too much work)  
Please see our specific responses to…..

**Detailed comments:**  
Abstract:  
What about the flexibility to include new sampling strategies (user defined one) or including new estimation approaches

Paul – all yours😊.

Introduction:  
L43: quality of

We have made the suggested change.

It would be good to add few references here e.g. L50,

We have added references as suggested (we need the refs).  
  
Method:  
L69-73: I think it would be good to add the reference to the specific function name listed in Table2. This way, I would be more explicit and avoid possible confusion. For example, in my case, when I first read the section header “simulate abundance”, I was expecting to see the way you dealt with the spatial distribution of abundance.

We have made the suggested change.

L94&95&104: I just want to make sure that the bias correction has been applied to these two equations. If logN (or logZ) is normally distribution with mean mu and sigma, then the N (or Z) is lognormally distributed with mean exp(mu+sigma^2/2). Therefore, when you write “mean” in table 3 for R and Z, I hope that you modified in your actual equation for log(Z) to:  
log(Z) ~ normal(log(mean)-sigma^2/2, sigma)  
In other word, the mean(R) is not simply exp(meanR\_log\_scale). exp(meanR\_log\_scale) is the median of the distribution of R.

Paul – all yours😊.

L107: there is not enough description to understand how you converted the abundance at age to abundance at length. What were the choice of length bin groups? Every 5 cm, 10cm? Such information is also missing in the tables. Please add that. But then you have to calculate some cumulative distribution (until length l) for the length at age distribution (using the VB growth equation) and do some subtractions to be able to allocate the abundance at age to each length group.  
See equation A.1.14 in here for example. [https://www.nwfsc.noaa.gov/news/events/program\_reviews/documents/C.2\_Methot\_Wetzel\_SSTechnicalDescription.pdf](https://webmail.mar.dfo-mpo.gc.ca/OWA/redir.aspx?C=5PGcmuyz2ftwpdMJypSWczx8i9PHq9PXMFtp3JW6dfukL9EAanTXCA..&URL=https%3a%2f%2fwww.nwfsc.noaa.gov%2fnews%2fevents%2fprogram_reviews%2fdocuments%2fC.2_Methot_Wetzel_SSTechnicalDescription.pdf)

Paul – all yours😊.

“Simulate spatial distribution”:  
I have a few comments on this section:  
1. First of all, I think it is important to state that you assume that the population dynamic model and the spatial distribution is independent i.e. you do not have a spatially-explicit population dynamics model. And talk about what it means (is it realistic, limitation, etc).

We have added the following text to L161. The original text is as follows “”

In response to this suggestion and the previous one, we have modified the text (underline).Paul – just a suggestion on how to deal with this.

2. L161. I think it would be better to rename “depth” as “main covariate influencing the species distribution”. And “depth” happens to be one of them for many species, but there are cases when this is not the case.

See next comment

3. L161. I think it would be good to say upfront that there are two ways of defining the spatial structure. Using the function in the package or user defined.

The original text read:

The next step in the simulation is to distribute the abundance at age matrix simulated using the

cohort model throughout a spatial field. Here, a grid of 𝑠 cells is generated where each cell has

161 an area of 𝐴 and depth 𝑑; depth is defined using a sigmoid curve, applied across longitude only, with a depth range of [𝑑min, 𝑑max], shelf depth of 𝑑shelf and a shelf width of 𝑤shelf.

In response to this suggestion and the previous one, we have modified the text (underline).

The next step in the simulation is to distribute the abundance at age matrix simulated using the cohort model throughout a spatial field. The spatial distribution can be defined by user but here, we describe the default function which simulates a grid of cells is generated where each cell has an area of and a main covariate influencing species distribution, in this case depth (). Depth is defined using a sigmoid curve, applied across longitude only, with a depth range of , shelf depth of and a shelf width of .

4. L161: I think another possibility is to generate a random field by using the package “Randomfields” for example. This way you can generate a map where “depth” is patchily distributed (maybe more like an island type case study)

Paul – all yours😊. Website for Randomfields is attached.

<https://rdrr.io/cran/RandomFields/man/RandomFields.html>

5. L163-164: please add more description about the division or strata. How can we set it up and what do you specifically mean by division and strata? Is one nested within the other, or not necessarily? Your examples are based on Atlantic Ocean and people in other regions might not be familiar with how these divisions are created.

Paul – need your help on the “how can we set it up”.

To better define division and strata, we have added the following new text (underlined):

The grid can be divided into two hierarchical levels. For demonstration purposes, we envision these levels as part of a stratified-random survey within international fishery divisions, i.e., divisions (e.g. NAFO or ICES divisions) and depth-based strata.

