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Carbon Sink Capacity under Livestock Overgrazing in the Catalan Pyrenees' Peatlands

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Peatlands are considered strategic ecosystems in climate change mitigation due to their high capacity to accumulate carbon (C). However, the role of mountain peatlands as C sinks is severely threatened by rising temperatures and human activities, particularly livestock overgrazing. Negative impacts include adverse changes in aboveground biomass, plant composition, hydrology, and changes in greenhouse gas emissions due to the compaction and remotion of peat soil by trampling and pugging. Despite these impacts, the consequences of overgrazing on the C balance of peatlands and the potential implication for climate feedback remain unknown.

The PYREPEAT project, in collaboration with the ALFAwetlands initiative, aims to fill this knowledge gap by providing 1) the first estimate of C stocks and net C balance, and 2) a better understanding of the impact of overgrazing on CO_2 emissions in Pyrenean Mountain peatlands. With this aim, we selected 3 peatlands in the Catalan Pyrenees that have been under grazing exclusion since 2016-2018. The selected peatlands are characterized by different water chemistry conditions: i) an acid fen dominated by *Carex nigra,* ii) a moderately acid fen, and iii) an alkaline fen dominated by *Carex davalliana*. For each site, 3 levels of livestock exclusion (permanent exclusion, temporal exclusion, and no exclusion) were established. To determine the spatial scale at which the overgrazing signal was evidenced, within each treatment we classified plots on three habitats: plots with low water table level (WTL) and compaction, plots with medium WTL and trampling, and plots with high WTL and pugging. For each 1 m^2 plot we monitored C fluxes (i.e., CO2), vegetation composition, WTL, and soil water content monthly from July to October 2023. CO2 measurements were made using an EGM-5 infrared gas analyzer (PP-systems) connected to a closed static chamber in two successive phases: a light phase in which the chamber receives solar radiation and records net ecosystem exchange (*NEE*), and a dark phase in which the chamber records autotrophic and heterotrophic respiration (*RE*). The water table level was monitored using PVC wells. Additionally, soil water was sampled using lysimeters and analyzed for pH and conductivity on each occasion.

Determining whether peatlands will continue to function as net C sinks in the long term is complex because of the spatial variability and the different interacting mechanisms that influence their functioning. The spatial and temporal data collected during the first year of the project has the

potential to provide important insights into C dynamics in mountain peatlands and the effects of overgrazing on the C balance. Ultimately, this work will contribute with valuable data to support management solutions, such as exclusion fences, to ensure the role of peatlands as carbon sinks.