Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-401-AC2, 2019

Interactive comment on "Soil carbon, nitrogen and phosphorus stoichiometry (C : N : P) in relation to conifer species productivity and nutrition across British Columbia perhumid rainforests" *by* John Marty Kranabetter et al.

John Marty Kranabetter et al.

marty.kranabetter@gov.bc.ca

Received and published: 2 December 2019

Thank you again for some helpful feedback on our manuscript. Here are our comments to the suggested revisions:

Reviewer 2

The study is largely based on correlations analyses. In particular, the authors correlated element contents and element ratios (Table 2 and Figure 2). This is problematic in most cases because one precondition of a correlation analysis is that the variables

are independent. By definition the C:N ratio is not independent of the C content, thus the pre-condition of independence is not fulfilled. Therefore, the two variables should not be correlated

This portion of the manuscript followed the example of Tipping et al. 2016, who said "…previous analyses considered the C, N, P and S contents of the soil as a whole rather than SOM, whereas a more informative approach might to compare N:C, P:C, and S:C ratios, which are direct measures of the element enrichment of organic matter. Mazoni et al. (2010) for example, in a meta-analysis of litter stoichiometry, constructed plots of C:P against C:N as a way to visualise the data, and thereby demonstrated a strong pattern…" The reviewer is correct in that correlations of ratios are more prone to spurious correlations, but we argue that they can still be useful if care is taken not to overinterpret the relationships. We included the ratio correlations in Table 2 as it confirms the direction of these patterns and how closely it matches absolute C, N and Po correlations (e.g. consistent these patterns in organic matter quality). Note, for example, that C:N and C:Po are quite strongly aligned ($r = 0.8$), which by ecological theory should mean that plant-available N and P increase in lockstep. That this does not appear to happen in reality is a key finding of the study. Also the relationship between soil C and C:N was again promoted by Tipping et al. (2006) and so our finding of the inverse relationship is well worth highlighting here. We revised the Introduction to explain how the correlations follow the Tipping et al. (2016) protocol, and added a comment under Statistics to emphasize some of the issues in correlations of ratios (Jackson and Somers 1991).

One asset of the dataset is that the authors have collected data on stand productivity. This kind of information is many times not available in datasets on soil nutrient dynamics in forests and the authors should make better use of this data. The authors found negative correlations between the stand basal area and the soil C:N ratio which is interesting. However, to explain the observed pattern it would very likely be more meaningful to look at the relationship between soil N stocks and productivity. I recommend to not only consider the element ratios but to calculate the element stocks. The element stocks are likely also useful in explaining the foliage element contents.

A significant challenge with soil N stocks is that nutrient concentrations of each substrate have to be converted to content (kg ha-1) so that the total amount of N can be deployed. This requires accurate measures of bulk density for each substrate, plus coarse fragment content. In addition, some sites with deep forest floors will be compared to sites with thin forest floors and so the researcher has to decide whether N stocks needs to be scaled accordingly (e.g., sample deeper into the mineral soil profile when forest floors are thin). Soil stoichiometry bypasses all of these issues by focusing on organic matter quality. A number of studies have shown the utility of this approach (e.g. Littke et al. 2014; Albertini et al. 2015; Van Sundert et al. 2018), including the current work, and it seems increasingly likely that these ratio parameters will be of the most utility in largescale comparisons. We would also point out that the correlations in Table 2 clearly indicate that N% of either substrate are in any case very closely related to C:N ratios. But to partially answer your question, we tested mineral soil %N and forest floor %N against basal area and found them to be inferior to C:N, both in the AIC score and in the F values. Species effects and species interactions were also weaker or nonsignificant with soil %N. As we commented in regards to the previous reviewer, please keep in mind that our goal in this study was not simply to find the absolute best predictors of stand productivity, particularly since multiple nutrients might be at play and we have no way of testing all the possible interactions. Instead, we wanted to contribute to the growing interest in soil resource stoichiometry as a tool in understanding ecosystems (Zechmeister-Boltenstern et al. 2015; Spohn 2016). So we prefer to keep that focus in the manuscript and not add further sections examining possible model outcomes for nutrient stocks. A comment as to why resource stoichiometry might be preferable to nutrient stocks was added to the Introduction.

The results shown in Fig 3 are interesting. It would be helpful to see the 1:1 line in all three plots. The authors should discuss the question why the difference in the C:N

ratio between organic horizon and mineral soil is smaller than the difference in the C:P ratio.

The graphs were revised to include the 1:1 line. We included a comment on substrates as suggested in the Discussion “It was interesting to note that correlations between substrates for C:N were much closer to a 1:1 relationship than C:Po, indicating that P cycling through litterfall has been greatly impeded in comparison to N”.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2019-401, 2019.