**Response to** Robby Fonner Comments on “Spatial separation of catches in highly mixed fisheries”

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| 1. Big picture … aka story, contribution, soundness/appropriateness of methods |  |
| As someone who is not highly involved in spatio-temporal modeling with dynamic factor analysis, I thought the paper did a great job of clearly communicating the methods, objectives, and results clearly and in a meaningful way. | Great! |
| Consider revising opening paragraphs with the objective to “hook” the reader right away. Why is this paper important methodologically and with regard to fisheries management? Why should I care? |  |
| Page 3, paragraph two. – in framing the story, you may want to acknowledge that it is the objective of fisheries managers to utilize stocks to their MSY. Fishers, on the other hand, maximize their utility, which usually involves maximizing expected profit, managing risk, maintaining their cultural identity etc. They respond to economic incentives along internal (e.g. gear, effort) and external (e.g. switching fisheries) margins. So the trick, as I see it at least, is to understand what catch compositions are available to fishers, and then implementing policies that create incentives for them to harvest those compositions that promote utilization. This might not be critical to discuss in the current manuscript, but I think it makes for a more believable policy story. | I have added a sentence so it reads:  “societal objectives for fisheries are to achieve MSY across ecosystem components are framed alongside individual fishers goal to maximise utility; whether that be profit, income or continuance of traditional practices.” |
| 2. Missing references or context |  |
| Pascoe et al 2007 (attached) compare targeting ability for beam and otter trawlers in the North Sea demersal fishery. Findings include differences in targeting ability across gears and vessel sizes. These findings might enrich, verify or provide a comparison for the findings in this paper based on fishery-independent data.   * + For example, “differences in catches between locations” is supported by Pascoe at al … but they also find, as I recall, heterogeneous targeting ability among fleets. Considering the results of the current study, it is possible that the targeting heterogeneity found by Pascoe could be due to differences in “tactics” across fleets”. | Have included this reference in discussion on the extent to which altering catch compositions is possible.  “.. while differences in the ability to change catch composition has been observed for different fleets; in the North Sea targeting ability was found to differ between otter and beam trawl fleets as well as between vessels of different sizes \cite{Pascoe2007} |
| Page 14, paragraph One: *“… our framework could be used to simulate different fishing effort scenarios to identify lower bounds for optimum spatial avoidance* (Reimer 2017) *to support management decisions. Identifying the limits of spatial targeting and avoidance could support scientific contribution to meeting the goal of maximizing catches in mixed fisheries within single stock quota constraints*.”   * + I think I am missing exactly what is meant by this. Clarify with additional detail. I am also not fully clear what is being cited from the Reimer paper. | Yes, I can see that. I’ve rewritten this to try and make it clearer, it now reads:  “Our model captures differences between location fished for two gear types and their broad scale effect on catch composition, information crucial for managers in implementing the landing obligation. However, it likely the analysis reflects a lower bound on the utility of spatial avoidance as fine scale behavioural decisions such as time-of-day, gear configuration and location choices can also be used to affect catch\cite{Abbott2015, Thorson2016}. Results of empirical studies undertaken elsewhere\cite{Branch2008, Kuriyama2016} suggest limits to the effectiveness of spatial avoidance. Our framework allows for a quantitative understanding of the broad scale global production set available to fishers\cite{Reimer2017} and thus the extent to which they can alter catch compositions while operating in a mixed fishery. Simulations of spatial effort allocation scenarios based on the production sets could identify allow for identification of the lower bounds of optimum spatial harvest strategies, informing on the potential of spatial targeting in changing catch composition, thus provide a scientific contribution to meeting the goal of maximising catches in mixed fisheries within single stock quota constraints \cite{Ulrich2016}.” |
| 3. Future directions |  |
| Consider expanding the discussion (pages 13-14) to add specifics about how the modeling techniques, and results yielded by the modeling could potentially be used for informing policy (e.g. time-area closures, spatially heterogeneous catch regulations, move on regulations). The methods and results are clear and very well written. The biggest thing that jumped out at me is that the discussion about where this goes next is fairly limited and less detailed compared to the rest of the paper. | I’ve added some more on this, without being able to add too much text because of word count. For example,  “Advice informed by a model including a seasonal or real-time component could inform optimal policies for time-area closures, move-on rules or even as informal information to be utilised by fishers directly.” |
| Another thought I had is that the type of modeling in this paper could potentially serve as an input to behavioral models (e.g. location choice, production models) of fishermen where environmental conditions (e.g. species density) are unobservable or partially observable. | Agreed, I’ve added text to this effect – the potential for use of near real-time fishing vessel data (vessels-as-laboratories approach) to inform a seasonal model is a big strength over a model requiring environmental data as an input. |
| This framework could likely also inform bycatch avoidance. It might be worth developing a paragraph in the discussion around future directions related to the bycatch, or protected species context. | I’ve tried to draw more out on the benefits of using correlations among species to draw inference on poorly sampled species, e.g. protected elasmobranches. |