6. L163: Why only focus on “depth-based strata”? I think it would be good to allow the user to choose their own stratification approach. It could be depth based as you did (which happens most often in surveys) but it could technically be any other thing (user supplied). This allows more flexibility.

Paul – can you build in this functionality. Is this part of future work? Suggested start below……

“We agree with the Reviewers point and anticipate building this functionality into future versions of SimSurvey”???

7. L167: the equation is misleading and I am not sure it is right based on what is written in the text. You mentioned later on L178: that you “re-scaled” so that the total number of fish in a specific year and age across space is equal to the single number from the population dynamics model. If so, the re-scaling should be done in the identify (natural) scale, not in log scale. In log scale, even if ,, sums to zero across space, the sum in the identity scale won’t match. This is often refer to as “bias correction” for the log normal models. And you should ideally show how the rescaling was done in terms of the equations too.

Paul – all yours😊.

8. L167: this “depth preference” function is very simplistic and gives only very “smooth” symmetric distribution. More often, fish have a skewed depth preference: often right-skewed.

Paul – all yours😊. This seems reasonable – can this be added?

9. L173-174: I think it might be worth adding, in simpler terms, the meaning of the spatial smoothing and scaling parameters.

I have no idea what he’s talking about here. I thought you were clear. Could fight this or make a minor modification.

10. L178: it is another question of scaling. How did you exactly do the scaling? In the identity scale? By dividing my the sum of the effects? I am asking this because depending on how you did the rescaling, your correlation structure in space and age might have been affected and is not the same as the one specified in L172. Did you verify that?

Paul – all yours.

Table 4. “group\_ages”. Ok but how is the variance controlled for the other age classes?

Paul – all yours.

L189: “user supplied”. This is a good feature. However, I think it is important to mention here that user have to make sure that they use the correct projection method to ensure that each grid is of the same dimension.

We have made the suggested change.

L216: reference to figure 3?

We have made the suggested change.

L221: there is not “group\_years” argument in Table 4.

Paul – all yours.

L237: “this function”. I think it would be better to replace “this function” with “sim\_distribution” as you do not mention the word “sim\_distribution” in the sentence above this.

We have made the suggested change.

L158-251: In general, I think re-organising this section using sub-section headers could be useful. Just to guide the readers

This is an excellent suggestion and we have inserted headers where appropriate.

L254: you say that sampling is stratified random but SRS is also an option based on Table5. Please correct.

Paul - I’m not sure what SRS is

L257: what does this mean? Does this control the number of set but how is this calculated?

Paul – all yours.

L257: I do not see how you control for the total number of set in the survey? How do you control it?

Paul – all yours.

L261: I think you should mention here that you can also force the sample size (as seen on table 5). Moreover, in table 5, it would be good to set-up a “ages\_min” for the minimum number of ages to sample […]” so that it gives the ability to fix the sample size if needed by writing the same value for “ages\_min” and “ages\_cap”.

Paul – I don’t disagree but L261 is the equation. Just not sure what they are referring to..

L261: How are you making sure that the number of sampled fish for that specific cell, age and year won’t be above the total number of fish in that cell, age, and year? The probability value could be close to one and if you fish in a few a time, then you are at risk. Especially because your population dynamics model is not spatially explicit and is completely independent of the distribution function itself i.e. you can technically fish out all the fish in an area but it will be populated back the year after the way you implemented in this study… Maybe you need to put a condition (or just a note) for general users to make sure that this probability value is much below 1?

Paul – all yours.

L267: I recommend to clarify something here. 1. Depending on the number of fish caught? What do you mean? What is the rule you used? 2. The way you coded, sample by age is first decided, then the corresponding length is calculated, then age-subsample is determined. In reality, length sample is taken in the field, then age sub-samples are taken. While similar, I do not think it always equal. Especially, when you start including some correlation structure in the sampling. By the way, did you consider including some correlation structure in the sampling process to make more realistic?

Paul – all yours.

L275 Table 1 on should be table 5

We have changed the page numbers accordingly.

L275: Table5: “age\_sammpling” should be “age\_sampling”

We have made the suggested change.

L275: “min\_sets” you have not described it yet and what is it? You have sample from all cells? If no, this is not realistic.

Paul – all yours

L279: Table5 not Table1?

We have changed the page numbers accordingly.

L285-286: Could you be more specific on how custom closures can be supplied and where?

