

Editor's comments

After considering the comments of the two reviewers, which are provided below, I think your manuscript should be acceptable for publication after satisfactory revision. Please address the reviewers' comments when revising your manuscript. Thank you again for submitting your manuscript to Ecological Modelling.

Thank you for your comments, we have provided a detailed response to each of the points made by the reviewers along with a track-changed (as well as a 'clean') revision of the manuscript. In addition, we provide a short vignette detailing an example application and R code for the framework, which we hope will widen accessibility and take up of the modelling framework. We hope that together this satisfies your requirements and look forward to seeing the manuscript published.

Reviewer 1 comments

This paper introduces a simulation framework for assessing the effects of different spatial and temporal observation scales on management of mixed fisheries. An application of the framework is presented, and the findings from the example application provided insights into the importance of data resolution on design and effectiveness of closed areas. The model code is included as an R package so that other researchers will be able to implement it readily to address a wide variety of management questions. The question of appropriate scales is an important one, and I think this will be a valuable tool for researchers and managers. I recommend that it be published after minor revisions.

Thank you, we are grateful for your comments that have improved our manuscript and look forward to our work reaching and being used by a broad audience.

Comment	Response
Abstract	
I think it would be helpful to mention the name of the R package (MixFishSim) that accompanies this paper somewhere in the abstract. People will search for the package name, it would be nice if the term was included in the abstract so the paper will show up in the search too.	We have included <i>MixFishSim</i> in the first sentence of the abstract.
"true underlying populations" - somehow make sure readers know this is referring to simulated populations.	We have changed to "true (simulated) underlying populations" on line 10 of the abstract.
Could add something like "bycatch avoidance", or something like that, somewhere in key words or abstract; people searching for that term would be glad to find this paper, I would think!	Done, see keywords.
I think the abstract could be streamlined a bit. You seem to have 2 major objectives with this paper: 1) introducing and describing the simulation framework that could answer a number of important management questions, and 2) demonstrating its usefulness with an example application. One full paragraph for each should be adequate, with a conclusion that states the usefulness of the framework for answering a number of fisheries management questions.	We've worked to shorten and strengthen the abstract as suggested.

<p>Introduction</p> <p>Line 62: “Do different sources of sampling-derived fisheries data reflect”...</p> <p>Methods</p> <p>Why was the Matern covariance structure chosen? I am just curious about this; does it reflect the spatial autocorrelation of animal distributions better than a Gaussian or other type of covariance structure?</p> <p>It would be helpful to have explanation of thermal tolerance earlier than line 155</p> <p>The paragraph starting at line 179 would be helpful to have at the beginning of the section</p> <p>Line 187, make tenses consistent (e.g. determined vs. determines) - also this sentence is a little awkward to read.</p>	<p>Corrected at line 73.</p> <p>We used the Matérn covariance structure as it is flexible, and contains the exponential form as a special case. We’ve added text at line 170 to say “We use the most commonly used Matérn covariance structure as it is a flexible form that under certain conditions is of the same form as an exponential function and it enables us to model the spatial autocorrelation observed in animal populations where density is more similar in nearby locations, but that correlation decreases non-linearly....”</p> <p>We have now added a sentence at the beginning of the section (lines 153 - 154) that reads “described by a set of probabilities. Stochastic probabilities are affected by the suitability of habitat, temperature in a cell and the thermal tolerance of a population to that temperature.”</p> <p>Agree, we have moved this to now be the second paragraph in the section.</p> <p>We have changed lines 208 - 218 so that it reads in the past tense and rewritten the paragraph to improve readability.</p>
<p>Results</p> <p>Line 376: What does “Visualized using Gerritsen (2014)” mean?</p> <p>Line 397: Are these the same figures in Table 7? If so, just refer to the table and summarize</p> <p>Line 400: move % sign</p> <p>Line 406: “(in red)” - leave reference to color for figure legend</p> <p>Line 410: “Again” doesn’t need to be there, same in line 413</p>	<p>We’ve now added to the caption of Current Figure 3: “The figure shows catch composition at each spatial unit represented by a square pie chart of the four populations. The area of each colour is proportional to the weight of each population caught in that unit. Figure produced with the R package ‘mapplots’ (Gerritsen et al 2014).”</p> <p>Yes, they are the same and we agree this change improves readability and the two final paragraphs in section 4.2 (lines 424 - 432) have been revised accordingly.</p> <p>This paragraph has been revised so the point is redundant.</p> <p>Removed reference to color on line 435.</p> <p>Agree, it has been removed on line 430.</p>

