The Role of Cushion Plants in Carbon Dynamics of Tropical Alpine Peatlands: Insights from Ecuadorian Paŕamos

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ABSTRACT

Tropical alpine ecosystems in the Andean mountain range of Ecuador, known as paŕamos, are crucial for their ecosystem services like carbon sequestration, water quality maintenance, and biodiversity conservation. Peatlands, featuring high carbon concentrations, are prominent in these paŕamos, serving as significant carbon reservoirs. Among the key peat-forming species is the *plantago rigida*, a cushion plant, that creates unique microenvironments which shape the peatland's ecological succession. However, the relationship between cushion plants and peatland carbon dynamics remains poorly understood. In this research study, we investigated CO_2 and CH_4 fluxes from cushion plants at three different successional stages (from pure *plantago rigida* to completely overwhelmed *plantago rigida*) and analyzed their impact on net ecosystem exchange, ecosystem respiration, and gross primary productivity. The results from this research study suggest that as environmental change drives increased plant coverage on cushion plants of the paŕamos, significant alterations in carbon dynamics and storage capacity seem likely. This research sheds light on the influential role of cushion plants in shaping the carbon dynamics of paŕamo ecosystems, especially as a plant species that facilitates other plant species' growth.

STUDY SITE

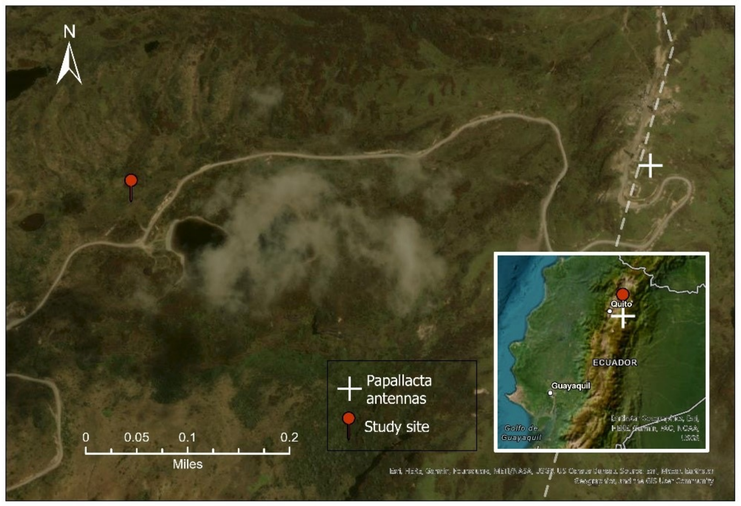
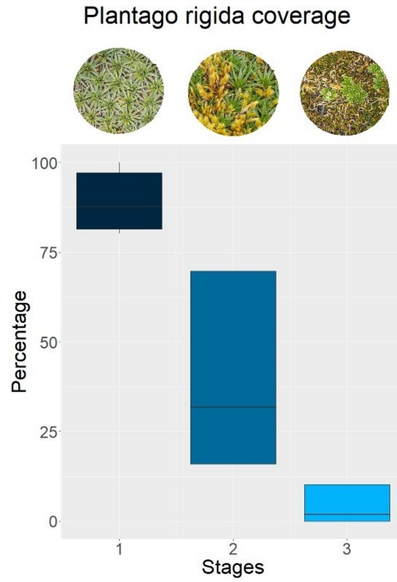


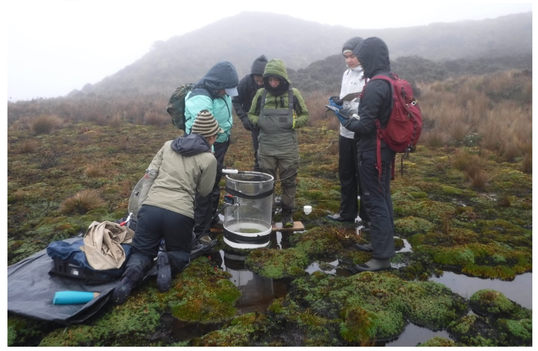
Figure 1: Peatland study site location near Papallacta antennas along E20 highway. The peatlands of the Ecuadorian páramo are among the most productive carbon sinks on Earth.

METHODS



Aerial quantification

Figure 2: Assigned stages to twelve plots/cushion plants with different coverage of *plantago rigida*. Stage one includes plots with pure *plantago* while stages two and three include a variety of other plants, like mosses, that grow on top of the *plantago*.