Paul – all yours

L306: how are these catchability corrected abundance matrices calculated? It is important to write this information somewhere (or write “please refer to the section “Stratified analysis” for further information on the calculation of abundance indices”) or something alike and Appendix S3.

We have adopted the Reviewers suggestion and referred the reader to the section on Stratified analysis. (Paul – I thought this was an easy out – your call as always).

L336: I think it would be good to say that other methods exist and people can use it in this package (maybe)?

Paul – all yours

L421: color gradient. Even though it is obvious it might be good to say green to purple gradient.

We have made the suggested change.

L427: instead of “sampling protocol”, I think it would be more meaning full to say the maximum number of length samples.

We have made the suggested change.

L452: say that the color ramps from yellow to purple

We have made the suggested change.

S1 appendix: missing figure in S1  
We have added the missing figure.

**Reviewer #2:** This manuscript describes an R package called SimSurvey. The package includes a set of functions for simulating point-based fisheries survey designs, e.g. bottom trawl surveys, for estimating abundance indices. It focuses on number of stations and number of fish sampled ignores other constraints such as distance between stations and day-time duration which impose strong constraints on real surveys. The functions included allow the user to first simulate age-and length structured population dynamics, distribute individuals randomly in space (assuming a certain correlation structure), carry out a survey and finally calculate abundance indices from the simulated data. The package will likely be of interest to researchers wanting to explore the precision achievable with different survey designs. My comments regarding the package and the presentation are summarised below.  
  
1. Optimization  
The title announces a package for optimizing survey designs. As far as I can see the package does not allow survey design optimization, neither in terms of defining survey strata nor in terms of number of stations per stratum. The strata are defined by the user. The only option available for the number of stations is proportional to stratum surface; the user sets the minimum number of stations taken in the smallest stratum. It would be useful to be able to specify the total number of stations and test different allocation schemes, such as proportional to surface area (implemented), equal number per stratum, Neyman allocation (accounting for surface area and abundance variability), etc.  
Please consider revising the title (e.g. “compare” and instead of “optimize)” and spell out the available sampling design options.

While somewhat trivial, as Bill says, the title is a mini-abstract. I think the points are small but valid. Suggest:

We agree with the Reviewer and retitled the ms “XXX”.  
  
2. Manuscript structure  
The manuscript might be easier to follow if the manuscript was restructured: 1) Model description, 2) Using SimSurvey. The later section would then group all example code which could again be subdivided into running simulations and exploring results (plot functions).  
Paul – this could be a lot of work. I leave this one to you but happy to discuss. – I’d be tempted to fight this.

3. Parameterisation  
To use SimSurvey for a real world problem realistic parameter values are needed. The package comes with default values chosen for a particular case study. However, no mention is made in the manuscript how to choose appropriate values for the many model parameters to tailor the simulations to a population of interest. I suggest the authors add a section on parameterisation and a table summarizing all parameters with a column specifying how to parameterize. For example, parameters for population dynamics and growth could probably be taken from the literature (or a stock assessment report). However this is not possible for the parameters of the spatial distribution function sim\_distribution() such as correlation between ages etc. Ideally the package would include a fitting function for estimating these parameters from actual data. These input data could come from a pilot survey and include location (lat, long) and numbers by length/age.  
Paul - This seems reasonable but I leave it to you.

Minor issues  
- line 93: I assume there is an age plus but this needs to be mentioned. Also, please specify how you set the initial numbers for plus group ().

Paul-help

- line 121: I don’t understand the explanation of a closure. What do you mean by “return functions”? Do you mean it returns an object with different attributes?

Paul-help

- line 125: the number of right and left brackets is unbalanced, please check

We have made the suggested change. Paul -I made a stab at this but not sure its right.

- line 126 “This structure was chosen to avoid the repeated specifications of ages and years”. As far as I can see the example code only specifies years, not ages.

Paul – can we modify the line to include ages???

- line 227 Please explain what a pipe is and how it is used. In the example I understand that the output of sim\_abundance( ) is provided to (piped) into sim\_distribution(). I am unclear what the object b contains. Is it the result of sim\_distribution()?

We have added the following text (underlined):

Also note that the key functions in the **SimSurvey** package have been set-up to be pipe [13] friendly, i.e. pipes are an operator to forward the values into a function or call expression.

Object b is the same as Object a but the variance in the size of clusters has been changed. We believe that this is clear from the text on L228-231 and the code on L235-243 but defer to the editor’s judgement on this matter. (Paul – I think this is reasonable?????).

- There is no table 1, please revise table numbering.

We have made the suggested change.