Dear Dr. Szuwalski,

Thank you for your recent submission to *Fisheries Research* titled "Estimating time-variation in confounded processes in population dynamics modeling: a case study for snow crab in the eastern Bering Sea". The manuscript summarizes modelling efforts for the Eastern Bering Sea snow crab with respect to including time-varying processes in the stock assessment model. Investigated processes include natural mortality and catchability, along with the combination of both processes. I found the manuscript easy to read and "complete" with respect to the analysis. I am suggesting that it be accepted with minor revisions because I would like to have a bit more interpretation of what is going on behind the scenes in the model and the management process that rejected the inclusion of the time-varying processes.

The paragraph that starts on line 56 was difficult to follow. I realize all of the information in it is about Eastern Bering Sea snow crab but it did not flow well for me. I think the topic sentence should be more general and just about snow crab rather than something specific about time-variation in snow crab because then I thought that the entire rest of the paragraph would be about biology and research associated with that biology. Also, the terminal sentence about not being able to age them and the definition of a pseudocohort should come before its use rather than afterwards in parentheses.

I did not like the use of code for labeling in the paragraph that starts on line 101. I think that it is more explicit to say a "vector of deviations" (i.e., labelled as 'dev_vector' in AutoDifferentiating Model Builder; Fournier et al., 2012)". In the next sentence you anthropomorphize the vector by saying that it estimates. When I believe that sentence should read "The vector includes an …".

Can you please include some text regarding the increase in the scaling parameter on the time-varying processes across models? You mention it at the end of the results but then I did not remember you addressing it in the Discussion section. Basically, I am assuming that the model can kill fish many ways and it does not have a conscious with respect to assigning changes in the data to one process or another. What data do you think is needed to flush this out? Or, is it a lack of specification in the model? I think it the former but would be happy to read text about either.

Discussion section is hyper-focused on time-varying processes rather than explaining or putting into context the resultant rejection of the time-varying models in the assessment process. I would like more context and explanation of the reasoning why the models were rejected and potentially why other models are rejected in favor of things that are "incorrect" simplifications. Feel free to reference other stocks. Also, you could talk about the min-max solutions as far as the least-worse outcome when we know that things will never be ideal.

Thank you for a well-written, easy to review manuscript. It was a pleasure to read. I just think that it needs a bit more in Discussion about why the models were not used if they provided better fits to the data. Below you will find minor suggestions in addition to the larger ones listed above.

Kind regards,

Kelli

Global changes

"e.g." to "e.g.,"

“eastern Bering Sea” should be “Eastern Bering Sea”

“status quo model” should really be “status-quo model”

Whenever the word data comes after “size composition” it should be “size-composition data”

All dashes between numbers should be en-dashes rather than just a regular dash, where an en-dash is a mid-sized dash approximately equal to the width of the letter n and used for ranges between numbers and dates.

You define OFL and then use it subsequently as “The OFL”. The article (e.g., the, an, a) is not needed unless you are using the acronym as a modifier, which you are not.

Should you use “MMB-per-recruit” rather than “mature male biomass-per-recruit”?

Parameters are only italicized in equations where they should also be italicized in the text in my opinion.

Remove the quotes from all subsequent uses of model names. Sometimes you use single quotes and sometimes you use double quotes but the single quote should only be used in the first instance.

You consistently anthropomorphize the models. Statements such as “Models … estimated” when the model doesn’t really estimate anything. Instead a parameters was estimated would be more correct.

All instances of “Fish Res.” in the References section should be “Fish. Res.”

Information printed on the screen is NOT read by screen readers and is therefore inaccessible to those with disabilities and should be clearly laid out in all captions.

Full stops at the end of figure captions.

Line-specific changes

6: “mortality (M)” to “mortality, M,”

7: “catchability (q))” to “catchability, q)” to get rid of the double bracket.