Gas exchange

Figure 3: Research team measured the carbon dioxide and methane fluxes, deploying a Picarro (portable gas analyzer) at the field site.

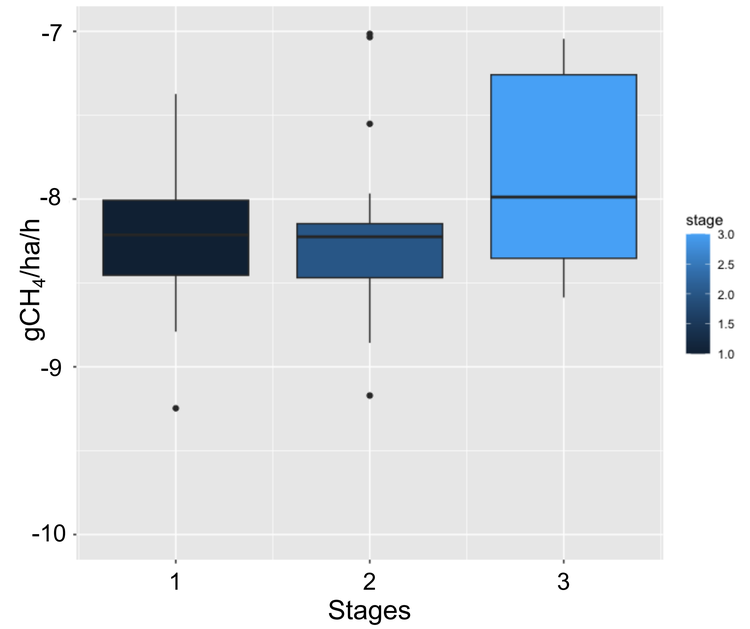


Figure 5: Methane fluxes at each of the three successional stages. While understanding carbon dynamics was the main purpose of the research, a surprising finding was how methane fluxes differed between each stage.

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RESULTS

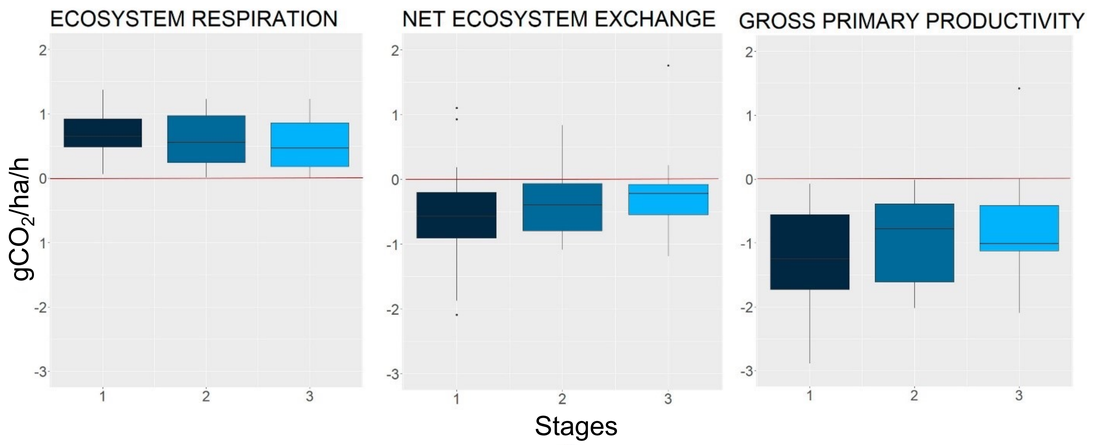

Figure 4: Ecosystem respiration, net ecosystem exchange, and gross primary productivity for each of the three stages of *plantago rigida* coverage. The range of carbon uptake appears lowest in the third successional stage.

SUMMARY

1.1 Investigated CO_2 and CH_4 fluxes from cushion plants at three different successional stages in Ecuadorian paŕamo ecosystems.

2.2 No clear differences were found in the net ecosystem exchange, ecosystem respiration, or gross primary productivity. However, we observed that, overall, the range of carbon uptake was lowest in the third successional stage. Similarly, the range of methane uptake appears to fall lowest in the third successional stage.

3.3 Our research shows that there appear to be differences in carbon dynamics and storage among successional stages, highlighting the importance of understanding cushion plants and their response to environmental change.