Line 416: This section is a little confusing and needs to be refined/streamlined.	We have now revised this section to clarify and improve readability. For example, shortening sentences and ensuring one point is made per sentence (lines 443 - 455).
Line 418: This paragraph should be in methods. But you did it for all populations, right? Not just population 3?	That's correct, the closures affected all populations but the closures were targeted to reduce fishing mortality on population 3. We have clarified and moved to the methods section now at lines 378 - 386.
Discussion / Conclusion The discussion and conclusion overlap a bit; I felt I was reading similar things over again; perhaps these can be streamlined? Line 560: change "reduced" to "reduce" Line 663: change "hypothesis" to "hypotheses"	We have reviewed but believe each paragraph makes an independent point except the final paragraph, which does repeat some of the previous conclusions. As such, we have removed the final paragraph of the conclusions. Done on line 581. This paragraph has now been removed at the suggestion of reviewer 2.
Figures Figure 1: nicely summarizes the model. It took me a little bit to figure out that "Rec" referred to recruitment - even though it was in the legend (I missed it when I read it the first time)... is it possible to choose an abbreviation that makes it more obvious, maybe something like "Recruit" or even "Recr"? It also occurs to me that there is an opportunity to introduce the terminology from your R package here to make it very clear to the people using your code how the functions work together... this is only an idea though... or maybe a similar figure could be included with the vignette. Figure 5: Do the colors indicate the dominant population in each cell? It is hard to imagine that one would assume only the presence of specific population in the cell? Or do I have the wrong idea about what the plot is showing? Figure 6: Add what the different colors mean to the legend Figure 9: So the top two panels show spatial distribution for population 3? That needs to be added to the legend. Also there should be a red box on the top plot too.	We have changed to 'Recr' to make clearer. Rather than change the schematic, we have included a short example vignette demonstrating the use of the code to increase accessibility and further uptake. Each cell has the four colours in proportion of the weight of each population caught (as a square pie chart) - we've clarified this in the figure caption. This is already included as the legend shows which population is represented by which colour. The top two panels show the spatial distribution of the fishing effort before (a) and after (b) the spatial closures, while the bottom (c) shows the suitable habitat for the population. We've clarified in the figure caption.

Reviewer 2 comments

The paper Dolder et al. presents a new highly resolved spatiotemporal model that simulates populations of species and fishery dynamics to assess if data from commercial catches and fixed-site sampling surveys on different spatiotemporal scales represent the real distribution of the populations, and if these data are effective to base management programs. Moreover, they presents other applications of the model.

This is a very interesting paper, and the model provides several applications for management programs. I have only few greater questions and some small issues, most of them about the presentation of the information.

We thank the reviewer for their comments and suggestions that have greatly improved the presentation and interpretation of our methods and results.

