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Carbon mineralization and soil fertility at high altitude grasslands in the Bolivian Andean

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The high grasslands of Apolobamba provide a natural habitat for a high number of wild and domestic camelids such as vicuna (Vicugna vicugna) and alpaca (Lama pacos) in Bolivia. Because of the importance of the camelid raising for the Apolobamba′s inhabitant economy, it is fundamental to determine the natural resources condition and their availability for the camelid support. The soil organic matter plays a crucial role in the maintenance of the soil fertility at high grasslands. On the other hand, soil respiration is the primary pathway for CO_2 fixed by plants returning to the atmosphere and its study is essential to evaluate the soil organic matter mineralization and the global C cycle. Based on this, the objectives of this research were to: (i) evaluate the soil fertility and (ii) determine soil organic matter mineralization on the basis of CO_2 releases in Apolobamba. Regarding the lastly vicuna censuses carried out in the studied area, eight representative zones with dissimilar vicuna densities were selected. Other characteristics were also considered to select the study zones: (1) alpaca densities, (2) vegetation communities (3) plant cover and (4) landscape and geo-morphological description. Soil samples from different samplings were collected. Soil respiration was determined at two temperatures: 15 ºC (based on the highest atmosphere temperature that was registered in the area) and 25 ºC, in order to monitor the increase in soil respiration (Q10). The physico-chemical soil results pointed out the good soil fertility. However, erosive processes could be taken place likely caused by the alpaca grazing. High total organic carbon contents were observed corresponding to the highest soil respiration at 15 ºC. This observation was supported by the relationship found between the total organic carbon and the soil respiration. A noticeable increase of the soil respiration when the temperature increased 10 ºC was reported (from 1083 $\pm$ 47 g C m-2 yr-1 at 15 ºC to 2786 $\pm$ 343 g C m-2 yr-1 at 25 ºC) which indicated the organic matter mineralization increase and likely the high C reservoirs decrease. Additionally, high Q10 values were observed (13.8 $\pm$ 1.5 in subsurface). This indicates that basically climate conditions are actually controlling organic matter mineralization and it is more evident in zones with high total organic carbon contents. Although no vicuna affection on the soil fertility was observed, the camelid grazing generally causes a reduction in the soil respiration rate in Apolobamba. Therefore, it should be undertaken some protection actions to prevent the biodiversity affection bringing camelid overexploitation under control in Bolivian Andean.

Keywords: biodiversity, high grasslands, camelid grazing, carbon mineralization, soil respiration