7: remove comma before “but”

11: Comma after “Here”

20: “natural mortality, catchability,” to “natural mortality (M), catchability (q),”

27: “in convincingly” to “when”

39-40: remove “(e.g. …)”

41: change “:” to a comma

66: “(Figure 1 & Figure 2)” “(Figures 1 and 2)”

68: I think “recruited to” should be “first selected by”

73: remove the comma

78: Add a comma after “Here”

90: there should be a space before “mm”

96: Change “Survey biomass indicies” to “Survey indices (mt)” or whatever unit of biomass that you are using

97: add the units associated with fishery and bycatch biomass

101: Change “:” to a comma and remove the sentence starting with “Each” as it is redundant with other information

108: Should it be “Eastern Bering Sea” rather than just “Bering Sea”?

116: Add “models with” after “and”

117: Remove the sentence starting with “A retrospective pattern “ because you have already used the term two times in the manuscript, and thus, you already expected the reader to know what you were talking about.

119: I think the sentence would flow better if you used commas rather than parentheses for the which clause

129: The integer 7 should be written out in words

Eq (1): Why does only the first definition include bycatch because presumably bycatch occurs no matter what MMB is

136: change “MMB is the projected mature male biomass” to “MMB” and change “mature male biomass” to MMB in the subsequent sentences. Remove “he” before “F_{OFL}”

140: Why did you use 0.1? Perhaps add a reference.

150: It is unclear to me what confidence intervals you are talking about, can you please specify which model they were estimated in?

165 and 167: remove the comma before “but”

168: remove “model”

169: change to “estimates of natural mortality were much higher than estimates from status quo in recent years. Estimates from”

170: remove “very”

173: Did you call the survey the NMFS survey before, if so I don’t remember you it and the defined name of the survey makes me think that there are additional surveys rather than just one

179: change “natural mortality” to “*M*” and “mature male biomass” to “*MMB*”

188: THANK YOU for doing this additional analysis, what great foresight.

193: remove the comma

215:216: I think we meant to suggest that it should be a minimum default given realistic amounts of available data in Johnson et al. (2014).

246: looks like the link was botched and the underscores should be single where the manuscript looks like they were doubled, i.e., "__" rather than "_"

249: no page numbers

271: I think all authors need to be listed or at least a first x number of authors, not sure

330: Fix the abbreviation of Reviews in Fisheries Science

Appendix: TLDR but I am assuming it is fine

Table 1. Acronyms used in the table need to be defined in the caption. The table would be easier to read if the decimals lined up going down a column. Number of decimals should be consistent, i.e., the trailing zeros should be present, e.g., "0.00" not "0".

Table 2. MMB is not defined nor are other acronyms used in the column headers. I recommend changing the header of average recruitment to "avg rec" and defining it in the caption rather than "avg__rec". It is unclear if you are reporting differences or actual values because you say "Changes in".

Figure 1: Change "inthe" to "in the". Change "1000t" to "1000 mt" in the y-axis labels. Define MMB in the caption. You do not talk about the year in which quotas were introduced in the text.

Figure 2: Use actual lines in the legend rather than a rectangular gradient because you use integers rather than a continuous representation of these values, i.e., you always report them for a given point in the year rather than fractions of years as implied with a gradient legend. I think you can shorten the survey name to just "survey" because there is only one survey. Which model is the dashed green line from?

Figure 3. Need to define the model names used in the legend in the caption. Use a full stop after "survey". Change the y-axis label to "(1000 mt)" rather than "(1000t)". What are the points and vertical bars from?

Figure 4. Reference caption from Figure 3 for more information. Define MMB and change units in y-axis label. Change "mature biomass at survey" to "mature male biomass (MMB) of the survey". Use en-dash for year range.

Figure 5. Define what the points and vertical lines mean. Do you really need the male label when all you are plotting are males? Colors are not defined. Change units in y-axis label. Define Mohn's rho.

Figure 6: "Model predicted" should be "Model-predicted". Same comments as some of the other figure captions.

Figure 7. Only the lower panel is labeled, all three should be labelled as defined in the caption.

Figure 8. Use actual math notation with a superscript in the y-axis label. Change "time varying" to "time-varying"

Figure 9. Cannot you just plot one line and say that all models used the same information?

Figure 10. Change y-axis label to have “mt” rather than “t”. The caption should explain the point versus line.

Figure 14. Do not use the same colors for males and females that were used for models in previous figures.

Figures 15-18. No y-axis label.

Figure 22: “time varying” should be “time-varying”. Fix y-axis label.