Comment	Response
General comments	
How many species does the model simulate? The authors refer to the issue of catching unwanted species (vulnerable or low quota species) when available quota species is caught, and it suggested me that populations of different species is modelled at the same time. However, they did not describe how many species could be simulated in each simulation, only that four populations were simulated. Does the populations simulated in different simulations, or all of them are simulated simultaneously? The results indicate that the four populations were simulated in the same simulation. Please, clarify this in the MM.	We now emphasise on line 100 that the framework allows the user to define as many species as required. There will be some computational/memory cap but we see no reasons why you could not include 10s or more. We chose four to keep the analysis more tractable. All the populations are part of the same system, irrespective of the number of species included, hence they are simulated in the same simulation.
There are too many figures and they should be better edited. Why the name of the row and columns are inside the graphics? The axes scales and the axes title should be greater. I would also send the figure 2, 3 and 9 as supplementary data.	We have revised the main figures to increase text size and changed to bold font; we have also moved figures 2 and 3 to the supplementary figures. We have retained figure 9 (Current Figure 7) as we believe it gives understanding to the fishery - population interactions before and after the spatial closures which is important for the narrative of the example application.
The legends of the supplementary figures should be more informative. In the Figure S2, what the light gray spots are? Habitat preference? Are the squares the spawning areas? In the figure S3, are each square a week?	We have revised the captions for the supplementary figures to provide additional information, including the issues you've identified. Specifically, Figure S2 (Current Figure S3): "with the darker colour showing greater habitat suitability". Figure S3 (Current Figure S7): the caption reads "for 52 separate weeks"
I am not native English, but the language seems good for me. However, I missed several commas along the text that make the sentences too long and hard to understand. I suggest a revision of this.	We have revised the text to ensure readability.
Small issues	

Line 14 - 18: This phrase is too long and hard to understand. Please, rephrase this in shorter sentences to clarify this idea.

Lines 20 - 43: These two paragraphs seem redundant.

Line 68 - 72: The authors mentioned that the Mix-FishSim could be used to infer if fisheries data are the real community structure. I suggest adding one or two phrases to explain how the model could help in this.

Line 90. The authors presented the time-step of each module, except the Recruitment dynamics. The recruitment dynamics probably follow the population dynamic, but it would be interesting present this explicitly.

Line 282: How these population parameters were selected? Randomly? Using real data? Or the authors only created them?

Line 426: What does adapted means in this context? Exploring new opened areas?

Line 613: Do not use parenthesis inside of other parenthesis.

Table 2 and table 3 are not cited in the text Citation of the supplementary figures are out of order

Figure 3: Individual years ARE the light grey lines

Figure 4. What do the purple spots represent? Describe these spots in the capture

These sentences have been revised to clarify in lines 14 - 21.

We believe these paragraphs set the context for an important premise of the paper: That identifying the correct spatial scale for management is important to achieve the anticipated outcomes; particularly in mixed fisheries where there is a 'cost' through loss of fishing opportunities for other fisheries which management seeks to minimise. However, we have revised at lines 23 - 34 to make our point clearer to the reader.

We explain that as our community structure is simulated and therefore known, by comparing our inferred community structure from commercial catches with our known true structure we can understand how biases introduced by using commercial fishing as a sample affects our understanding. These points are covered on lines 79 - 83.

Recruitment occurs along with other population dynamics, but only during defined periods for each population. We've clarified by saying in lines 100 - 102 "Population dynamics for any number of species, as chosen by the user, operate on a daily time-step (*with recruitment occurring only during defined seasons for each population*), while.."

The demographic parameters were chosen by the authors to broadly reflect population dynamics for a four-species assemblage representing species typically found in a demersal fishery. We have clarified by including in lines 310 - 313 the sentence: "The population demographics were chosen to broadly represent three mobile low-medium value groundfish species and one high value species with low mobility, with the dynamics hypothetical but as you might expect to find in a typical demersal fishery."

Yes, we have clarified in the text on lines 446 - 447 that the fisheries "adapted" to the closures textitby fishing new areas of high abundance to fish

We have changed on lines 632 from "(e.g." to ", e.g." to eliminate one set of parentheses.

This is now corrected with references inserted for Table 2 (line 204) and Table 3 (line 274) and the supplementary figures reordered.

Corrected.

This has been clarified (in Current Figure 2) to be the revenue at each location (darker areas indicate higher revenue).

Figure 7. Add what “res” means in the caption.

Have clarified in the legend text that it means “resolution”

Figure 8. What F means?

Changed to read “Fishing mortality”
