**Michael Philben (Referee #3)** (Received and published: 2 August 2019)

*Keenan et al. use C and N stable isotope ratios to demonstrate that N derived from carrion can persist in the soil for >1 year, down to ~10 cm depth and up to 60 cm from the site of the carcass. This shows that these decomposition hotspots can have a surprisingly long-term impact on soil nutrient status and biogeochemistry, even after visible evidence of carrion has disappeared. Previous studies have examined this question, but the present study is unique in also examining the lateral and vertical extent of carrion-derived N after 1 year.*

*Overall I found the paper to be interesting, concise, and easy to read. The qualitative conclusion (that carrion N can persist in the soil for >1 year) is very well supported.*

*However, I think the explanation of some of the quantitative aspects should be improved before publication.*

***General comments:***

*1) Some issues with the mixing models:*

*1A) The 2-source mixing model assumes differences in d15N are caused only by mixing of sources and are not affected by diagenetic fractionation. As noted elsewhere in the manuscript, it's quite likely that the elevated N availability would result in additional nitrification and denitrification, which would increase the d15N independent of source mixing. This assumption should be stated and its potential influence on the quantitative results discussed.*

> **Response**: The reviewer is completely correct, and perfectly summarized that two distinct but related processes are controlling $\delta^{15}N$ in these soils: input of an N-rich (and enriched) source and subsequent diagenetic fractionation (driven by microbes). We have included a sentence from the reviewer's comment above into the Discussion, and added a paragraph to more clearly state that our two member mixing model likely includes contributions from both the N-enriched carcass and subsequent diagenesis.

*1B) Conversely, calculation of the isotopic discrimination factor (Figure 6) appears to ignore the impact of having a 15N-enriched source in the surface soils but not the deep soils. In other words, if the d15N depth profile is driven by distinct sources (as indicated by figures 4 and 7), then the slope in figure 6 does not represent the isotope discrimination factor.*

> **Response**: We reworded any reference to "discrimination factor" for clarity and replaced it with "observed isotopic discrimination" to emphasize that we are not trying to make inferences about processes occurring, rather that the slope of these lines changes. As the reviewer mentions, this is driven by changes to N sources, rather than some underlying process.

*1C) I was confused by the use of both a 2-end member and a 3-end member mixing model. I think I understand that the former is for comparison along the lateral transect while the latter is for comparing soil profiles. Some additional explanation would be useful.*

> **Response**: The reviewer is correct—the two end-member mixing model is for the surface soils and the three end-member model was used for soil profiles. However, based on comments and critiques from both Reviewer #2 and #3, we elected to remove the three end-member mixing model from the manuscript.

*2) The introduction states a goal of ultimately moving toward quantifying ecosystem impacts of carrion inputs (Line 71). However, there is little discussion of how the results could be scaled to contribute to the ecosystem level. Can you put in context how much N was added via carrion, how much remains in the soil after 1 year, and how much was lost from the soil? It seems like this should be a relatively simple calculation using the biomass and %N of the carrion and the N content of the soils. This would be very helpful for quantifying the importance of carrion in the ecosystem N cycle.*

**Response**: This is an excellent suggestion. Text was added to the discussion to provide these details (Lines 279-284).

***Specific comments:***

*3) Abstract: the abstract is heavily weighted toward background information rather than results and experimental design*

**Response**: The abstract was edited to remove some of the background information and to include more results.

*4) Lines 47-50: can you be more specific about the direction of changes observed (e.g. does pH consistently decline, etc.)?*

**Response**: This was also brought up by Referee #2 (comment 9) and the text was modified to describe the direction of changes.

*5) Lines 154-157: I'm confused about the inclusion of both shallow and deep control soils in the mixing model. Can you explain the justification for this approach in more detail?*

**Response**: We removed the three end-member mixing model.

*6) Lines 273-275: offer an explanation why carrion had not effect on d13C? (looks like the decomposition fluids had similar d13C as the surface soil)*

**Response**: We provided a reference for Wheeler and Kavanaugh (2017), where the authors go into great detail explaining a lack of observed change in $\delta^{13}C$. We added a sentence to our MS to offer a brief explanation, guided by previous suggestions by Wheeler and Kavanaugh.

*7) Table 1: indicate why the 1-yr samples are bolded. N.M.=not measured?*

**Response**: Text was added to the figure legend explaining the significance of bolded data and N.M. abbreviation.

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**References Cited**

Wheeler, T. A., and Kavanagh, K. L.: Soil biogeochemical responses to the deposition of anadromous fish carcasses in inland riparian forests of the Pacific Northwest, USA, Can. J. Forest Res., 47, 1506-1516, https://doi.org/10.1139/cjfr-2017-0194, 2017.