EGUsphere, author comment AC1
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Reply on RC1

Alexa K. Byers et al.

Author comment on "Soil depth as a driver of microbial and carbon dynamics in a planted forest (*Pinus radiata*) pumice soil" by Alexa K. Byers et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-689-AC1, 2022

General comments

The authors examine an important topic: what is the size and age and variability of soil organic carbon (SOC) in deeper portions of the soil profile (30 -100 cm in depth e.g. subsoil), and how do these quantities vary across space? The authors description of SOC and soil microbe composition changes along the soil profile will inform ongoing scientific discussions of soils and their ability to store carbon (C). This question and the findings of this study are also relevant for the growing number of projects (public and private) hoping to mitigate climate change through increasing SOC pools via soil amendments or ecological restoration.

The methods used by the authors are appropriate for investigating this topic. I am also pleased by their use of multiple estimates of SOC age - which gives confidence to their findings. I found the manuscript to be well written, maintaining a healthy balance of thoroughness and interest throughout the text.

Response: We thank Reviewer 1 for providing their time and expertise to review our manuscript and provide constructive feedback. We found the comments helpful and presented in a kind and balanced manner. We believe that taking on the recommendations you have made will improve the quality of our manuscript. We have responded to Reviewer 1's specific comments below. For most comments, we are happy to revise the manuscript according to the reviewer's recommendation.

Specific comments

To understand and generalize from these dynamics, I (and I assume readers) would be interested to know the average and range of pH in the soils of this planted forest. I would add this information to the description of this site (which is otherwise fairly comprehensive).

Response: Thank you for taking interest in the finer details of our field site. Puruki Forest has an average soil pH of 5.2 (Beets & Brownlie, 1984). Further research by Beets et al. (2004) identified the soil pH of Puruki Forest to increase with soil depth, reaching pH 5.62 at soil depths of 2 m. We are happy to add this information to the manuscript under the reviewer's recommendation.

The authors need to pay attention to the notation that they use and keep this consistent throughout the text and figures. At times they switch between percent and permille for 14C (Fig. 2). Figure axis titles should also be the appropriate symbol, and not %o for permille.

Response: Apologies for these errors, we are happy to correct these in a revised manuscript as per the reviewer's recommendation.

CRA is not defined in the text. Please do so before introducing this as a measurement.

Response: We apologize for not defining CRA properly. We are happy to add the following sentence to the revised manuscript to clarify our terminology- "Conventional Radiocarbon Age (CRA) and ^{14}C are reported as defined by Stuiver and Polach (1977), with CRA presented as years before present (yBP) and ^{14}C presented as per thousand [per mille, ‰]."

My understanding of Fig. 5 is that C and D are replots of A and B, but just now with the environmental vectors overlaid. These replots with the environmental vectors don't allow me to interpret the shifts in your data points (the data is too scrunched near 0,0). I suggest either removing C and D or re-scaling the vectors (divided by 10 maybe) and replot A and B with these rescaled vectors so that readers can see how these environmental variables are affecting your estimated microbial compositions.

Response: Reviewer 1 is correct; subplots C and D are re-plots of A and B with fitted vectors. We agree that these plots are not easy to visually interpret- which makes their purpose potentially redundant. The information visualized in subplots C and D was detailed in-text in Results section 3.4 (lines 251 to 257). Considering this, we are happy to remove subplots C and D from Figure 5 in the revised manuscript.

6 has some bizarre mispellings of names (Sebciunkles instead of Sebacinales) and I would standardize the names to remove the trailing '_ unk' artifacts of taxonomic clustering

Response: Such errors are well noticed by Reviewer 1, apologies for the misspellings. We fully support the recommendation to standardize the names and remove '_unk' from Figure 6 in a revised manuscript.

Line 175 - McMurdie not Mcmurdie

Response: We are happy to correct this error in a revised manuscript.

It's not clear to me why you exclude negative interactions from the network analysis. If you can justify this briefly, do so in the text.

Response: we excluded negative interactions as we were primarily interested in observing positive species co-occurrences. That is, we focused on which species are commonly present and defined the 'core microbiome' of the topsoil and subsoil. However, we understand including negative interactions is an insightful piece of information to present. If deemed appropriate, we are happy to re-run the analyses to include negative interactions in a revised manuscript.

Line 414/415- you didn't examine microbial biomass though, you quantified DNA and you've stated that you did not partition between viable and nonviable cells/hyphae. While DNA abundances can be used as a proxy for biomass in controlled systems of relatively short age I don't agree with claiming this as biomass here, as much of the DNA you

sampled from these lower depths may actually be relictual. Best refer to it as something neutral like 'DNA abundance'

Response: Reviewer 1 provides a valid argument that we support. We are happy to rephrase the term *microbial biomass* to *microbial DNA abundance* in the revised manuscript (or words to the same effect if this does not grammatically fit the sentence in question i.e., microbial 16S rRNA gene abundance).

I found it interesting that Bray P did not correlate with other factors (Fig. 4). In the text you mention that you also measured total soil P, however it looks like this wasn't included in analyses. Was this estimate just not variable? I noticed that the soils are very young (from a recent volcanic eruption even), so I'm assuming that the microbes and vegetation are more N limited while P is abundantly available? If it's not too much trouble I'd add general P and N abundance or availability at this site in the site description (plant-microbe people love this). Total P should atleast show up in the supplemental materials along with total C and N(e.g. Table A2)

Response: We measured many different soil properties. As the primary focus of our research was carbon, to keep our analyses focused we selected a few non-carbon metrics. However we agree with Reviewer 2, information relating to soil phosphorus is interesting regardless of whether we included it in our analysis. Thus, we are happy to revise Table A2 to add the data for total P, as well as inorganic P and organic P. Or as an alternative, we would also be interested in submitting a Data in Brief article to accompany this manuscript to provide the full datasets for all the soil chemical properties we measured. This may be more valuable to the wider scientific community. Whatever the Reviewer or Editor feels is more appropriate and useful.

As background, Puruki Forest was formerly pasture that was converted to *Pinus radiata* forest in 1973 (Beets & Brownlie et al., 1984; Meder et al., 2007). During the establishment of Puruki into pasture in 1957, superphosphate treatments were applied and therefore the site has a high soil fertility including soil N and P – see Beets & Brownlie (1984).

- **Meder, R. O. G. E. R., Beets, P. N., & Oliver, G. R. (2007). Multivariate analysis of IR, NIR, and NMR spectra of soil samples from different land use conversions: Native Forest, pasture, and plantation forest. New Zealand Journal of Forestry Science, 37(2), 289.**
- **Beets, P. N., & Brownlie, R. K. (1987). Puruki experimental catchment: site, climate, forest management, and research. New Zealand Journal of Forestry Science, 17(2/3), 137-160.**