

## ***Interactive comment on “Livestock enclosure with consequent vegetation changes alters photo-assimilated carbon cycling in a *Kobresia* meadow” by J. Zou et al.***

**Anonymous Referee #2**

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This study investigated the impact of 6-years livestock enclosure on plant community structure and C cycling on a grassland field on Qinghai-Tibetan Plateau. Based on the plant survey, authors found livestock enclosure reduced the plant species diversity, in particular legumes and forbs. In addition, livestock enclosure significantly increased the litter production and reduced the fresh plant biomass. By applying the  $^{13}\text{C}$ -pulse labeling technique, authors tracked the C entered the plant and soil system for 32 days.

The biggest concern I have for this study is the experiment design. Based on authors' description, there is only one fenced area (100 x 100 m) for the livestock enclosure treatment. All the sites for fenced treatment were chosen within this 100 x 100m area – a typical pseudo-replication. Is there any reason for not having proper replications? If

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experiment was based on pseudo-replication, is there any information/analysis authors can provide to increase the confidence of this research finding? Apart from this issue, the grazed sites were chosen from outside the fenced area. This is a very vague description of grazed experiment sites. Were these four grazed sites from the same side of the fenced area (say all in south side of the fenced area?) or were these grazed sites from four different side of the fenced area? How far were these four grazed sites apart from each other (same for the fenced area- although they were inside this 100 x 100 m area)? Such information is important, as the results could be, or at least partly, due to the location effect (water flow, lights. . .).

When analysing  $^{13}\text{C}$  in soil, authors first remove carbonates in soil. I assume the carbonates C present as a reasonable amount in relation to total organic C. How much C present in carbonates in this type of soil in general? If carbonate-C is a not neglectable, why authors did not measure the  $^{13}\text{C}$  present in inorganic form? Authors traced the  $^{13}\text{C}$  from plant shoots, roots and soil. However, they removed the soil attached to the roots. These soils, also named rhizosphere soils, normally contains a great portion of freshly fixed C and are considered a C hotspot. Plant exudes C compounds into this narrow zone and the microbial biomass (particularly the ones utilize the plant-derived C) are normally much higher than these in the background soil. Such important C niche should not be discarded.

Authors mentioned that history, degrees of degradation, grazing intensity ect. are also important for assessing the impact of enclosure on grassland ecosystem function. So please provide all the relevant information in the manuscript, such as grazing intensity (rather than simply state moderate grazing in winter). Why the  $^{13}\text{C}$  is shown in the % of recovery rather than the amount of  $^{13}\text{C}$  entered in different fractions?

The manuscript needs to be improved significantly for publication in terms of English (make sure the sentences are complete and clear), content and clarification. The manuscripts can also be reduced in size greatly to improve the precision. For example, on page 10 line 5-8. These two sentences can be easily combined into one. In

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the result section, authors do not need to repeat all the data which are already present in the table or figures. Another example is the first few sentences of discussion section 4.1 is simply repeating the results section. On page 15, line 9-18 can be removed from the discussion section, as they are either not relevant or belonging to method section. On page 15, line 16 “we used an average  $\delta^{13}\text{C}$  of the four replications to assess the dynamics and allocation of  $^{13}\text{C}$  in the plant-soil system. . .”. Why use average  $\delta^{13}\text{C}$  of four replicates instead of use individual measured  $\delta^{13}\text{C}$  to calculate the total amount of  $^{13}\text{C}$  and recovery of  $^{13}\text{C}$ ?

Discussion part needs to improve significantly (go deeper instead of touch the surface). Authors compared the findings with other studies, but did not discuss the importance and impact of such findings to the ecosystems. In addition, in many places, authors provided the possible support for the observed results without further explanation. For instance, on page 15 line 5, authors mentioned that nutrient level may be another factor affecting the plant community. Is there any data or data from other relevant studies to support this hypothesis?

I felt very strange that the  $^{13}\text{C}$  in roots was so much lower than the  $^{13}\text{C}$  in soil. As I understand, C allocated from atmospheric  $\text{CO}_2$  to belowground is mainly through plant roots, apart from a small portion of C can be directly fixed by autotrophic microbes from  $^{13}\text{CO}_2$ . Authors only simply stated that “the finding is consistent with another study using stable C labeling (hafner et al., 2012)”. Then authors explained the plants were in the flowing stage and most of C may be attributed to produce the seeds. This explains low  $^{13}\text{C}$  in roots. But where the large amounts of  $^{13}\text{C}$  in soil come from? I would like to read more to understand this unusual finding.

On page 18, line 3-4, “suggesting that more  $^{13}\text{C}$  is allocated into roots in the fenced grassland”. From figure 3, the difference is not significant. Also on page 18, line 5-6 “there was less  $^{13}\text{C}$  migration into soils under exclosure”. However, from page 11 line 9-10, authors stated that more  $^{13}\text{C}$  entered plant-soil system in fenced compared to control grazed plots (495 mg vs. 370 mg). Simple calculation showed that more  $^{13}\text{C}$

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amount present in soil in fenced than grazed plot. I think authors want to say is the “less portion of total fixed  $^{13}\text{C}$  by plants migrated into soil in fenced plot compared to grazed plot.” Please be precise on describing and making conclusions. But again, why not use amount of  $^{13}\text{C}$  data? Why use recovery %?

In the conclusion section, authors stated on line 6 “There were relationships between the variations of vegetation community structure and C cycling”. From the manuscript, I did not find any data to support this sentence. Authors did discuss the possible links between these two parts, although. Without further supporting evidence, please reword this sentence accordingly. Do the C% in shoot and roots among four types of vegetation differ a lot? Is it possible to find some links by the shifting the biomass of different types to the C cycling? Just an idea.

Table 1: why not present the SD for the species richness? What is the vegetation cover (%)- which is never be mentioned in the manuscript.

Table 2: Which sample day is the presented C stock data based on?

Figure 1 can be removed, as it did not add any extra information to the manuscript.

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